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NATURAL HISTORY

THE MAGAZINE OF THE
AMERICAN MUSEUM OF NATURAL HISTORY

VOLUME XLVI

June-December

1940

TEN ISSUES A YEAR

Published by

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

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J. M. GUERRY

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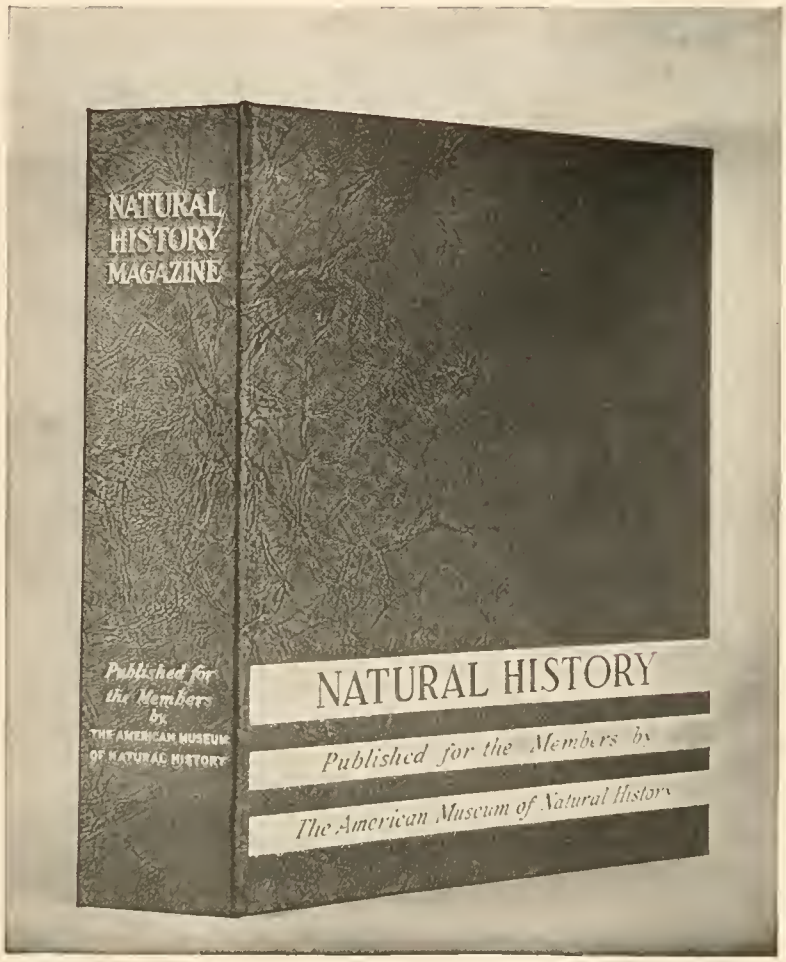

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Advertising Department

THE AMERICAN MUSEUM OF NATURAL HISTORY

Central Park West at 79th Street
New York, N. Y.

Natural History

ILLUSTRATIONS

are printed from photo-engraved plates made by STERLING ENGRAVING COMPANY, 304 E. 45th Street, New York, N. Y.

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* * *

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JOSHUA TREE: A picturesque tree found only in southwestern United States between southwestern Utah and the Mojave Desert in California, but having close relatives in Mexico. Photograph submitted by Edward Bouton.

•

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The Magazine of the American Museum of Natural History

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From a painting by Joseph M. Guerry

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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.

ASSOCIATE: D. R. Barton.

PRODUCTION: 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 DEPARTMENT: Sherman P. Voorhees, Manager.

REPRESENTATIVES:
Frank S. Whitman, Chicago, Ill.
Warwick S. Carpenter, Santa Barbara, Calif.
Howland & Howland, Inc., New York, N. Y.

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The American Museum of Natural History wishes to express gratitude for the assistance in the promotion of the interests of NATURAL HISTORY that has been rendered by the Work Projects Administration.

NATURAL HISTORY is published monthly (except July and August) at New York, N. Y., by The American Museum of Natural History, Seventy-ninth 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 CICADA

THOUGH the cicada is much larger than the wasp, the latter never hesitates to attack. A darting "pursuit plane" equipped with a powerful sting, she fights for an opening, then injects her paralyzing poison. Cicada-wasp battles often last several minutes, the antagonists tumbling to earth in their struggles. The victim is nearly always a male cicada, and since only this sex can "sing" the wasp is believed to hunt by ear. But having paralyzed her prey, she has won only half the battle. She is now faced with a ticklish problem in aerial transportation, for the cicada is more than twice her weight

AMNH photo by Coles

KILLER

AMNH photo by Kirschner

By C. H. Curran
Associate Curator of Diptera, The American Museum of Natural History

(Left) Undaunted, the wasp takes hold with her four hind legs, using the front legs to climb any convenient bush. From this elevation she takes off, wobbling slightly like a heavily-laden bomber. She may have to make several landings and take-offs before reaching the nest

On powerful wings the cicada-killing wasp hunts victims, paralyzes them with her sting, and then carries off the helpless burden to provide her underground offspring with live food. But at the nest a third "aviator" lurks nearby hoping to claim a share of the booty

Toward the end of June and through the months of July and August, when the cicadas are singing in the trees, shrubs and tall weeds, and the so-called "dog days" are with us, there will be a war even more bitter and deadly than that now being carried on in the Old World. And it will be as one-sided as any war ever fought by men. It will be a war to the death, in which the aggressor seeks food and the right to live, and possesses all the necessary armament for destruction, while the victim is helpless and must rely for protection upon concealment and flight. This struggle can be witnessed by anyone residing in almost any part of the United States.

The principals in this never-ending drama are the cicada-killer, which is a tunnel-digging wasp and the largest one found in the United States, and a fairly large number of different kinds of cicadas. The kind of cicada captured by the killer depends upon size, only the larger varieties being sought. Since this is so, the well-known seventeen-year locust, its relatives, and other smaller species are not molested.

It must not be thought that this wasp kills for the mere joy of slaughter or without a definite purpose. She kills for the purpose of providing food for her young; and it is a strange paradox that the young, though still unborn at the time the victim is captured, actually take part in the killing.

When the adult wasp emerges from the tunnel in which, up to this time she has spent her entire life in darkness, she is entirely capable of doing all those things that are necessary to propagate her kind and is one of Nature's most efficient "mechanized units." The burrow in which she spent the winter was located in a gravelly or sandy patch. After finding a mate, the female wasp will either locate in the same patch or seek another suitable place in order to provide a home for her family. She alone must now carry out all the plans for the future generation.

When the place has been found, the big wasp begins to dig, scratching the soil and pebbles out with her feet and throwing the material up behind her, all of her legs moving with great rapidity. She digs straight down for a considerable distance—from six to twelve inches or more—then the tunnel curves sharply and is continued for another five to seven inches. Of course, once the shaft has progressed some distance it is no longer possible for the wasp to scratch out the soil; she must carry it to the surface in her mouth and deposit it in a mound away from the entrance.

The shaft itself is about half an inch across, being just large enough to permit the wasp to turn around. The wasp accomplishes this feat quite nicely by doubling her abdomen under her thorax, thus reducing her length by about one-half. If pebbles or small stones are encountered, these are removed from the tunnel; but if larger stones are in the way, the tunnel may be detoured around them. If the obstruction proves to be so large that a detour of any great extent is required, the wasp forsakes the partly-built nest and begins a new one. This is because the conditions for rearing her young must be absolutely perfect, and the wasp knows exactly what those conditions must be. Apparently an almost straight shaft is necessary; and the condition in the brood chamber, which extends horizontally from the shaft, must be exactly right as to temperature and humidity for the wasp's larvae to survive.

After the brood chamber has been prepared, the female wasp sets forth in search of the foredoomed

cicadas. It is believed that she locates them by their singing, as almost all of those found in the burrows are males, who alone are equipped with sound-producing organs. The few females are probably located entirely by accident while the killer is in search of some singing male.

The wasp may fly long distances to reach suitable hunting grounds. When a victim has been located, the killer dashes at once upon her prey, grasps it in her strong legs and attempts to sting it in a vital place. Sometimes the struggle is brief, but frequently the cicada puts up a strong battle, and occasionally it escapes. If the wasp succeeds in stinging at the first onslaught, she may be able to hold the victim and retain her position on the tree or shrub. But if the cicada struggles violently, the two are likely to drop fighting to the ground, where they may land with a noticeable thud. I have seen them fall through the air, twisting and turning, more than 20 feet, the cicada making every effort to free itself, while the killer was doing all in her power to prevent the escape.

The struggles on the ground are sometimes of considerable duration, but the cicada has little chance of breaking free, and sooner or later the long stinger of the wasp will find an opening and inject its paralyzing poison.

A difficult take-off

The cicada-killer is now faced with the problem of transporting her drugged cargo to her burrow, where it will serve her purpose. She can't as a rule take off from the ground, because the cicada is much too heavy to be lifted by wing-power alone. But she loses no time in overcoming the problem of gravity. She grasps the cicada with her four hinder legs, and by use of her front legs and the rapid motion of her wings, she climbs a tree or shrub until she reaches a height from which she can gain sufficient flying speed to take off. If the distance to the burrow is great, the wasp may be unable to make the trip in a single flight and may find it necessary to repeat the climb and the take-off several times.

In the case of one wasp and her prey, my own leg furnished an excellent climbing post. For a few seconds I was worried lest the wasp might choose the inside of my trouser leg for her ascent, and my young son who was with me kept warning that I would be stung. The insect proceeded up my trouser leg and onto my coat, her front legs climbing at unbelieveable speed and her wings vibrating rapidly. It was difficult to watch the whole progress, particularly when she got rather near my neck, but anxiety was not justified. For a moment she rested, then suddenly took off, dropping down a foot or two in the first ten yards. Then, rapidly gaining height, she cleared a two-story house a hundred yards away.

If we could have followed this wasp to her burrow, we would have seen her single it out without hesitation from all others. But she does not usually attempt to enter the shaft at once. Instead she drops the cicada a few inches from the entrance and goes into the shaft for a tour of inspection. It is quite possible that she will find everything in order, in which case she drags the cicada down the shaft and into the brood chamber. But if she finds that some of the sand forming the sides of the shaft has been dislodged during her absence, she must clean it out. Then, too, she may find that her treasured brood chamber has been invaded; for, despite her size and strength, the cicada-killer is not without enemies who endanger her offspring.

The interloper

If one observes carefully the area in which the series of burrows have been dug, he may see many small, blackish and grayish flies. The lives of these flies are inextricably interwoven with the lives of the cicada-killers and other wasps, and they are particularly adapted for survival even in competition with this large marauder. The flies seem rather furtive in their actions and usually approach the burrows cautiously, as though aware of being upon a dangerous mission. As long as a wasp is about, they generally remain at a safe distance and watch proceedings with an air of expectancy, content to delay their business until the wasp leaves in search of additional prey.

The wasp's aim is to hatch her eggs on the cicada, where her progeny will have plenty of fresh food on which to grow to maturity. Accordingly she may place from eight to more than a dozen cicadas in one brood chamber and upon certain of these she deposits an egg. The egg does not hatch for several days. During this time the cicada might putrefy or dry out and thus become useless—except for one thing: the cicada is not dead but merely paralyzed. The hatching larvae are thus assured an ample supply of fresh food to tide them over until they reach maturity and pupate. After the process of hatching and pupating, the young wasps await the coming of hot summer weather before emerging. At least this will be the order of events if the flies do not alter the situation.

But just as the wasp is intent upon storing away paralyzed cicadas as food for her larvae, the flies are waiting at the burrows with a similar purpose. And the helpless cicada, like Poland of a few months ago, after being stunned by a mechanized invasion from one side, is exposed to a second assault from the other.

From time to time a particularly daring fly will

dash upon a cicada, even while it is being dragged into the burrow, in an attempt to deposit a maggot on it. More often the fly will wait until the wasp comes out after depositing her burden; then the fly will swoop down upon the entrance and disappear within. The cicada-killer is apparently not unaware that these ghouls are about, because, after emerging from the shaft, she usually remains about the entrance for some time, running here and there or flying about as though to chase them away. A number of kinds of wasps cover the entrance of their burrows after each victim is brought in; but the cicada-killer does not do this, and the entrance is there for all to see unless, as sometimes happens, it might be concealed by a tuft of grass or a slightly overhanging stone.

Both invaders succeed

If the fly merely laid eggs it would be at a great disadvantage, because the much larger wasp grubs would consume the food and might logically be expected to attack the small fly larvae. But the fly deposits living maggots upon the helpless cicada, which immediately penetrate the latter's chitinous skeleton and take up their existence in the midst of an abundant food supply. With this head start and a naturally faster growing rate, they need have little fear of the competition. These flies also utilize the prey of a number of other kinds of wasps and bees that provision their nests with insects and spiders.

As a rule both cicada-killers and flies develop to maturity in the same brood chamber, because very seldom are there sufficient fly maggots to devour the entire food supply. They do cause starvation of a certain proportion of the wasp larvae by their inroads upon the available food, but not enough to reduce noticeably the general average of the wasp population.

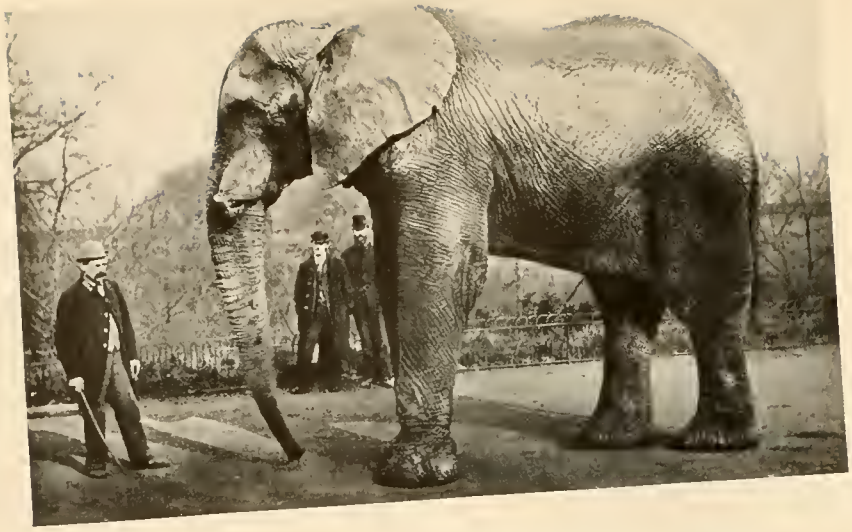
So, if we are bent on ridding some region of these burrowing wasps it will prove futile to rely on Nature. For the most part the cicada-killer is to be looked upon as a beneficial insect and not a pest. However, during recent years there have been many complaints. Evidently the cicada-killer has been increasing in numbers in the vicinity of New York, invading lawns and golf courses. Usually colonies begin with only two or three burrows the first year, but unfortunately for some ground keepers, the number increases each succeeding year.

Nevertheless it is useless to fill the holes as soon as they appear, since the industrious creature very quickly cleans out the shaft, leaving as before the piles of soil that disfigured the landscape. And after the eggs have been laid, the wasp herself packs the entrance. Other means of control must be followed. There are several ways of doing this, but the easiest and most convenient is to watch until the wasp is in the burrow, then—set a funnel in the opening and pour in a pint or two of kerosene. There are other efficient methods but they are not recommended because they require the use of dangerous poisons.

Most people express fear of being stung by the wasps, and are especially concerned if they have children. Yet despite its size and power of sting, this wasp is not at all truculent toward humans. I have stood in the midst of dozens of burrows with wasps flying about in large numbers but have never been stung by them. They do sting occasionally, but the sting is little worse than the sting of a honey bee.

More to discover

If there are children or others who might be interested in observing Nature, they can learn much from observing the work of the cicada-killer, its prey, and the flies that are always present to gain their share of the food. This should prove to be a most interesting study through which one might well discover much about the life history of an insect that is not fully known. For instance, we do not know how long it takes to build the burrow, the exact depths in different types of soil, the moisture condition in the brood chamber, the exact time between the laying of the eggs and the emergence of the adults the following year. Then there is a more pragmatic reason why the cicada-killer should be tolerated whenever possible. It does do a great deal of good by destroying cicadas, which injure trees and shrubs during egg-laying—a fact which certainly should be appreciated by every gardener. Surely the drama of the marvelously equipped aggressor, the luckless opponent and the crafty interloper, interacting in a remarkably intricate natural process, is worth even the most casual observer's attention.



JUMBO

The animal who conquered the hearts of two continents. The human story behind an unusual American Museum exhibit

By LEONARD J. BOLGER

NO beast of the jungle living or dead, has ever captivated the admiration of the public as did this mammoth elephant over 50 years ago. He epitomized all that was powerful, yet he possessed a disposition tending toward extreme gentleness. So great was his popularity at the time, that to this day innumerable persons who never had the opportunity of seeing Jumbo, speak of him with reverence. Jumbo was not only the ideal of countless thousands of children, but he basked in the veneration showered upon him by an equal number of grownups.

When quite young, he was captured by some Arabs in 1861 on the banks of the Settite River in Abyssinia.* At this time he is described as having stood only three and a half feet high, a size which scarcely foreshadowed the eleven-foot stature and six and one-half ton weight he was later to attain. It should be remembered in connection with Jumbo's career that he was an African elephant and not the Asiatic variety, which is more tractable and is the elephant we ordinarily see in circuses. After his capture Jumbo was traded to the Jardin des Plantes in Paris, and was later transferred to the Zoological Gardens in London. It was in London that he first attracted nation-wide attention.

He was sympathetically responsive to the timid gestures of the many youngsters who ventured close enough to offer their pittances of friendship, and he would quickly alleviate their fears by kneeling on his forelegs and offering by implication to help any tot daring to risk mounting his massive back. The invitations were quickly and even greedily accepted. It was no unusual sight to see Jumbo strutting around his enclosure with three or four wide-eyed youngsters joyously perched upon his back.

Is it any wonder that this great beast rapidly became a byword in all households? Because of his great size and popularity, the word "jumbo" was formally adopted into the English language as a term for anything unusually large. Every child in the British Isles longed to visit London "just to ride Jumbo." For seventeen years Jumbo was the great pet of English children.

P. T. Barnum, the great American showman, on one of his numerous trips to Europe, witnessed the thousands who daily thronged to Jumbo's court, and quickly realized the tremendous attraction of this elephant. Without further ado, Barnum arranged to purchase Jumbo from the Zoological Gardens for $10,000. Upon completion of the transaction, the entire British public gushed forth their wholehearted indignation in furious uproar. To them Jumbo had become a national institution to be jealously guarded, and as such should not have been sold. Even the Prince of Wales publicly condemned the procedure. It was only by subterfuge that Barnum was finally able to spirit the elephant on board the *Assyrian Monarch,* and the acquisition of Jumbo had by now cost him an additional $20,000.

With bands playing and trumpets blowing, Jumbo arrived in America on April 9th, 1882. Here he immediately took up where he had left off and endeared himself to the American people, both young and old. For the next three years he was exhibited by his circus owners all over the United States and parts of Canada. The receptions accorded him in every city, town, and hamlet were tremendous. His presence alone meant thousands of dollars to the coffers of the circus.

For his daily food ration, he ate the following: 200 pounds of hay, two bushels of oats, a barrel of potatoes, ten or fifteen loaves of bread, two to four quarts of onions; and according to his trainer, Scotty, he relished an occasional keg of beer.

It was on the night of September 15th, 1885, to a capacity audience in St. Thomas, Ontario, that Jumbo completed what was destined, alas, to be his last, magnificent performance. He was escorted by the faithful Scotty, to the waiting circus cars, there to be loaded for the next stop on the itinerary.

The circus train had been backed onto the only siding of a one-track line, ready to receive and quickly load all the circus possessions. To expedite the loading, a gap had been torn in the fence along the right of way, and a space had been left between the cars on the siding to permit access to the main track.

Just preceding Jumbo through this opening was Tom Thumb, a small elephant of Indian origin. The "Palace Special," Jumbo's private car, was some distance down the main line, and it was while walking to this that a shrill whistle signaled the approach of an oncoming freight train on that very same track. The railroad employee whose job it was to flag down any advancing train while the circus was being loaded, had, on hearing that Jumbo was coming through the gap, left his post the better to view the elephant.

Hysterically, but too late, the flagman ran toward the swiftly approaching train, waving his red lantern. Brakes were speedily set, sparks flew from the locked wheels, but the downward grade had already given the onrushing train a tremendous impetus, allowing the brakes to have little effect in the short distance.

Scotty frantically turned Jumbo around, shouting, "Run, Jumbo, run!" Jumbo responded with alacrity and, raising his huge trunk high in the air, commenced to retrace his steps to the opening through which he had just passed. The oncoming engine had struck Tom Thumb, who was ahead of Jumbo, knocking the smaller animal aside to the embankment. Jumbo, running wildly had in the meantime passed the opening he sought by two full car lengths, before he realized his mistake. Turning around to retrace this precious distance to safety, he was met head on by the engine.

The force of the impact was so great that the engine was derailed, as were several of the following cars; the pilot of the engine is said to have been driven fully three feet deep into the ground. Jumbo's head was crushed between the box car and the next flat car.

In a law suit that followed between the railroad and the circus, a settlement was reached out of court, whereby Barnum received $10,000 in cash and the free use of that railroad for one year for the transportation of the circus. Barnum claimed that the loss of Jumbo meant at least $100,000 at the gate.

Jumbo was then mounted and displayed by the circus for a period of two years as a silent added attraction of what was once mighty and strong. Later Jumbo's skeleton was presented to the American Museum of Natural History, where it may be seen to this day at any time during visiting hours, on the third floor of the main building. The hide was reconstructed, stuffed, and sent to the Barnum Museum at Tufts College, where P. T. Barnum was on the Board of Trustees.

Jumbo, King of Elephants, was mourned far and wide. He was eulogized as the "Pet of Thousands," "Friend of All," "Pillar of a People's Hope." Jumbo was one of the few African elephants ever brought to America, and he was an animal whose reputation eclipsed that of any favorite that since has been presented to the public.

*While this Abyssian origin has commonly been ascribed to Jumbo, some doubt remains, and account should be taken of a statement by the English naturalist and paleontologist Richard Lydekker that Jumbo ". . . was brought to France from some part of the French Sudan, probably southward from Lake Chad . . ." (*Proceedings of the Zoological Society of London,* Vol. 1, p. 399).

CHICHEN ITZA

The Thrice Conquered

Out of the jungle of Yucatan rises the ruin of a New World Rome, in eloquent tribute to the architectural genius of aboriginal America

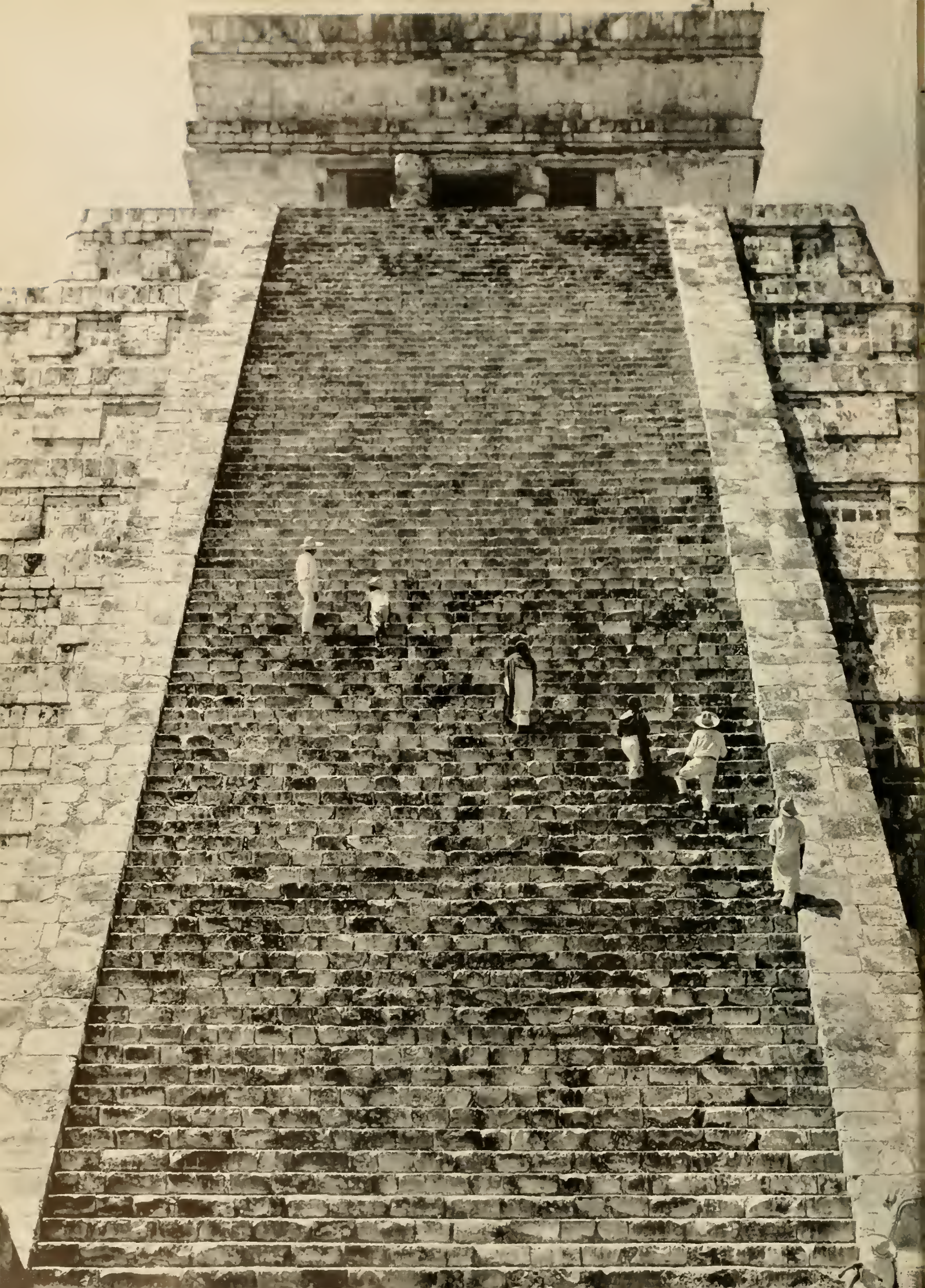
Photographs by LAURA GILPIN

Text by GEORGE C. VAILLANT

Associate Curator of Mexican Archaeology, The American Museum of Natural History

EMBODIED in the powerful masonry below is much of Mexico's early history. Five centuries before Spain's armies blighted the flower of Indian civilization, this site was named "Wells of the Itzas," after a Maya tribe which held the territory unaided for about 150 years, erecting the earliest of the surviving temples. Then came an ill-starred confederacy with Uxmal and Mayapan, two neighboring city-states. Inner dissensions flamed into war, and strong allies were imported from Mexico proper. These newcomers were signally successful and claimed Chichen Itza in the apportionment of spoils. They introduced many new religious and architectural ideas, and with their occupancy, Chichen Itza entered its golden age. But about 1473, the dynasty of this middle period collapsed, and again the territory passed into Maya hands, where it remained until the Spanish Conquest. However, the iron hand of Spain rested lightly on Chichen Itza, so that the hacienda and church of relatively recent date are insignificant compared to the ravaged splendors of the past. Below is the central temple built during the golden age intervening between the breakup of the confederacy and the last Maya period. Popularly called the *Castillo* (castle), the edifice is really the shrine of ancient Mexican gods.

Miss Gilpin's photographs, reproduced here and on the following pages, express the supernatural spirit of Chichen Itza and illustrate the three stages in its history. She shows glimpses of the original Maya buildings and the stately structures which the Mexican intruders built to supplant them. The final period of Maya re-occupation is represented by a furtive structure tucked away in a corner of the city as shown in the last view of this series.

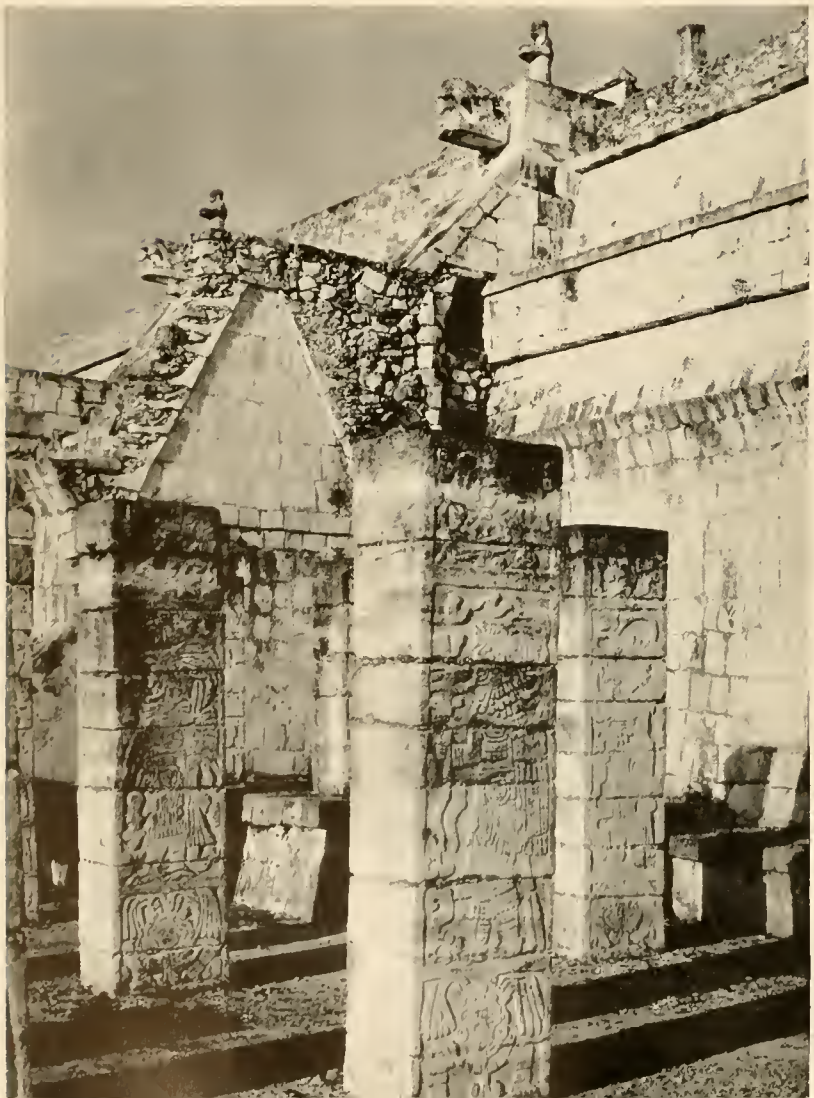


(Left) North entrance of the *Castillo*. Like the Maya deities whose reign they interrupted, the Mexican gods ruled all natural forces and dwelt in the sky. Accordingly, their shrines tower far above the ground. A stately staircase rises sharply to the holy place from all four sides. Implicit in the dramatic movement is the profoundly religious feeling of the Indian architects

(Right) Main staircase in silhouette. The balustrades bordering the stairs express a serpent motif, the long body being indicated on the ascending plane. At the foot of the staircase *(lower left corner)* appear the yawning mouth and darting tongue of this mythically conceived reptile. The snake, as portrayed in the religious art of Middle America, was equipped with tiger teeth and bird feathers in addition to his usual attributes

(Below) Main portal of the *Castillo*. Before its partial destruction this entrance was flanked by massive rattlesnake columns. At the base were the huge heads. The columns proper formed the trunks, the capitals being treated as the rattles at the tip of each tail. Today these columns are badly battered, yet they still reflect the sensations of the ancient worshipers who mounted the ladder-like stair to peer into the serpent's open maw. In their eyes the terrifying spectacle symbolized the powers behind Nature

(Left) FRAMED BY THE MAIN PORTAL of the *Castillo* is an angle view of the ornate ruins of the "Temple of the Warriors." This majestic edifice has been the scene of the principal excavations conducted by the Carnegie Institution at Chichen Itza. Under the skillful direction of Earl Morris, what was once a shapeless mound has been re-created into a magnificent monument to the native architects of Yucatan



On these pages are three views of the "Temple of the Warriors," so-called because of the armed men carved on its surfaces. Below left, is part of the Northwest Colonnade. The square pillars reveal the dexterity of the Indian carvings which adorn much of the building. The inverted V of dressed stone seen in the background shows the Maya method of constructing a false arch, their principal method of roofing

(Below) A carved colonnade screens the main stairway. These columns were once roofed with a series of corbeled arches, the upper part of the stairway remaining in the open. Like all Yucatan buildings, the structure proper is of rubble, faced with cut stone. Both the carving and the masonry were done entirely with stone tools, a remarkable achievement despite the fact that the native limestone, when freshly quarried, is soft and relatively easy to cut

(Left) The Ball Court, conceived on a gigantic scale, is one of the principal structures at Chichen Itza. The prominent doughnut-like ring was the goal through which a solid rubber ball was propelled by the blow of an elbow, hip, or thigh. It was at one of these games that Europeans first became acquainted with the properties of rubber. In the lower left corner appears one of the small temples located at either end of the court. As in ancient Greece, religion so dominated Indian life that it even pervaded their athletics

(Below) The North Colonnade is a forest of columns situated immediately south of the "Temple of Warriors." Beams were laid on top of the columns to support the vaults of the roof. While popularly called the *Mercado* or Market, it is doubtful if this murky fastness would have been suitable for the lively chaffering of trade. Its sweeping grandeur makes the building seem more appropriate for some religious rite

(Right) The *Caracol* or Shell is a spectacular, rounded structure, built during the Mexican interregnum. In Mexico proper, temples of this form are associated with the worship of the Wind God. However, the fact that windows have been cut in the *Caracol* may indicate that Indian astrologer-priests used them to observe the passage of the planets. Here again we see the tour de force of Yucatan architecture—a massive staircase—, which makes a fitting approach to a building so closely connected with the most arcane rites of the Indian priesthood

(Lower left) A CLOSE-UP of the *Caracol's* wall showing the mighty bulk of the *Castillo* rising in the background. No large buildings ever broke the sweep of space between these two temples. But today a tangle of second growth covers the pavement which once surrounded the temples of the sacred city, Chichen Itza. The detail of the mask *(upper right corner)* and the boldly executed cornice break the otherwise monotonous lines of the *Caracol's* masonry

(Below) The *Monjas* or "Nunnery" is the popular designation of the most imposing building of the early Maya Period. It is built in several stories, each of which rests either on a solid platform or abandoned rooms, solidly packed with masonry. In the foreground appears a subsidiary temple dating from the Mexican Period

(Below) THE TEMPLE OF THE THREE LINTELS is a little gem of early Maya architecture. The building was reconstructed by the Carnegie Institution of Washington to bring out the singular beauty of its proportions and the balanced harmony of its decorative scheme

(Above) THIS MASK from the "Temple of the Three Lintels" out of which projects a huge hooknose, is a mosaic of separately cut stones which, united, form the face of a grotesque divinity

(Below) The Temple of the Initial Series takes its name from an inscribed stone. This block was set on top of the two upright figures by Edward H. Thompson, the former owner of Chichen Itza and the discoverer of the treasures in its Sacred Well. The block is carved with a dated inscription in the style of the older Maya cities to the south of Yucatan. Yet no other stones carved like this one have appeared in these ruins, and the two supporting figures typify the Mexican style. Perhaps in the dim twilight of the Maya re-occupation some of the returning emigrants brought this block from another locality to commemorate the restored supremacy of the older Maya culture

DO NOT MISS

In **GUATEMALAN SOJOURN** that indefatigable world traveler, Martin Birnbaum, will provide a beautifully illustrated account of the lush, tropical country to the south of Mexico, where the old Maya race still lingers. Indeed all the richness and variety of Guatemala's past is implicit in her colorful present, while her jungle fastnesses may guard as yet unrevealed secrets of her ancient civilization.

HOME LIFE OF THE BIG WOLVES, soon to appear in NATURAL HISTORY, is a veteran naturalist's moving tribute to these lean, gray hunters now almost gone from the United States. Few animals are more devoted or faithful in their home life, braver or more intelligent. But they were meat-eaters, as we are, and there was not meat enough for both.

DR. EDWIN H. COLBERT, whose article on the prehistoric fish, "A Fossil Comes to Life," proved one of the most popular subjects published last year in NATURAL HISTORY, will soon tell the story of one of the most important conflicts between mind and mass the world has ever witnessed. The mammoths, unsurpassed in size by any other land animals of their day, strove to live on earth at the same time that early man was feeling the power of the most highly developed brain that had ever been created. Do not miss this scientific glimpse of the animals our ancestors of the Ice Age had to contend with—animals that have died so recently in the geologic sense that the dogs of modern explorers have fed on their flesh.

Among the far-off East Indies lies the **MYSTERIOUS ISLAND** of Nias—a living paradox, whose human culture remains one of the riddles of anthropological science. In a forthcoming issue, S. Dillon Ripley tells the strange story of Nias and of a mission to one of her most powerful chiefs, an erstwhile head-hunter, significantly named "Killer of Dutchmen."

Why haven't I been told . . . ?

This is the common complaint of thousands of persons who by chance have come across NATURAL HISTORY MAGAZINE. The American Museum is eager to bring attention to the opportunities of membership, its nominal dues and its beneficial privileges, including NATURAL HISTORY MAGAZINE. You or your friends are cordially invited to become an integral part of this great institution and enjoy its benefits.

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THE AMERICAN MUSEUM OF NATURAL HISTORY

79th Street and Central Park West, New York City

RAREST TREES

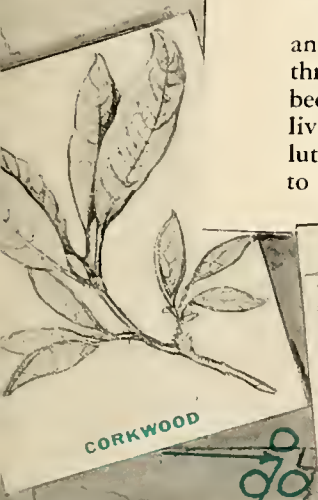
Drawn by LAURENCE BLAIR
for NATURAL HISTORY MAGAZINE
JUNE, 1940

OF AMERICA

IN the struggle to survive and develop through some 200 million years, trees have had to contend with many enemies. Climatic vicissitudes have repeatedly dictated death or decimation, and more aggressive forms of life, all striving to wrest a living from the available land, have forced them back. Man himself is probably their greatest enemy. Many trees have been eliminated in this age-old struggle; and, once exterminated, these will never return, for evolution does not reverse itself. The coming centuries will see the destruction of others.

For these reasons, and because of the inherent charm of unusual things, NATURAL HISTORY Magazine presents this array of thirteen "rugged individualists," which ten leading experts have voted our rarest trees. Many other trees, rare in the United States, extend over a larger range to the south, or else do not differ strikingly from commoner species. The trees selected do not grow anywhere else in the world. They have also been selected partly because of distinctive characteristics which make them recognizable and interesting.

Justifiable pride is shown in rare trees wherever they grow, and many travelers journey far to see them. It is hoped that through this presentation, persons who otherwise might not become acquainted with them, may notice and enjoy these living forms, whose seeds contain 200 million years of evolutionary history, though their range is limited, in some cases, to a few hundred acres.



Fred Hess & Son photo

J. Horace McFarland photo

THE "LOST" FRANKLINIA

THIS TREE *(Franklinia alatamaha* Marshall) has not been found growing in the wild anywhere since 1790. One day in the autumn of 1765, John Bartram, a friend of Benjamin Franklin's, was exploring in the woods of southeastern Georgia. Somewhere along the Altamaha River in the vicinity of Fort Barrington, he found a beautiful tree, whose gorgeous blossoms, over three inches in diameter, resembled those of the camellia. Recognizing its extraordinary beauty and value, the plant explorer made other visits to the spot and introduced the tree into his own famous garden in Philadelphia, naming it after his celebrated friend.

In 1790 the original grove of Franklinia trees was visited for the last time; for from that day to this, though many expeditions have searched, no one has seen this tree growing in the wild. All the known descendants, growing in cultivation, have come down to us from the specimens brought to Philadelphia over a century and a half ago in an overloaded saddlebag.

The smooth, dark gray bark, covering a slender trunk and graceful, sinewy branches has been likened to a greyhound's satin skin. The tree starts blooming when no more than three or four feet high and attains a height of 15 or 20 feet, even 30 feet in extreme cases. From about the middle of September there is a constant succession of blossoms until hard frost. Frequently even after the foliage has turned an autumn crimson the tree remains abundantly starred with white flowers.

The fact that Franklinia prefers an acid soil was discovered by the late Dr. Frederick V. Colville, Chief Botanist of the U. S. Department of Agriculture, working in collaboration with Miss Elizabeth C. White. The Franklinia prefers full sun and has proved entirely hardy about New York and in favorable locations about Boston. It is regarded as a desirable tree for small gardens and thrives when planted by pools and streams.

Photos courtesy of Elizabeth C. White, Joseph J. White, Inc., Whitesbog, N. J.

THE LIGHTEST WOOD IN THE UNITED STATES

NOT FAR from the original home of the Franklinia tree in Georgia can be seen the rare Corkwood tree *(Leitneria floridana* Chapman), which also grows in a few isolated groves elsewhere as shown on the map introducing this article. Rarely described in popular books on trees, this 20-foot shrub or small tree has a slender, straight trunk four to five inches in diameter, branching into a loose, open head. Its bark, about $\frac{1}{16}$ inch thick, is dark gray and faintly tinged with brown, and is divided by shallow fissures into narrow, rounded ridges. Annual growth rings are hardly distinguishable in the pale yellow wood. Exceedingly light and close-grained, it is occasionally used for the floats of fishing nets. The leaves are four to six inches long, and the flowers open at the end of February or early in March.

Drawing by Annie E. Hoyle, Courtesy of U. S. Forest Service

STINKING CEDAR

Photos by Florida Forest and Park Service

THE RARE Florida Torreya (*Tumion taxifolium* [Arnott] Greene) is a worthy member of the aristocracy of rare trees because it is confined at the most to a comparatively small number of trees scattered over a 20-mile range. The fact that its sap, crushed needles, and the juice from the seed cone give off an odor resembling that of green tomatoes, has led to its common name, Stinking Cedar.

In about 1834 a young planter and amateur botanist by the name of Hardy Croom, while traveling to a plantation that he owned in Jackson County, was obliged to wait for a ferry to cross the Apalachicola River. Viewing the nearby landscape that was then an almost roadless wilderness, his attention was drawn to a wooded slope on which grew a grove of evergreen trees that differed from any he had previously observed.

On his return trip, he collected specimens for study. Unable to identify them in his books, he sent samples to Dr. John Torrey, of Columbia College, the outstanding botanist of the day. Torrey reported that the tree was a totally new genus never before recorded.

Fortunately the Florida Torreya, unlike the Franklinia tree, has survived to the present, though its range along the east bank of the Apalachicola River and in the vicinity of Dog Pond, Jackson County, is extremely limited.

The tree seldom attains a diameter of ten inches or a height of more than 50 feet. The branches and twigs are lined with flat, stiff needles about an inch and a half long. The wood is yellow and hard, and is prized by the natives for fence posts, for which it is all too commonly cut. The protection of this unique tree should be ensured by stricter laws than are now in force. The existence of the Torreya State Park in Liberty County gives the only prospect for its preservation.

Hardy Croom, the discoverer of the tree, is said to have planted the specimen shown in the accompanying photograph on the State Capitol grounds at Tallahassee.

(*Information by courtesy of William F. Jacobs and the* Journal of the Florida Education Association)

Devereux Butcher photo

Drawing by Annie E. Hoyle, Courtesy of U. S. Forest Service

FLORIDA YEW

THIS TREE (*Taxus floridana* Chapman) grows in the same section of Florida as the Stinking Cedar, but is even rarer. It sometimes attains a height of 25 feet, with numerous stout, spreading branches above a short trunk, which is occasionally a foot in diameter. But it is characteristically shrubby in growth and more often reaches a height of twelve to fifteen feet, frequently spreading out on the ground.

Its flowers appear in March, and the fruit ripens in October. The wood is heavy, dark, and very close-grained, with nearly white sapwood.

Photo by U. S. Forest Service

Drawing by Mary Robeson Sargent

BIGCONE SPRUCE

THIS WORTHY RARITY *(Pseudotsuga macrocarpa* [Torrey] Mayr) occupies steep rocky mountain slopes at elevations of between 3000 and 5000 feet in limited sections of southern California. It is valuable for its adaptability to situations too dry for most other trees, rather than as firewood, for which it is unfortunately largely used. The trunk of the Bigcone Spruce is also utilized by California woodpeckers, who drill into it extensively for the storing of acorns.

The Bigcone Spruce is usually 40 to 50 feet tall, rarely 90 feet, with a trunk three to four feet in diameter. Its wood is heavy but not durable, and is consequently not desirable as lumber. The tree is most serviceable as a protective cover in semiarid mountainous regions at lower elevations, mostly on the sides of canyons.

AMERICA'S RAREST PINE

A STRIP OF TERRITORY eight miles long and less than two miles wide along the mouth of the Soledad River in southern California is the only continental range of the Torrey Pine *(Pinus torreyana* Carrière), though it grows on the island of Santa Rosa and is now planted in the parks of San Diego and in New Zealand.

While it is usually a small tree 20 to 40 feet high, it sometimes attains a height of 60 feet, and under cultivation it promises even greater size than on its native cliffs. Its large, edible seeds are gathered in quantities and eaten raw or roasted. The wood is light, coarse-grained, and not strong; and there is little demand for it, except now and then as fuel.

Edward Bouton photo

Drawing by Mary Robeson Sargent

Photo by U. S. Forest Service

THE WORLD'S TALLEST TREE

A SEED scarcely larger than a pinhead is the beginning of the world's tallest tree, the majestic Redwood *(Sequoia sempervirens* [Lambert] Endlicher), which sometimes grows to a height of over 350 feet. The trunk may be as much as 28 feet in diameter and is usually free of branches for 75 to 100 feet. Redwood bark is from six inches to a foot thick.

The Redwood is native to the fog belt along the coast ranges from the southwestern corner of Oregon to Monterey County, California, from ten to 30 miles inland. It is rarely found over 3000 feet above sea level. Specimens about 3000 years old are known.

The wood of the Redwood, from whose color the tree gets its name, takes a fine finish and is of great commercial importance. Durable in contact with the soil, it is light, soft, and close-grained.

Though not strong, it is easily split and worked. Its satiny luster makes it a favorite for fancy furniture and bric-a-brac, while good shingles, fence posts, and railway ties can also be made of it. A concerted effort has fortunately been made, however, to conserve the Redwood, and lumber companies are to be commended for the farsighted policies they have adopted for the preservation of this unequalled giant among trees.

The Redwood grows rapidly and is often cultivated as an ornamental tree in the temperate countries of Europe and occasionally in the southeastern United States.

THE WORLD'S LARGEST TREE

Photo by U. S. Forest Service

Drawings by Mary Robeson Sargent

EXCEEDING THE REDWOOD IN GIRTH, though a trifle under it in stature, the Bigtree of California *(Sequoia washingtoniana* [Winslow] Sudworth) is probably the mightiest living work of Nature. This species is a living descendant from the Age of Dinosaurs and once thrived in great forests in central and northern Europe and in mid-continental America, even to the Arctic Circle. But its range has not spread since the Glacial period, and it is now limited to a number of groves totalling an area of only about 50 square miles, scattered along a 250-mile strip on the seaward slopes of the Sierra Nevadas in central California.

The first white men to see a California Bigtree were most likely the members of Captain Joseph R. Walker's party in 1833. The first report was scoffed at as a wild tale from the Golden West. Color was lent to it by the statement that because there were no seedlings nor young trees, these must be the last specimens of a vanishing race.

The name was taken from a wise Cherokee Indian, Sequoyah, who in 1821 invented the Cherokee alphabet of 85 characters, by means of which the *New Testament* and a newspaper were published for his people.

The giant Sequoias are usually about 275 feet high at maturity, but have been known to reach 320 feet. The trunk ranges from 20 to 35 feet in diameter, and in an old tree is often naked for half the total height. The bark itself may be as much as two feet thick. The gigantic bulk of a single Bigtree is sufficient to produce enough lumber to build a village of 150 five-room houses, yet it all grows from a seed ⅛ to ¼ inch long. The root system of a mature Sequoia spreads over an area of between two and three acres.

So long is the life of the Sequoias that trees which sprang from the soil before Greece and Rome rose to greatness and even before Tutankhamen reigned in Egypt may still be growing. The average age of the big Sequoias is probably about 2500 years, but stumps now standing show 4000 annual rings, and competent authorities have estimated the age limit to be above 5000 years. Measurement of the growth rings, which vary in width according to the amount of rainfall and other climatic factors, has yielded important information about climatic changes through the ages.

Almost every mature Bigtree has been struck by lightning, but no ordinary bolt seriously injures one of these giants. Fire may repeatedly attack it, charring away a large proportion of the bark or eating out as much as 200 feet of its vitals, yet it still lives on. The wood is very light, coarse-grained, and brittle. Even though days may be spent in preparing a soft bed on which it may fall, one of these Goliaths weighing hundreds of tons is usually shattered into unmerchantable lengths when felled. Wood of the Bigtree has been used for shingles, fencing, and in general construction.

A grove of Bigtrees is surely a place where the Romans would have placed their inscription: *Numen inest*—"God is in this place."

THE ORNAMENTAL BRISTLECONE FIR

From Unsere Freiland-Nadelhölzer, *by Count Silva Taronca and C. Schneider*

Drawing by Mary Robeson Sargent

THIS TREE (*Abies venusta* [Douglas] K. Koch), with handsome, dark green foliage, is restricted to the outer rim of the Santa Lucia Mountains in Monterey County, California, usually at elevations of about 3000 feet. Trees 30 to 100 feet high are normal, but a height of 150 feet is possible, and the trunk may reach a diameter of three feet. The Bristlecone Fir is occasionally and successfully grown as an ornamental tree in the milder parts of Great Britain and in northern Italy, but it is not hardy in the eastern United States. The wood, light brown tinged with yellow, is heavy, coarse-grained, and not hard.

MONTEREY PINE

THIS RARE TREE (*Pinus radiata* D. Don), whose distribution on the mainland is restricted to a narrow strip a few miles wide on the California coast from Pescadero to the vicinity of Cambria, is an exception to the other trees in this collection in that it is found in one place outside the territory of United States, on the island of Guadaloupe off Lower California. It is also found on the California islands of Santa Rosa and Santa Cruz.

It is a large tree, reaching a height of 100 feet or more, with a trunk possibly five or six feet in diameter. Planted successfully in parks and gardens, its quick growth destines it for popularity with landscape gardeners wherever the climate is mild enough in winter. Its wood is soft, close-grained, and weak, and is sometimes used as fuel. It has proved valuable for forestry purposes, particularly in Australia.

Photo by U. S. Forest Service

Drawing by Mary Robeson Sargent

MONTEREY CYPRESS

Harry E. Rieseberg photo

THE LAST STAND of this twisted tree (*Cupressus macrocarpa* Gordon) in its native state is limited to an area of about two miles long and 200 yards wide south of the Bay of Monterey, California, with a small grove on Point Lobos nearby. The crumbling bluffs of the shore are gradually being undermined by the waves, and though the gnarled roots of these trees range wide for a foothold, the trees in the front rank seem destined to go down one by one. It is possible that the last of these trees in their native soil will eventually be swept out of existence.

However, the Monterey Cypress has been cultivated for hedges, windbreaks, and as park trees, and is fairly widely grown along the Pacific coast, though it has lately been attacked by a fungus disease. It is occasionally planted in the southeastern states and is common in western and southern Europe, temperate South America, and in Australia and New Zealand.

The Monterey Cypress attains a height of from 40 to 75 feet and in old age becomes picturesquely gnarled and flat-topped.

C. Edward Groves photo

Drawing by Mary Robeson Sargent

AMERICA'S RAREST SPRUCE

DROOPING BRANCHLETS four to eight feet long hanging from the parent branch give the Weeping Spruce *(Picea breweriana* S. Watson) its name and distinctive form. The small section to which it is restricted in northwestern California and southwestern Oregon is not much more than 100 miles from north to south and even narrower from east to west. Perhaps more interesting still is the fact that the range is restricted vertically as well as horizontally: the tree grows only between the altitudes of 4000 and 8000 feet.

A pioneer California scientist, William H. Brewer, was attracted to this then unknown tree, whose drooping branches add charm to so many vistas of lakes and mountains where it grows. In 1863 he collected the first specimen, but since the cones were missing, the Weeping Spruce was not permanently brought to light until 1884, by Thomas Howell.

The tree seldom attains a greater height than 100 feet, though specimens 125 feet tall have been mentioned. The trunk is about two or three feet in diameter above the enlarged base, and in the open is crowded with branches to the ground. The wood is heavy, soft, and close-grained. It is of no commercial importance.

Recent inclusion of the home of the Weeping Spruce in a Primitive Area of the U. S. Forest Service should give this rare tree the protection from future danger that it deserves.

Drawing by Mary Robeson Sargent

PORT ORFORD CEDAR

ONE OF THE MOST BEAUTIFUL of the larger cone-bearing trees is the Port Orford Cedar *(Chamaecyparis lawsoniana* [A. Murray] Parlatore). Limited to the coast mountains of Oregon and California, it occupies a strip no more than about 200 miles long and extending rarely more than 40 miles inland.

This unique cedar is a spire-like forest tree growing to a height of 200 feet, with a trunk sometimes as much as twelve feet in diameter.

The 20-mile belt of Port Orford Cedars near the mouth of the Coquille River in Oregon presents a sight that has thrilled many visitors. The feathery, almost lacy, appearance of this "handsomest of the conifers" and its sharply slanting limbs give it so distinctive an appearance that its identification is easy.

The wood is hard and light, and has a pleasant aromatic odor. Very durable under exposure of any kind, it has extremely high commercial value, being used in house-finishing, flooring, boat-building, railway ties, and fence posts. Port Orford Cedar is also prized for the manufacture of battery cases and is extensively exported for making venetian blinds. It is ironic that the wood of this rare tree has been used extensively in the manufacture of matches, a symbol of so much forest destruction.

Photo by U. S. Forest Service

Wild Palms In Arizona

THOUGH not included in the foregoing list of THE RAREST TREES OF AMERICA because related or identical species extend over a fairly wide distribution in Mexican territory to the south, these wild palms are mentioned because their existence in a restricted section in southwestern Arizona has not been duly recorded and because their story demonstrates the opportunity for the keen-eyed observer even in this day to discover unknown stands of rare trees.

The Desert Palm of southern California and Lower California, which this tree apparently most closely resembles, is not described in recent literature as growing anywhere in Arizona. "Very few people know about Arizona's only native palm," writes our correspondent, Mr. Sherman Baker of the Ranger Station at Cochise, Arizona, who submits this account. And even fewer have ever seen this mysterious inhabitant of Yuma County—only an occasional botanist or wandering prospector.

"I recently set out to find these curious palms and to photograph them," writes Mr. Baker. "Just why or how these trees grow there, nobody knows. Are they lonely survivors of a remote geological age when Arizona had a more tropical and less arid climate? Or have their seeds been brought there in more recent times by traveling birds? Perhaps the seeds were introduced by bands of Indians from Mexico. Nobody knows.

Photos by Sherman Baker

"Leaving the paved highway, my companion and I turned the nose of our Ford out over the middle of the La Posa Plain. Somewhere in the crags and canyons of the Kofa Mountains, we were told, grew the wild palms. This is one of the most fantastic mountain ranges I have seen in my many years in the Southwest. Otherwise known as the S. H. Range, it looks as if a giant had thrown a pile of enormous rocks into a Gargantuan piece and left them. Enormous cones, blocks, and pinnacles rise tilted in all directions. From a few miles away absolutely no verdure is apparent, and one has the feeling of approaching the unreal landscape of a dead planet. The sun was setting, and a cold north wind was raw in our faces as we wound through ocotillo, cholla, and occasional saguaro cactus and entered a canyon that was like a great sword slash in the rock-body of the mountain. Up this canyon the light of a little campfire showed up where two old prospectors were camped, who we felt sure could tell us where the palms were.

"They had spent many winters prospecting this locality, but they had never seen any trace of the palms. It was evident that we were on the wrong trail. We camped here for the night and retraced our tracks the next morning, heading into another section of the mountain after leaving our car at the base of towering cliffs.

"The first definite account we have of a visit to the Arizona palms was in 1923. Since then several

Continued on page 41

OUR FRIEND THE EARTHWORM—*Universal soilmaker who plows, drains, airs, pulverizes, fertilizes and levels, and tempts the "early bird" by staying out too late*

By HERBERT S. ARDELL

THE common earthworm needs no introduction to the man or boy who digs his own bait for fishing, or to the farmer and gardener who tills the soil. To most everyone else—for it abounds in all parts of the globe—it is at least known by name, but unfortunately little recognized for its agricultural importance, which places it among the most helpful animals in the world.

Universally loathed, it excites no more appreciation on the part of mankind than do most crawling creatures. Perhaps you, too, have scorned it as a mere worm of no salutary account; but it is much more than a mere worm, being a plowman, cultivator of the soil, a coworker on the farm and in the garden —in short a real friend of humankind. The earthworm is entitled to our sympathy in its life of underground seclusion. There, driving its subterranean passage in all directions, it never meets with its own except at night, when it comes cautiously to the surface searching for leaves and stray bits of vegetable matter which it drags into its burrow to be nibbled and swallowed at leisure.

That the earthworm is both deaf and blind doesn't seem to be a handicap, for it is so sensitive to light as to distinguish between the degrees of light intensity. It is further compensated by a highly developed sense of feeling affording a peculiar and instant awareness of the approach of enemies: the most delicate vibration of any object with which it comes in contact, or slightest tremor of movement through the soil will cause it to draw together instantaneously; this exquisite acuteness is of lifesaving value, often enabling the worm to escape extreme danger from many diurnal animals.

Like most creatures of nocturnal habits the earthworm has an intense dread of strong light and little reason to learn much if anything about the upper world, so we rarely see one during the daytime. In the twilight of dawn it may be seen just within the entrance of its retreat or partly extended, not having yet retired. This is the origin of the maxim "the early bird catches the worm," although it is not good natural history, for what the bird captures is the belated worm that "stayed out too late."

In summer weather earthworms may be found almost any night during a short stroll over the lawn, garden, fields, and paved courtyards. After dark with the aid of a lantern I have observed a multitude of these "night crawlers" reaching out from their burrows to an almost incredible extent. They very seldom leave their homes completely. Lacking eyes, they are seemingly conscious of the inability to find their way back home again, or perhaps instinct tells them it would be dangerous, so they anchor tight by their flattened tails (the pointed end being the head) while stretching their elastic length for a foraging expedition. When they do leave their homes, it is to seek a mate or a new locality.

Contrariwise these obscure creatures collect in great numbers upon sidewalks and paved streets following a severe rain storm, and this accounts for that oft reported statement that they have actually "rained down." It might better be said that they are "rained out," for the threat of suffocation within the burrow through loss of part or most of their oxygen, forces them to ascend to the surface. This explains the sudden appearance upon the ground of thousands of apparently helpless worms, bleached and emaciated.

Earthworms spend the winter either individually or collectively in a mass at the bottom of their underground home. The only accessible place to find them in the late fall or winter is under manure heaps, where on account of the heat evolved by the decaying matter the frost is kept out. In the fields during cold weather I have found hundreds of active worms under caked cow-droppings—a good spot for them to keep warm.

The alacrity displayed by an earthworm is indeed astonishing. In one of my night prowls I saw one stretching itself at the door of its abode searching the ground within the length of its body for something to eat. I became curious to see just what this earthy creature would do should I frighten it. After a moment's hesitation I stamped lightly some distance from the burrow. My foot had barely touched the sod when hocus-pocus! the trickster vanished. It seemed more like a rubber band that had been stretched and suddenly released instead of an agile body—a good illustration of reflex action.

Now, if you want to know where our little enchanter is, you will have to make haste, for I dare say it is by this time well in the depths of its tunnel fastness. You hurry in your effort to dig it out. From all appearances you are challenged to a race. In your eagerness to win, you rapidly turn over the earth, lump after lump. Shortly you become slightly vexed because of your evident failure. You thrust that sharp pointed stick into the ground for the last time when behold! there is one end of the worm protruding from a mass of earth.

Feeling elated over this victory, you proceed to separate the dirt. But all is turned to gloom—you have cut our friend earthworm in two. You would not, however, be dismayed if you accepted the erroneous belief which many persons do—that each severed part will survive and grow to be two independent, though imperfect worms. This fallacious notion was probably fabricated from the fact that reproduction in some families of worms is largely replaced by fission, in which the worm in a natural manner splits or breaks apart and forms two. It is true that earthworms—like spiders, crabs and lobsters—do possess a certain regenerative capacity or replacement of parts, for under propitious circumstances they do regrow a new tail to take the place of the one which a robin, perhaps, has pecked off.

Have you ever tried to pull an earthworm from its burrow? Of course you have seen a robin exerting all its strength in an attempt to draw one forth; but did you stop to think why it required such effort? At first sight the earthworm's body appears to be smooth and naked. No one would suppose that a creature so soft and seemingly so helpless would be capable of such strength. However, its muscular system is highly developed, as is evident from the strenuous resistance offered when trying to draw one from its burrow. But this does not altogether explain the apparent mystery.

If you were to look through a magnifying glass at our subject in all its nudity, you would see a large number of stiff, hook-like bristles or *setae* covering its body. To be exact there are eight of them on each of the 120 cylindrical rings, or segments which make up its body. These take the place of feet and enable the worm when it expands its sinewy body to take a firm hold on all sides of the earth. You can readily understand why, with these clinging projections, its grip upon the soil in its burrow is so powerful. When it wishes to advance on the surface, it pushes its body forward, the retractive bristles grazing the ground, then by successive contractions of the muscular segments it brings itself forward, and to paraphrase the act, is ready for another step. I once placed an earthworm on a pane of smooth glass, and it was pitiful to see it try to make headway, for while the contractions continued, its progress ceased.

In these days of man-made tunnels, earthworms can safely claim for themselves the distinction of being the original tunnel builders. I am sure much has been learned from them on how to sink a shaft scientifically. One winter I confined several earthworms in a specially built glass box for study. I observed that they "dig" in two ways: first, in pushing away the soil on all sides (in excavating we imitate them to some extent); second, by swallowing the earth in great quantities. By this latter procedure the earth is passed through the body, the organic particles digested and defecated on the surface of the ground in the form of "worm casts." These vermiform objects reared into small rugose, conical heaps are strewn about garden paths and yards. Accumulating year after year and century after century they form the layer of humus, or top soil in which vegetation chiefly thrives and on which the farmer and gardener depend for the successful growth of crops. These terrestrial creatures which bury themselves in loose earth in two or three minutes may be said literally to eat their way through the soil.

Earthworms run their shafts to a depth of three or four feet perpendicularly into the ground, and in this way bring large quantities of subsoil to the surface, thus making the earth more porous for the penetration of the all-important oxygen of the atmosphere and rendering it permeable to the rain and air. John Burroughs, referring to the earthworm in one of his essays, says "it plows, drains, airs, pulverizes, fertilizes and levels."

To impart some idea of the amount of earth which is brought up by worms from beneath the surface, Charles Darwin, that great thinker and observer, who made an extensive study of the earthworm, tells us that a narrow path running across part of his lawn was paved in 1843 with small flagstones set edgeways; but worms threw up many castings and weeds grew thickly between them. During several years the path was weeded and swept; but ultimately the weeds and worms prevailed, and the gardener ceased to sweep, merely moving off the weeds, as often as the lawn was mowed. The path became covered up, and after several years no trace of it was left. On removing, in 1877, the thin overlapping layer of turf, the small flagstones all in their proper places, were found covered by an inch of fine mold.

In rich garden soil, where worms are especially numerous, it is computed there may be over 50,000 individuals to the acre, and the quantity of earth passing through their bodies would amount to ten tons. Surely, earthworms are the universal soil-makers.

There would seem to be little if any relation between the late disastrous floods in the East and earthworms, yet you need but read an article in *Science Service* by Paul B. Sears, professor of botany at the University of Oklahoma and advisor to the Department of Agriculture, to appreciate the significance of the destruction by floods of the living soil which earthworms help to build up. Professor Sears writes, "Traveling through the oldest agricultural states in the Union, the writer has scarcely seen a place where the old top layer of soil is left. Careless methods of farming have allowed it to wash away in the last two or three centuries. . . . It is this dark, spongy top layer of soil—what the specialist calls the A-horizon—which is our only effective protection against floods. One can build dams downstream, construct mazes of levees and ditches and still not touch the source of trouble. The water must be caught where it falls and the one thing that can arrest it and hold it in place is the dark A-horizon of the soil."

Earthworms are omnivorous eaters. What they live on besides the nutriment extracted from the earth consists of decayed leaves, which, pulled down into their burrows, provide leaf mold which helps enrich the soil; raw meat and fat, when they can get it, sometimes their own, should these be dead. While they have no jaws or teeth, they do very well with their mouths which act as suction pumps drawing food into their bodies, where, in the gizzard, the food is rubbed and crushed into a fine powder—a feeding process unique among animals.

The reproduction process is of peculiar interest in these creatures. Like snails, the earthworm is hermaphroditic. That is to say, each worm is both male and female. Despite this, it is necessary for the individuals to fertilize one another. This takes place in the spring. The egg-laying, too, is a singular performance. About one-fourth the distance from the head-end of a full grown worm, is located a thickened cylindrical band or sac-like ring called the clitellum. This girdle contains the eggs and is worked forward and slipped over the head, whereupon both ends snap tightly together, making a perfect little egg capsule or cocoon, which is then deposited in the earth under stones and manure piles. When hatching takes place, the young—perfect miniatures of the adult—shift for themselves. There is a popular yet misleading belief that this modified region is a healing mark showing where a worm cut in two has grown together again.

The angleworm has many enemies besides man. It is a tasty morsel of food for many different kinds of birds, predatory beetles, venomous centipedes, carnivorous slugs, salamanders, some snakes and moles. The latter are known to store a mass of them as provender for the winter. Hostile forces are forever at work yet the earthworm still survives all vicissitudes. It is rather curious that at one time the earthworm was on the pharmaceutical list. A greenish oil extracted from its body was used as a remedy for earache. Nature doesn't need man's interference to keep them in check.

Would you be inclined to discredit the statement that earthworms possess a voice? Well, they do after a fashion, for they have the habit of making slight smacking sounds which remind one of drops of water from a leaky spigot. This is produced by the rhythmical opening and closing of the cavity of the mouth. Why they do this, so far as the writer knows, is a secret belonging to the worm.

I was once asked, "Do earthworms ever do anything that is considered injurious?" My answer was, "No! but they are regarded a nuisance by the golf enthusiast, who, with mixed feelings for their presence, finds that the little heaps of castings make the soil lumpy and deflect the ball in what might otherwise be a perfectly good shot." We may sympathize with the golf fan, but the earthworm is more useful.

That the humble and retiring earthworm is one of our greatest benefactors, and has throughout time played an important part in the history of the world, is a bit of knowledge that dates from Aristotle, who called earthworms the "intestines of the earth," Truly, this little yet mighty engine is among the most terrestrial of all animals. Its complex and wonderful structure is beautifully adapted to the needs of its way of life underground and, without the ministrations of this despised and persecuted animal, many a fertile expanse would be barren.

There never was anything committed to paper about earthworms quite so worthy of note as that penned by Gilbert White, the English naturalist and antiquary of the seventeenth century, when he wrote, "Earthworms, though in appearance a small and despicable link in the chain of nature, yet, if lost, would make a lamentable chasm. . . . Worms seem to be the great promotors of vegetation, and the earth without them would soon become cold, hard-bound, and void of fermentation, and consequently sterile."

The clergy often has exalted the earthworm in proclaiming man to be "a brother to the worm." This reminder of inevitable fellowship has not always been graciously received. But many men of letters regarded this seemingly insignificant creature important enough to accord it recognition for the role it plays in the economy of nature. So, let us, too, give it the consideration it deserves, and have in mind what the poet Cowper contributed to posterity:

"I would not enter on my list of friends
(Though graced with polished manners and fine sense,
Yet wanting sensibility) the man
Who needlessly sets foot upon a worm."

NATURE *through* THE COLO

Like most moths, *Callosamia promethea (at left)* pupates in a cocoon, as distinct from most butterflies, which pupate naked

"FLYING FLOWERS"

Color photographs by FLORENCE STUCK

Knobbed antennae distinguish the butterfly *(below)* from the moth *(at left)*, whose antennae are characteristically feather-shaped: a fundamental distinction to which there are few exceptions

(Below) The Papilio or swallow-tail follows the usual butterfly rule of pupating naked, hanging from a twig or branch

CAMERA'S EYE

Dog-tooth violet or trout lily *(Erythronium americanum)*

Water lily *(Castalia odorata)*

FLOWERS OF EARLY SPRING AND SUMMER

Color photographs by Frederick H. Pough

Full-color transparencies augment the dried herbarium among photographically-minded botanists who follow Nature through the seasons

(Below) A moth which breaks the rule *(Citheronia regalis)*. It pupates naked like a butterfly, but unlike a butterfly, underground

Canada lily *(Lilium Canadense)*

THE GHOST CRAB—*Adventures investigating the life of a curious and interesting creature that lives on our doorstep, the only large crustacean of our North Atlantic coast that passes a good part of his life on land*

By ALEXANDER M. PHILLIPS

It is a warm, sunny day on one of the barrier beaches of southern New Jersey. Behind me dunes rise to cut off the view of the bay; before me is the beach, and beyond, the dark blue ocean. A southeast wind, cool and tangy, sweeps whistling across the sand. There is the shrill, steady whistle of the wind, the muffled crooning of the surf, and an occasional muted roar as a car speeds past along the road behind the dunes. Now and then a gull calls remotely.

Near the edge of the water the sandpipers are feeding—running swiftly after the backwash and halting so abruptly I wonder they don't topple over. Far down the beach a group of gulls stand motionless, staring seaward.

One of the solitary wasps, hugging a grasshopper, circles near me, seeking her burrow. The near beach appears empty but for the dusty-looking grasshoppers and the faint pennants of blown sand that rise on the wind for a moment and then vanish.

Then something seems to blow across the sand, but it's going the wrong way, against the wind. It drifts swiftly along, close to the sand, then halts abruptly, and I see what looks like the ghost of a crab—a gray and pale blue little animal with two black, club-like eyes held vigilantly erect. As I watch, one of the eyes is drawn down and comically scrubbed clean of sand, the other eye remaining sternly on duty meanwhile.

A fleeing shadow

I move, and instantly, so swiftly that it becomes a flickering gray blur along the sand, the crab is in motion. It drifts to a dark-mouthed burrow on the beach and is engulfed like a puff of smoke.

This is the Ghost Crab, and he is well named: everything about him is ghostly and elusive. He is unique among the large crustaceans of our North Atlantic coast in being the only one to have left the ocean and made at least a partial adaption to an existence on land. And that existence seems cloaked in indefiniteness. The books have little to say about him, and that little sometimes oddly contradictory. Even in his scientific classification the ghost crab boasts an alias. He is identified as either *Ocypoda arenaria* or *Ocypode albicans* [pronounced O-sip'o-dee ar-e-nay'ri-a or O-sip'o-dee al'bi-kanz], but the latter is the correct name.

It was in 1936 that my curiosity concerning this strange little animal became definitely aroused. I have been visiting the beaches of southern New Jersey for a number of years, and have observed the ghost crab and his characteristic burrows on most of them. But, strangely, while the beach may be literally crowded with colonies at one spot, another location within a mile of the first may harbor none, though it appears ideally suited for them.

Experts at disappearing

Again, a beach that today may be dotted with the dark openings of burrows may tomorrow show not one. This was exactly the case on the beach below Ocean City, N. J., in September, 1938. Overnight the crabs or the wind had closed every burrow. And the only environmental change I could discover was a shift of wind. On the day the burrows had been open, the breeze was from the land, the burrows facing away from it. By the following afternoon the wind had shifted to northeast, blowing directly into the burrow mouths. And every one was closed. When I opened one whose location I remembered, I found the entrance blocked for two or three inches with loose, drifted sand: beyond this sandy plug the tunnel extended more than three feet, angling down beneath a small dune. The fact that every burrow in this colony had been closed suggested to me that it was done by the inhabitants—the wind would not be so uniform. It is a habit of the ghost crab to close his burrow on occasion by drawing sand into the burrow mouth with the legs on one side of the body. The legs are then pulled inside through the sand, and no sign of the burrow remains.

From several of the books I consulted I had received the impression that most of the burrows would be found along the edge of the water, but such has not been my experience. I did, of course, find colonies close to the water's edge, but the great majority were

far above high tide. On flat beaches without dunes the burrows were sunk in the loose, dry sand well back from the surf. Where dunes were present, burrows and colonies of burrows clustered on and about them, occurring along the base of the dunes, upon the sloping flanks, and even over the grass-crowned summits. They thinned out on the landward face of the dunes, but even here I found not a few. The dunes among which most of the photographs accompanying this article were taken were, in September, 1938, at least 40 yards above high tide marks, by rough measurement. This distance had lessened considerably by March 4th of the following year, which was the date of my first visit in 1939 to the locality. Winter storms probably caused this reduction of dry beach, for by September, 1939, the beach here was almost as broad as before.

Breathing apparatus

It is this fact—the relatively large distance from the ocean at which burrows occur—which raises the question of how the crab breathes. Since it is apparent from observation that the crab spends the larger part of its life in air rather than water, one might imagine that the creature had evolved lungs. But not so, in the ordinary sense of the word. It has breathing slits on each side of the body, between the joints of certain of the legs; and with this equipment *Ocypode albicans* is at least partially unshackled from the sea. Let Dr. Roy Waldo Miner of the American Museum of Natural History tell how: "The crab breathes by means of gills located in a gill chamber. Though the crab lives in the open air the greater part of its time, it occasionally dashes into the sea and fills the breathing chamber with water, which enters through the breathing slits. The water is kept in the closed chamber for long periods, thus bathing the gills."

By this time *Ocypode alibicans* had become for me an individual. I decided to try for his photograph. Almost daily, from September 1st, 1938, until the 10th, and again on October 1st and 2nd, I roamed the beach of Ocean City, N. J., between about 38th Street and 49th.

The streets here are streets in name only, being merely sandy, flotsam-strewn passes through the range of grass-grown dunes that parallels the beach.

This beach is inhabited throughout its length by the ghost crab, and is remarkably well suited to him. The sea encroaches here, and during periods of storm does considerable property damage. Consequently, pilings have been set, close together and continuously, all along the beach, and parallel to the sea—either up near the dunes or out in the shallow surf. For this reason bathers are infrequent, preferring the unobstructed beaches to the north or south. Even on the Saturday before Labor Day, customarily a day of great crowds at the seashore resorts, I was undisturbed, as the beach in this vicinity was almost devoid of people.

At home for visitors

One of the first things I noticed was the relative permanence of the burrows. Day after day I could return to the same burrow and find it occupied, apparently by the same crab. Certain crabs, alarmed by my approach, retreated into their burrows and remained invisible until I had gone; others habitually emerged from their burrows within a few minutes of my arrival. So definite was this response that I could take interested friends who wished to see a ghost crab to the burrow of an individual whom I knew would emerge quickly, and on only one occasion out of about four such visits did the crab fail to appear. Some of these burrows, which I had first seen early in September, were still occupied at the time of my second visit on October 1st and 2nd. Others showed unmistakable signs of having been abandoned.

Dr. R. P. Cowles, writing in the Carnegie Institution Publications, devotes considerable space to a description of the burrow of the ghost crab, three types being described. The most common, according to this authority, is a burrow dug on the open beach, from one to two feet deep, which descends at an angle of about 45°, usually extending directly away from the water line. A peculiar feature of this type of burrow is a branch passage which rises straight to the surface some distance back of the main opening, without necessarily breaking the surface. When it does break through, it is rarely used for entrance or exit. Doctor Cowles believes this branch passage is intended entirely as a safety exit, for use when the owner of the burrow is evicted by another crab or pursued into the burrow by any other enemies.

I saw no burrows of this type. The few burrows I did open were similar to the second type described by Doctor Cowles—a burrow similar to the first, but much deeper and without the branch passage. Doctor Cowles records one which extended for more than four feet, and one I opened was over three feet in length. This second type of burrow is described as occurring higher on the beach, where, in fact, I did most of my investigating.

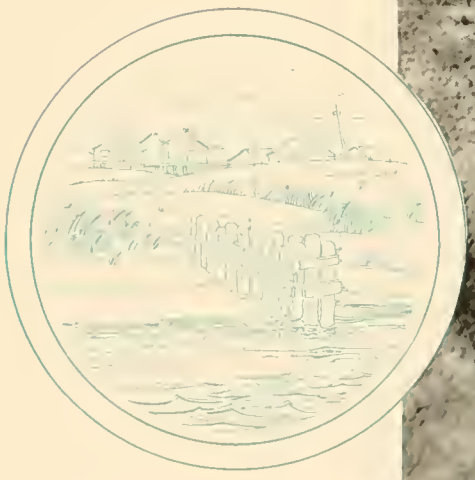
The third type of burrow described by Doctor Cowles is one excavated by young crabs and is a tunnel descending vertically for only a few inches.

Doctor Cowles says considerable care and great individuality are shown in the construction of the burrow, especially among old individuals. Some of these older crabs level the floor of the tunnel, and the terrain about the entrance is frequently landscaped by

A MOMENT BEFORE, *this stretch of New Jersey beach* (left) *was alive with large crabs like those below. Called ghost crabs, they are well named. Without warning comes a flickering gray blur. Then they vanish down the dark-mouthed burrows discernible at left. Unique among larger North Atlantic crustaceans, these crabs are adjusted to partial existence on land. Though breathing is performed by gills, they extract oxygen from sea water stored in internal breathing chambers*

All photos by
ALEXANDER M. PHILLIPS

(Below) THIS CRAB *is about to sidle into his burrow*



(Right) STOPPED *in his tracks by a snapshot, this "ghost" stares into the camera lens. His shoe-button eyes must be kept clean of sand. But this is easily accomplished. One flexible eye is lowered and comically scrubbed while the other remains sternly on duty*

(Below) A NEIGHBOR *is clearing away excess sand from his seashore home. But he can reverse the process. For the burrows, too, are will-o'-the-wisps, and when the crab descends he often shuts the door behind him*

the crab, hollows being filled in with sand, obstructions removed, and steep approaches graded.

One of the most interesting burrows I found was one located on the open beach. Instead of descending vertically or at an angle, as had all other burrows I saw here, this entered horizontally a tiny hillock of sand, no more than an irregularity of the surface. It penetrated this minute dune for a distance of about eight inches, and then angled sharply downward for about three feet. Unfortunately, I was unable to get a photograph of the owner. He had constructed at the mouth of his tunnel a small platform of sand, like a porch, with a slight overhang for roof. He was "at home" when I first found his unique ménage, and sat on his porch regarding me fixedly; but I was not equipped to photograph him, and when I returned a day or two later the burrow was deserted.

The passes between the dunes, leading from the road behind to the beach in front, seem to be a favorite site for burrows from a ghost crab's point of view. And even by human standards these burrows are far superior to the bare, featureless pits on the level beach. Grasses nod over them, and the slender, extended tentacles of the wild sweet pea crawl nearby. Then there are bur-bearing plants, which serve to discourage intruders, and farther back on the landward sides of the dunes, the dense bayberry bushes. Tiny blue flowers, blooming in September, gave a touch of color.

In these passes the burrows range from the edge of the path to the crest of the dunes. It was hot and still, and filled with silence and peace, though a September wind, racing from the north with a touch of ice to it, might be sweeping the beach outside. All over the dunes were traced the tracks left by the crabs in their foraging.

Some burrows were dug into the faces of sheer cliffs, three or four feet high, where the sand was packed tight and held together by intertangled roots. How the inhabitants of these "cliff dwellings" returned to their burrows after once leaving them I was unable to discover. I saw crabs sitting motionless in the entrances of such burrows, but never saw them enter or leave. Possibly burrows of this type have a second, lower, entrance. They certainly could not be entered swiftly by climbing.

Taking his picture

The ghost crab can be photographed with the simplest equipment. The burrow to be photographed is selected, the camera set up on a tripod, with a cord attached to the trigger. The photographer then takes a position ten or fifteen feet away, with the other end of the cord in his hand, and when the crab emerges and assumes a suitable position, the shutter is tripped.

Once the crab has emerged he will remain motionless for many minutes. One of those I photographed was engaged in cleaning out his burrow, yet, with an armload of sand to be thrown away, he invariably paused at the entrance for long periods to survey his surroundings.

An inhabited burrow can usually be recognized by the presence of tracks about the entrance, but the fact that it is inhabited is not an assurance that the owner will show himself. It is better to take a position from which a number of burrows can be watched, and stand motionless. Presently one or more crabs will emerge—sometimes within three or four minutes. Select the burrow to be photographed from among these whose owners are more active.

As soon as you approach the burrow, the crab will retreat inside, but after the camera is set up and the photographer has withdrawn, the chances are that the crab will again emerge after about the same interval as before.

I have followed this procedure and taken three or four photographs of one individual in about an hour's time, the crab scrambling back out of sight every time I approached to turn up the film, but shortly reappearing again and assuming almost the same attitude.

All of these photographs were taken between 2 p. m. and 5 p. m., although I have read that during these hours the crabs usually remain within the burrows. The best time to study the ghost crab is said to be in the morning until 11 a. m., and between 5 and 6 p. m.

A gentleman living along this section of beach informs me that the time of the crabs' greatest activity is at night. His residence is equipped with large searchlights, and he says these lights reveal legions of ghost crabs roaming the beach during the hours of darkness.

On many occasions I tried to approach an open dune cautiously enough not to surprise the crab residents sunning themselves on their verandas. I never succeeded. But in other locations, where I could approach under cover of intervening dunes I frequently found *Ocypode albicans* not only on his veranda but roaming about the beach or carrying sand from his burrow. As soon as I stepped into view a wild scramble began as each crab sped for his own burrow. Hysterical individuals who, by mistake or through panic, entered the wrong tunnel were immediately evicted and had to race around some more until they arrived at their own doorstep.

The food of the ghost crab must be quite various. Beach fleas and other minute crustaceans, bits of seaweed and shellfish, and even turtle eggs, have been listed. One observer reports a crab that leaped into the air in an attempt to capture a butterfly. The ghost crab must be a true scavenger of the beach, and I wonder if, given the opportunity, the eggs of birds would not be included in the diet of this enterprising crustacean.

Enemies

On the other hand, the shore birds do not overlook *Ocypode* when making out their pantry list. I have seen sandpipers and other birds pursuing small crabs, and found burrows of the little ones apparently dug into, and surrounded with bird tracks. Other natural enemies must include various rodents, and, in some parts of the ghost crab's range, perhaps snakes.

I returned again on March 4th, 1939, to the beach where these photographs were taken. It was raining heavily and I investigated only a short stretch of beach, but, where in October, 1938, the ghost crab population was dense, I found not one burrow.

Where the ghost crab passes the winter—whether it is resident, whether it returns to the ocean, or whether it migrates—I have been unable to learn; none of the books I looked into made any mention of this. Curiously, little seems to have been written about this interesting little animal living on our doorstep, while about some rare beast of distant lands you may uncover volumes.

Howard J. Shannon, in his delightful *Book of the Seashore*, makes an interesting suggestion as to why *Ocypode albicans* may have deserted the sea. The reason may be traced, suggests this author, to the oscillation of prehistoric shores. Elevation and subsidence are known to have occurred many times along our coasts, and Mr. Shannon suggests that during a widespread elevation of the coast line many crabs might have been entrapped in landlocked bays. These bays, in time, become wholly dry. Adaptive species might

thus have been persuaded to an existence, in part, at least, on dry land.

The adaptation of *Ocypode* is, at any rate, of no mean order. The name *Ocypode* means "swift-footed," and he is just that. Not only is the ghost crab a swift runner; it can also double and dodge with amazing celerity, changing and reversing its course almost without pause. And its weirdly intelligent observation of the intruder suggests an alert mentality, powerfully bent on survival, though ridden by a fearful distrust of its surroundings.

A possible water supply

The deep burrows, in some cases, go down to damp sand, and it has occurred to me to wonder if the ghost crab could possibly get the sea water necessary for breathing purposes by carrying these deep burrows down to water. How long water held in the gill chambers would sustain life I do not know, but I have known crabs to remain within the burrow for as long as three hours or more.

Another curious trait I noticed among the ghost crabs along this stretch of beach was the habit of emerging from the burrow right side first. In all the time I spent in this crab metropolis only once did a crab emerge left side first. The crab often has the large claw on the right side. According to Doctor Cowles, it uses the small claw for digging and so enters the burrow with the small claw going down first. It seems to find the large claw most effective for defense, which may be the explanation for presenting that side to the outside when emerging from the burrow.

Between land and sea

This mid-world of the beach, standing between the two great divisions of land and water, is a strange region, and has, for those who know it, a fascination not unlike that of the desert. Deception is its very spirit. It appears permanent, changeless, yet it is transient and forever being altered by the sculpturing sea; it gives a sense of vast distances, yet is itself narrow.

It is curiously timeless. No other region I have ever visited has possessed that persistent, ceaseless atmosphere of loneliness, remoteness—that sense of a separate existence under another time than that ticked out by the clocks of cities. Three or four hundred yards away from the cluster of houses that mark a seashore resort, and I am utterly alone. Then there is the sense of silence and immobility, while actually there is always the moan of the sea or the rush of the wind.

And lastly it appears lifeless, yet gives life and shelter to its own strange children. Its deception, its spirit, is incarnate in *Ocypode albicans,* "the fleet-footed one of white"—an occult, secretive alien from the ancient depths of the sea.

WILD PALMS IN ARIZONA —*Continued from page 30*

parties have penetrated the secret place of the palms; but up to the present only one main canyon was known where they grew.

"All day we hiked up the deep, rugged fastness, where we felt sure no man had ever before penetrated, and explored vast and fantastic canyons. Exhausted, we were returning to our car when curiosity led me up a little side canyon. To my surprise and joy I spotted a dead palm frond in the water course. Then another, and another! We knew that if we followed these dead leaves up the drainage course, they would lead us to the trees themselves. But approaching darkness and complete lack of water forced us to backtrack and wait until the next day.

"After a hard night trying to sleep on sharp rocks, we were up at dawn, listening to the coyote howl his age-old cry of hunger and desolation. In the chill mystery of dawning light, the mountains seemed even more unreal. We followed the trail of water-borne palm fronds to a great cleft in the north slope of the mountain. A gigantic fallen boulder blocked the narrow entrance. Struggling up beneath the boulder, we came upon a small canyon that widened. In a few minutes we spotted our first palm, a large tree half hidden in the rock base high above us.

"Here was our curious and elusive quarry. The little canyon contained two separate levels with three or four palms at each level. The climb into the upper basin was very difficult without ropes, but we finally made it. There were no signs that this little canyon had ever been visited by men before; and in my opinion there are at least three separate wild palm sites, all near together in this range. In the main and best-known canyon there are about 65 palms; perhaps altogether there are not more than 100 native palms in the area. One of the palms in our little hidden canyon was about 50 feet high and had a diameter of about two feet.

"Now that this whole area has by Presidential Proclamation been created a Game Refuge for the protection of the bighorn sheep, it can be hoped that the mysterious and lonely Arizona native palm can be preserved for posterity."

THE SEA

Drawing by W. Dittmer

THE NATIVES of New Zealand, who referred all the phenomena of this world to their special mythological framework, attributed the creation of the islands to the mighty god Maui, who seems to have got his fishhook caught in a submarine rock and thereupon pulled the whole land up to the surface, as depicted at left. Perhaps this story was invented to account for the phrase "Fish of Maui" as applied to the shape of the land as a whole and especially to the shark-

DIAGRAM OF THE GEOLOGY OF NEW ZEALAND

THE STORY OF NEW ZEALAND'S patchwork of rocks covers a span of some 400 million years, as indicated in the accompanying table.

Most of the sedimentary rocks were laid down as sediments under water; therefore the land they now occupy was submerged at the time when they were formed. The age ascribed to each is that at which the muds and sands were deposited, not the age at which the rocks were sculptured to give the landscape its present character

After P. G. Morgan, based on a sketch map of the New Zealand Geological Survey; data by von Hochstetter, Hector, Park, Marshall, Morgan and others

D.F. Levett Bradley

NEW ZEALAND SEDIMENTARY ROCKS	MILLIONS OF YEARS AGO	NEAREST EQUIVALENTS IN THE NORTHERN HEMISPHERE: PERIODS	AGES	ERAS
		PLEISTOCENE	MAN	CENOZOIC (Recent Life)
		PLIOCENE	MAMMALS	
6 CENOZOIC		MIOCENE		
		OLIGOCENE		
		EOCENE		
		UPPER CRETACEOUS	REPTILES	MESOZOIC (Middle Life)
5 CRETACEOUS	100			
		LOWER CRETACEOUS		
		JURASSIC		
4 TRIAS-JURA (HOKANUI)				
		TRIASSIC		
	200	PERMIAN	AMPHIBIANS	PALEOZOIC (Ancient Life)
3 PERMO-CARBONIFEROUS				
		CARBONIFEROUS		
2 UNDEFINED OR DOUBTFUL PALAEOZOIC	300	DEVONIAN	INVERTEBRATES AND FISHES	
		SILURIAN		
1-A ORDOVICIAN AND SILURIAN		ORDOVICIAN		
1 PRE-ORDOVICIAN	400			

IGNEOUS ROCKS

7 Acidic (often granitic intrusives, of different ages)

8 Basic and intermediate (mostly volcanic, of relatively late date)

GOD'S PATCHWORK

like tail of North Island. And since North and South Islands are separated by a strait of the sea, this "parting of Maui's fish" was attributed to another hero, Kupe.

Such explanations, which commend themselves to unscientific persons, are refreshingly simple in contrast with the complexities of the facts which have been patiently discovered by geologists, whose broad results are outlined in the present article

How New Zealand was put together through the ages to become a paradise for birds and men

By WILLIAM K. GREGORY
Curator, Departments of Fishes and Comparative Anatomy

and

G. MILES CONRAD
Assistant Curator, Comparative and Human Anatomy
The American Museum of Natural History

THE early travelers in New Zealand, as well as almost everyone who has since visited this antipodean paradise, were amazed at the great beauty and variety of its natural resources.

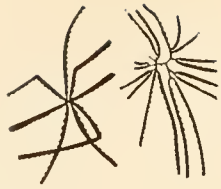
As members of the recent Michael Lerner Australia-New Zealand Expedition, the authors had the privilege of seeing many of the more famous localities of geologic interest. They also had the opportunity of studying the fine geologic exhibits in the museums in Auckland, Wellington, and elsewhere. Innumerable photographs of natural features were taken; and others were procured from government and private sources. All this was with the view to planning and assembling a New Zealand hall in the American Museum of Natural History.

The geologic story of New Zealand is the background against which all of the unusual animal and plant life of this interesting region should be interpreted. This story is complex, for more than a century of intensive work by geologists has gone into the story of New Zealand's mountains and glaciers, rivers, valleys, caves, rocks and minerals. As a result, however, the broad lines can now be sketched fairly briefly. And because New Zealand's varied landscape illustrates almost every known land-shaping agency, this country provides one of the world's best opportunities for a rapid and comprehensive insight into the basic processes of earth-building.

Courtesy of the New Zealand Government

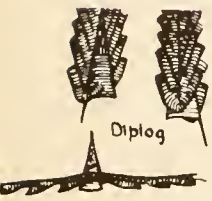
THE FOUNDATIONS of New Zealand. These fiords, winding their way among mountains sometimes more than 3000 feet high, give the visitor an impression of immeasurable age. Yet it is not the fiords that are old in the geologic sense but the rocks they expose to view. The fiords have been cut in relatively recent time, perhaps not more than ten or twenty thousand years ago, but the most ancient of the rocks in their walls are probably not less than 400 million years old.

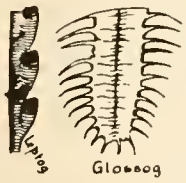
What we believe to be the oldest rocks in New Zealand (**1** on diagram, opposite page) are found in western Southland, on the southwestern coast of South Island. They consist of gneisses and schists originally laid down as sediments beneath the sea but greatly squeezed and altered, plus intruded granites and other igneous rocks formed by solidification of inflowing molten material originating within the earth



Fossil Tokens of New Zealand's Earliest Days

Courtesy of the New Zealand Government





EARLIEST LIFE OF NEW ZEALAND'S WATERS. A land lying possibly to the west and south but now no longer in existence provided the worn-down sands and muds in which the oldest known remains of New Zealand animal life were cemented as fossils. These fossils *(at left)* are graptolites, delicate sea animals of branching habit, related to the lower invertebrates. Still farther back in the earth's history, the relatives of these creatures may have been the direct ancestors that laid the foundation of higher animal evolution.

In these graptolites we have some direct evidence not only of the geologic age of these New Zealand rocks but of the world-wide distribution of certain classes of marine organisms during the earlier ages. For, besides being found at Collingwood and Westport in the northwest district of South Island, and at Preservation Inlet, similar ones are found near Albany, New York, and in Victoria and New South Wales, Australia. Their widely scattered distribution in New Zealand (**1-A** on diagram, page 42) indicates that marine rocks of Ordovician age—roughly 400 million years old—may have formerly underlain a great part of South Island. Since these creatures lived under water, the portions of New Zealand where their fossils are found were all submerged at that time.

For almost 150 million years following the period when these graptolites lived, the story of New Zealand is but scantily recorded. Rocks representing this great span of time, Silurian and Devonian periods, cover immense areas in New York State, the British Isles, and continental Europe, but in New Zealand they are meager, being limited chiefly to areas in the northwest (Nelson) region of South Island (**1-A** on diagram). However, the few fossil marine shells found on the Baton River compare closely with Upper Silurian forms of some 350 million years ago in Europe and North America. In central Otago (**2** on diagram) large areas of sedimentary rocks which might have told the life story have been greatly altered by intense pressure and heat, so that no fossils are visible and the rocks can only be called of doubtful Paleozoic age.

Toward the end of this era, in the Carboniferous and Permian periods, approximately 275 to 200 million years ago, large sections of the United States (Texas and Pennsylvania) were accumulating thousands of feet of fresh-water and inland deposits. In New Zealand, however, we find only an extremely narrow sliver of rocks of this age (**3**), near Nelson. Nor have we much record of the land animals and plants that lived during this time, when elsewhere the first reptiles and amphibians were developing. Notice that up to now we have referred only to the South Island. In North Island if any Paleozoic rocks are present they lie far beneath the surface, from which they are now, so far as known, conspicuously absent

THE ROCKS shown in this photograph of Mount Cook represent the next episode and were laid down about 175 million years ago in the Triassic period, to form the backbone of New Zealand. Soon after these Hokanui rocks (**4** on diagram, page 42) were deposited under the water they were thrust violently upward into jagged mountains, the remains of which form the Southern Alps. At present these rocks are mostly harsh, crystalline graywackes, hard on the shoes of geologists.

Now for the first time North Island comes into the picture, as this same system of rocks is exposed beyond Cook Strait, following the main axis of the island. And, as Dr. P. G. Morgan has pointed out, the gigantic folding of the system may be considered as giving New Zealand its first independent existence: "Previously it was but the foreshore of the now dismembered continent Gondwanaland [a land area believed to have previously connected India, South Africa, and Australia]. Henceforth . . . at no time was the whole of the present land area submerged."

Approaching the Age of Dinosaurs (approximately 160 to 170 million years ago), we find no record of these well-known reptiles in New Zealand. But the

tuatara* and several species of lizards are living testimony of that age. By what route the ancestors of these primitive, living animals reached New Zealand has not been definitely determined.

Swimming reptiles (plesiosaurs and mosasaurs) as indicated by their fossil remains, disported themselves in the waters of the Cretaceous age (**5** on diagram) approximately 100 million years ago, where the northeast corner of South Island now lies. Related sea reptiles of similar age have also been found in Australia. As in the case of Ireland, snakes apparently never reached New Zealand.

Thus in an age when reptiles ruled the land elsewhere in the world, only the lonely tuatara and several species of lizards reached New Zealand. And as the Age of Reptiles gave place to the Age of Mammals, the isolation of these islands prevented all land mammals from coming, with the exception of two species of harmless bats. Bird life, however, made up for this lack, flourishing in abundance amidst a rich covering of vegetation

*See "By Boat to the Age of Reptiles," by G. Miles Conrad, NATURAL HISTORY, April, 1940, pp. 224-231.

Photos courtesy of the New Zealand Government

GRADUALLY the Hokanui mountains were worn down by weather, water, and other natural agencies. Thereafter the country had several ups and downs. At times great blocks settled and the sea overran part of the land. The most terrific disturbance took place when the Southern Alps were pushed farther upward, carrying the old Hokanui backbone to much higher levels. This movement, like all similar ones on the face of the earth, rejuvenated the drainage system and started rapid wearing away by the swifter flowing rivers. The sediments they carried went into the building of a coastal plain similar to those now existing. After another long period of wearing down, the last major upthrust of the Hokanui "backbone" produced the Kaikoura Range in the northeast part of South Island (see distant mountains at left)

VIOLENT EARTHQUAKES shook the land during certain periods of mountain-building, when, as shown in the accompanying photograph, massive layers of rock under great strain fractured along diagonal or nearly vertical lines and were displaced. This faulting happened fairly recently, in the geologic sense, as the rocks themselves are not more than 20 million years old (Upper Miocene)

Photos by James B. Shackelford

AT OTHER TIMES the rocks tilted with less fracturing as shown in the photograph at right, taken at Auckland Harbor, as was the preceding one

THE VERTICAL CLIFF on the right side of this peaceful scene indicates a block which must have been thrust up recently or it would have been weathered into a sloping hillside

Courtesy of the New Zealand Government

Photos courtesy of the New Zealand Government

THE FINAL CHAPTER IN NEW ZEALAND'S STORY comes when the Glacial Period arrived to carve the land with ice. Remnants of the large glacial masses still linger in the valleys of the Southern Alps, as in the case of the Franz Josef Glacier, shown above. When the long and cumulative lowering of temperature again changed at the close of the Ice Age, the glaciers retreated, leaving hanging valleys and much debris now called moraines, drumlins, and tills

AS THOUGH TO COMBINE Nature's coldest and hottest tools in the fashioning of New Zealand's spectacular recent scenery, volcanic activity on a large scale was added to the work of the glaciers. As can be seen (**8** on diagram, page 42), volcanoes broke out in many places, their hot liquid rocks dissolving their way through the overlying rocks and pouring out over the surface.

New Zealand is, in a sense, still in the age of glaciers and volcanoes, for representatives of both are seen there today. The scene at left is of Mount Egmont, reflected in the lake which bears its name

(Left) THE POLUTU GEYSER in eruption. Surface water drains down to a reservoir in hot rock, where it is turned into steam. when a sufficient "head" of steam is created, the water accumulated in the main tube is forced out in eruption

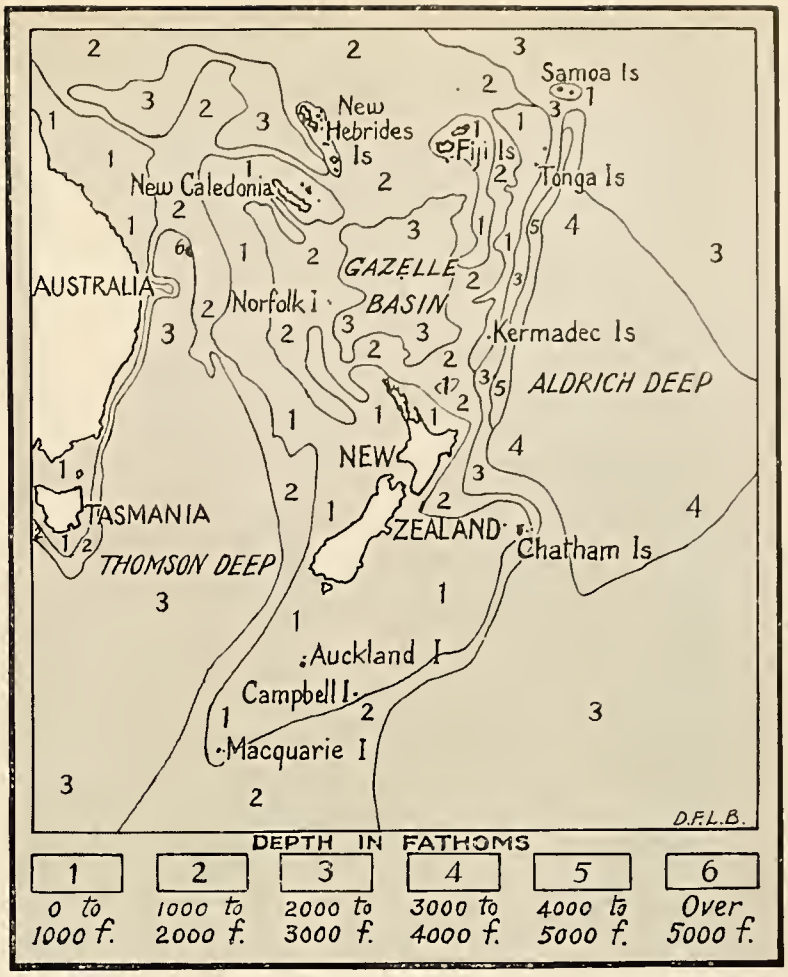
Courtesy of the New Zealand Government

Photo by Frank H. Ramsay

(Right) THIS STEAM JET, or fumarole, at Wairakei releases superheated steam often at a temperature of 1200° F. Although part of the steam is derived from vaporization of surface drainage, much of it must be of volcanic origin

How long has New Zealand been isolated from other lands? According to the geologists, the present-day New Zealand is merely the remnant of a land which up to several million years ago (Pliocene times) extended far to the south, including the Auckland, Campbell and Macquarie Islands. In the east this land reached as far as the Chatham Islands, and to the northwest it may have included Norfolk Island and New Caledonia. At present the relatively shallow waters represented on this map are held in balance by the Aldrich and Thompson Deeps and Gazelle Basin. New Zealand itself appears to represent both the top of the arch of a long convex system of anticlines and a huge block thrust up from below.

In earlier geological ages it had more or less temporary contacts with the Malay Archipelago, Australia, and the islands of the Pacific (for example, Kermadec, Tonga, etc.). To the south it may have even reached Antarctica. From all these sources it derived its present fauna and flora, which even before the coming of Man presented a confusing mixture of native and foreign elements



After P. Marshall

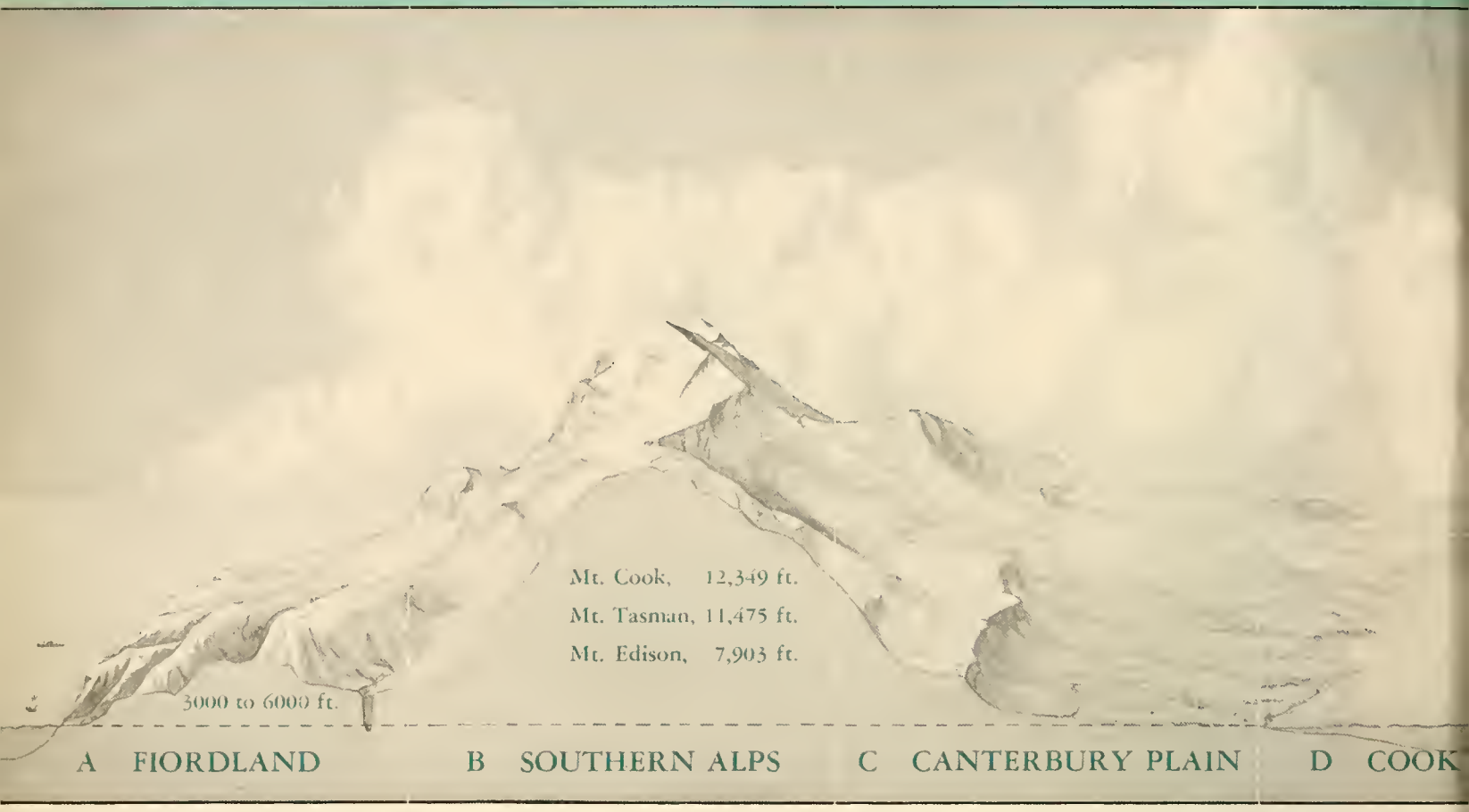
Courtesy of the New Zealand Government

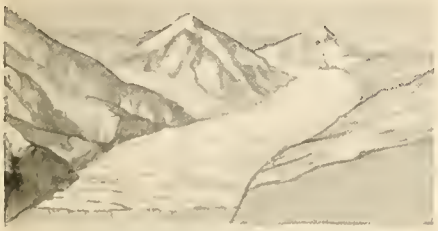
(Above) The volcanic districts in the center of North Island have entered the dying stage of the volcanic cycle: hot springs, geysers, steam jets, mud volcanoes, and "porridge-pots" remain. The scene shown is at Tikitere, Rotorua

Photo by L. Ferraglio

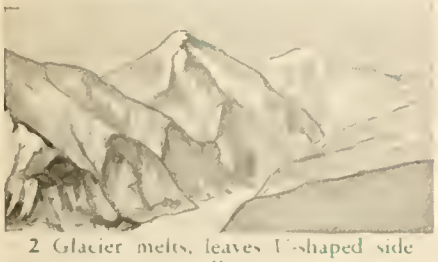
These spectacular limestone caves at Waitomo have been formed by the dissolving action of surface water trickling down through cracks and joints in the rocks. Stalactites and stalagmites are deposited by the evaporation of the dissolving waters

NEW ZEALAND RISES





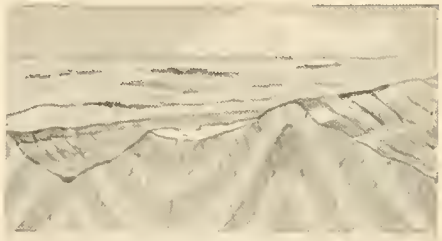
1 Glacier, flowing to sea, digs valleys



2 Glacier melts, leaves U-shaped side valleys

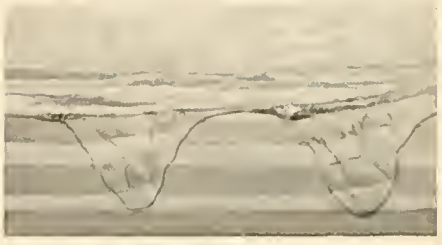
3 Sea enters main valley, forming fiord

The fiords of South Island, like those of Norway, were cut by heavy glaciers flowing slowly from the inland heights down to the sea. The glaciers of Fiordland have disappeared but many are still active in the Southern Alps, notably the Franz Josef and Fox glaciers



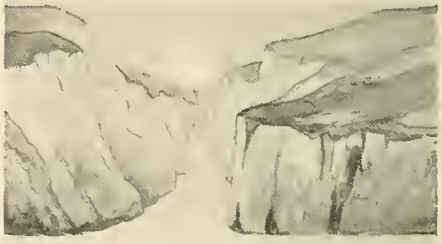
A Fold mountains

B Block-fault mountains



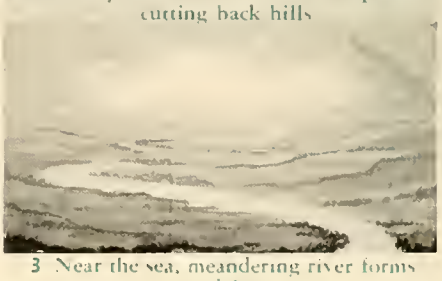
C Residual mountains

Three mountain types: (A) fold mountains, often remnants of still larger folds; (B) upthrust block, split along fault planes; (C) residual remnants of high plateau, dissected by erosion. These, together with "dome" and volcanic mountains, are all found in New Zealand



1 Young gorge with steep walls

2 Valley widens out into floodplain, cutting back hills



3 Near the sea, meandering river forms a delta

From gorge to floodplain. When a country is elevated its river systems are "rejuvenated," tearing gorges through the mountains, wearing down and widening valleys, ending in wide floodplains, where the river blocks its old channels and forms wide "meanders," as in the Canterbury Plains

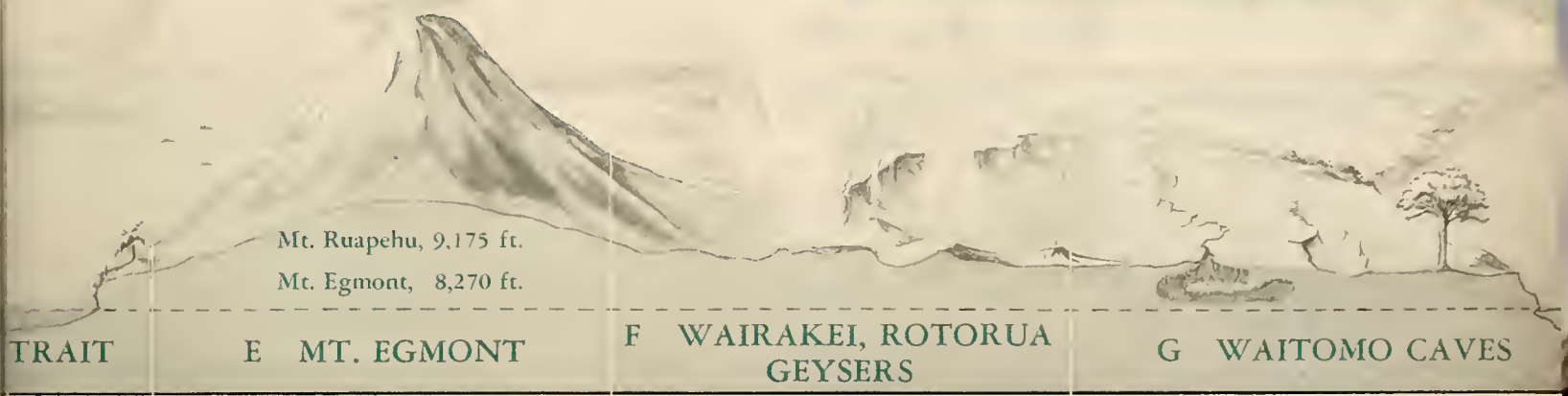
1 Steep cliff from sid

2 Initial retreat

3 Further retreat wit

Wave attack on newly upthrust fault-block. The cliff is constantly being eroded away. Wave-cut caves are formed at the base (see

FROM THE WAVES



ult-block

liff face

formation

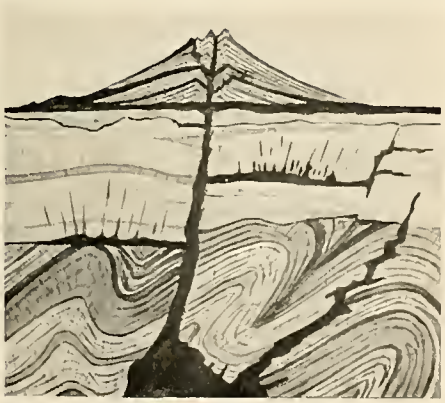


Diagram of volcano

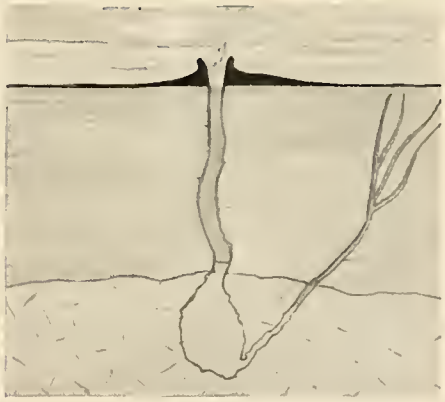
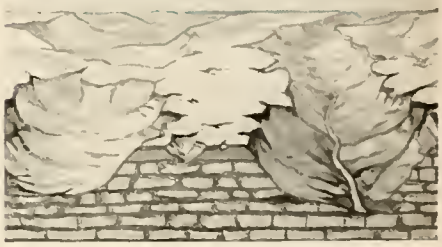


Diagram of geyser

1 Marine limestone, early plateau stage

2 Beginning of cave erosion


3 More mature stage

NEW ZEALAND lies above one of the submarine hot spots of the great "ring of fire" around the shores of the Pacific, spreading from Tierra del Fuego to the Aleutian Islands and from New Zealand through the Solomon Islands, New Caledonia, Philippine Islands, Japan and Kamchatka to Alaska.

In recent geologic times volcanoes were very active in New Zealand, covering great areas with lava and ashes. At the present time only one or two feeble remnants still produce a little smoke and sulphur.

Less violent subterranean heat produces the geysers, hot springs and steam vents of the thermal districts

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(Above) Diagram of volcano in section, showing reservoir of hot rock (black) giving rise to subterranean dikes (vertical) and sills (horizontal), and to lava flows on the surface. The molten rock eats its way up through the submerged mountain folds of the Hokanui system, through the overlying marine limestones to the cone which it has previously built up.

The drawing of a geyser shows the steam chamber in hot rock, with feed pipes at right and chimney. A discharge takes place when the steam pressure in the chamber is sufficient to blow off the column of water above it

How limestone caves are formed: (1) Initial stage following uplift of ancient marine limestone; (2) Stream cuts through surface deposit and into limestone, while ground water, leaking through cracks and sink holes, gradually dissolves limestone, producing numerous passageways and caverns (3)

Drawings by JOHN GERMANN. Data from Marshall, Cotton, Park, Lobeck, and the Auckland Museum.

DOGRIB TREATY

By RICHARD FINNIE

June finds the largest Indian tribe in Canada's Mackenzie River District assembling to make a foremost social occasion of the payment of their Treaty money

(Below) MUSKRAT SKINS OR WIVES *may be the stakes in the traditional gambling game of the Northern Indians away from the settlement; but here at the annual official gathering at Fort Rae, matches suffice. The game is an elaborate version of "Button, Button, Who's Got the Button?" The man with the token (lower right) sways and hums to an incessant rhythm of hand drums*

MORE than 20,000 crisp new one-dollar bills in neat bundles are sent by airplane to Fort Smith, Fort Resolution, Fort Simpson, and Fort Norman. At these and eleven other settlements in the Western Canadian Arctic and sub-Arctic the banknotes will be handed out to Indians and half-breeds, between the end of June and the end of August this year and every year.

"As long as the sun shines and the rivers flow, each man, woman and child will receive an annuity of five dollars . . ." In 1921, using such phrases, officers of the Government concluded with the tribes inhabiting the Northwest Territories the eleventh and last of the Canadian Indian Treaties, the first of which was signed in the eighteenth century in accordance with a Royal Proclamation. It guaranteed protection of

(Right) THE WIDEST ASSORTMENT OF FURS *in all Canada is brought in here at Fort Rae, though not the largest quantity. Besides one of the Hudson's Bay Company's 250 trading posts, an independent Syrian trader, Jim Darwish, is located here, to do business with the Indians. He is shown in this photograph considering the purchase of some skins, amid bales ready for shipment*

All photos by RICHARD FINNIE

their hunting and trapping rights, aid for their sick and destitute, schooling for their children, besides annual payments of arbitrary interest on the value of their lands appropriated by the Crown.

In the Mackenzie River District all of the indigenous tribes are of Athapaskan stock and total some 4000 souls, including Chipewyans, Loucheux, Hares, Slaves, Yellowknives and Dogribs. The latter, now the most numerous, are so named because of legendary canine descent. In pre-European times there may have been more than 1200 of them. Today, with white blood coursing in their veins, and ravaged by tuberculosis and other imported diseases, they number about 700. They roam the wilderness between the North Arm of Great Slave Lake and Great Bear Lake, and make Fort Rae their headquarters.

Early in the morning of July 2nd we boarded a Mackenzie Air Service plane and took off from the sub-Arctic gold-mining town of Yellowknife. Bush fires were raging all along the land to our right. Once we descried a boatload of Indians traveling in our direction, northward. There were no other signs of life. Then we reached Fort Rae.

It was Sunday, and as the plane circled the settlement we saw Indians coming out of a white-painted church and streaming over a little bridge from one island to another. The plane landed and taxied slowly to shore, maneuvering between rocks jutting up through shallow water. Everywhere, too, were fish nets which had to be avoided.

The settlement is spread over several small islands, where vegetation is lush in cracks and open spaces of earth between vast expanses of smooth granite. On each island there are tents and a few crude log cabins put up by Indians and half-breeds, while more substantial frame buildings are occupied by the Hudson's Bay Company, an independent Syrian trader named Jim Darwish, Roman Catholic priests, and the Royal Canadian Mounted Police.

When we arrived, Fort Rae was crowded with Dogribs who had been congregating there since the end of May. Leaving their far-flung hunting and trapping camps of winter far to the north, they had first gathered at a point about two miles above Rae, then drifted in to begin trading. Following a practice developed through a century of contact with whites, they would at the outset offer a few muskrats and beavers with which to buy immediate necessities, afterwards returning to their spring camp. Early in June they came in a body to Rae to remain until after Treaty Time.

Fifteen years ago they still had birch bark canoes and skin-covered tepees. But now all but one or two of their canoes were imported, many powered by outboard motors, and their tents were exclusively of the manufactured variety.

A few days after pitching camp at Rae they began trading in earnest, submitting their furs for appraisal at both trading posts. Muskrat, marten, mink, fox, lynx, beaver, otter, and ermine made up the widest assortment, though not the greatest quantity, accumulated at any of the more than 250 Hudson's Bay Company trading posts throughout Canada.

Few of the Dogribs would be consistently loyal to either of the competing traders, dickering with both for maximum prices; but the debt system would bring the bulk of many a hunter's catch to one store or the other. The debt system is a curse brought upon northern traders by themselves through frantic competition. A native approaches a trader in the fall and asks for a grubstake to carry him through the trapping season, in consideration for which he promises to bring in all of his furs. Usually he does, although not infrequently he takes them to a rival trader and the debt-giver loses out. Indians cannot be prosecuted for debt. Thus the unscrupulous among them as well as the improvident are encouraged to buy all manner of luxuries for which they cannot or will not pay.

The Indians had already traded most of their furs by the time we got to Rae; albeit they were still making purchases with odd skins and such credit (it wouldn't last long) as was left in their accounts, and they were eagerly looking forward to the annual visit of the district Medical Officer and Agent of the Indian Affairs Branch of the Federal Department of Mines and Resources. This was Dr. J. H. Riopel, making his rounds in a little motor-schooner from his headquarters at Fort Resolution at the south side of Great Slave Lake, 150 miles away.

When the Doctor failed to appear on the day expected, the Chief of all the Dogribs buttonholed Robert W. Dodman, Hudson's Bay Company post manager, reminding him that he had let it be known that if the hunters paid their debts he might treat them to a feast. The Chief felt that now would be an appropriate time for it. Although there were still a few accounts outstanding, Mr. Dodman was suffi-

ciently satisfied to offer $80 for foodstuffs. The Chief called in his six subchiefs and councillors to help make the selection. Shortly the supplies were piled on a rock in front of the store, and they included: 300 pounds of flour, 30 pounds of sugar, six pounds of butter, six pails of lard, six pails of syrup, six pails of jam, eighteen pounds of rice, nine pounds of dried apples, eight pounds of raisins, six pounds of baking powder, five pounds of Fort Garry tea, four cartons of matches, one case of pilot biscuits, 30 pounds of hard candy, and one box of 30.30 cartridges. The cartridges were to be fired into the air to summon the people to the feast. Rival Trader Jim Darwish contributed also.

In the afternoon a throbbing of drums was heard through the settlement. It was the beginning of a traditional gambling game as a preliminary to the feast. Two rows of players squatted opposite each other in a large tent. Several others stood behind them thumping drums. In unison a weird, monotonous chant was sung by everyone. Each player in turn would grab a small token, juggle it from left hand to right or vice versa, folding his arms, bending low, thrusting clenched fists beneath a shawl or cap, his body swaying to the primeval rhythm of the drums. The object of the game was to guess which hand held the token. It was an elaboration of "Button, Button, Who's got the Button?" The stakes were matches. At some other time, away from the settlement, the stakes might have been marten or muskrat skins—or even wives. Inveterate gamblers all, the northern Indians have brought their picturesque, age-old drum game into ill-repute through such abuses. In recent years the white man's poker has been taking its place, for poker can be played more quietly, away from the prying eyes and ears of missionaries and the Royal Canadian Mounted Police.

Toward evening the game stopped, and nearly every man, woman and child gathered around a ceremonial tent. Cooking had been going on all day, and great slabs of bannock bread had been baked wherever there were ovens. Now the feast was ready. The guests were served with heterogeneous mixtures which, while they might have been revolting to outsiders, made the mouths of the Dogribs water. Most of them had lately been living on a straight fish diet, and fish was none too plentiful. But no one touched the food. The Chief, Jimmie Bruneau, must first make a speech and ask a blessing. All of the people joined with him in reciting a prayer, crossed themselves piously, then fell to.

There were not enough tin plates to go around, so two or more guests would often be seen eating from one plate. Little children armed themselves with big spoons and scraped out the cooking pots. They ate ravenously, and whatever food was finally left over was carefully wrapped up to be taken home. They had certainly never heard of Emily Post, these Dogribs, and the word "hygiene" was not in their vocabulary, but they rigidly observed one rule of etiquette: their food must not be allowed to rest on the ground or bare rock. Each family had a roll of oilcloth spread out on which to place its share of the dainties.

At the close of the feast cigarettes and handfuls of pipe tobacco were passed around, and then Chief Jimmie Bruneau and his subalterns delivered speeches

(Below) THE CHIEF OF ALL THE DOGRIBS, *wearing the gold bands and red trouser stripes of his office, greets the Indian Agent, Dr. J. H. Riopel, who had been delayed by sick calls along the way. The Chief's uniform is supplied by the Government and replaced every three years. The Doctor is the official dispenser of the $5 annuity money to which each man, woman and child is entitled ". . . as long as the sun shines and the rivers flow." The Head Chief is given $25, lesser chiefs $15*

from their appointed places in the tent, about which the people were clustered. Carefully avoiding babies and dishes, I crept into the tent and found a vantage point for my cameras. After the Chief had been haranguing his people for some time on economic conditions in general, I suddenly became aware that he was now addressing himself to me. An English-speaking half-breed came forward to interpret. Chief Bruneau was bidding me welcome and giving me assurance that he and all of the Dogribs were happy that I was taking their pictures. In fact, so pleased was everyone that a flag was flying above the tent in my especial honor.

This was more than I had hoped for. Some natives are camera shy, others are indifferent, but here were nearly 700 whose leader was giving me carte blanche. I replied in all truth and sincerity that I appreciated the honor bestowed upon me, explaining that the film record we were making would be seen by the Great White Chiefs in Ottawa, who might thereby gain a better knowledge and understanding of the Dogribs whose affairs they were administering. Everybody seemed to feel good about that.

Chief Bruneau asked another blessing and the feast was over. Drums began throbbing again, this time to introduce a tea dance. Several drummers stood in front of the tent and, as they chanted to the rhythm of their sticks, the Chief and a half-dozen young men swept off their hats and executed a lively jig. The doffing of hats was in deference to a taboo imposed by a prophet of Great Bear Lake. In a few minutes they were joined by more young men. Gradually they formed a circle, moving clockwise in Indian file, while older men and then women of all ages crowded in. By this time the tempo had been reduced, and the dance degenerated into a sideways shuffle. The ever-widening circle moved round and round and round. Everybody was singing. The inspiration of the drums was no longer required. At 11 p.m. the sun went down in the northern sky, but the dance continued through the sub-Arctic twilight until the sun reappeared and the church bell clanged to summon the Dogribs to early Mass.

Later that morning a mast was sighted. It was that of the *Peter Pond,* the Indian Agent's schooner, coming from Fort Resolution. Doctor Riopel and his party were welcomed by the resident traders, Corporal William Carter of the Royal Canadian Mounted Police, and Fathers Laperrière and Trassard, besides most of the Indians.

Wasting no time, Doctor Riopel first visited some Indians who were gravely ill and then had his Treaty tent erected. He seated himself at a flag-draped table in the rear of the tent, flanked by his boat engineer who served on shore as clerk, and his interpreter. Chief Jimmie Bruneau entered, followed by Lesser Chiefs Louis Beaulieu, Old Tatsy, Johnny Lily, Zimmie Pig, Louis Migwi and Susie Rabasca. Each headed a band of hunters frequenting a different district; each wore a blue serge suit with brass buttons—supplied by the Government and replaced every three years—but Jimmie Bruneau's suit denoted his higher rank by gold bands on the sleeves and red stripes on the trousers.

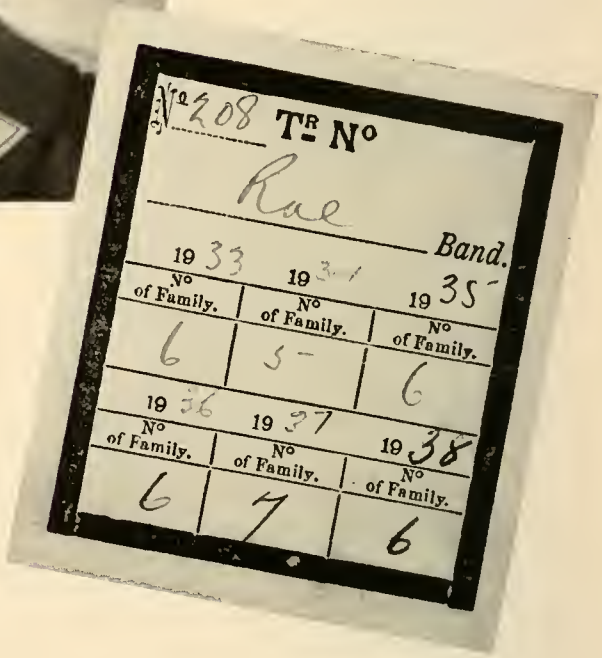
Chief Bruneau delivered a formal speech of greeting to the Doctor, and proceeded to present his peo-

THE WHITE MEN *were taking gold from the North; why didn't the Indians get a share? So said Chief Bruneau at the annual "airing of grievances." The Agent pointed out that the Indians were free to prospect for gold. (Below) Pouring a gold brick at Yellowknife*

THE INDIANS *once found plenty of game, complained the Chief; bush fires were now bringing want. But the Agent replied that bush fires broke out where no white man had yet set foot. (Below) Part of the Canadian Government reindeer herd, for native welfare*

A GRINNING DOGRIB *receives his treaty money from the Indian Agent, Doctor Riopel: part of the $20,000 Treaty money distributed annually at twelve settlements in the Western Canadian Arctic and sub-Arctic. Bundle after bundle of crisp new one-dollar bills were broken and handed out, until there were no claimants left*

AN ACTUAL CARD OF IDENTIFICATION *which the Indian presents at Treaty time. If a half-breed forfeits his card, he is never again entitled to free schooling and hospitalization but is legally able to frequent a pool hall and drink with the miners—a step in life which some have thought desirable*



ple's grievances. He pointed out that the Indians had been roaming the north long before its invasion by white men; that the Indians used to be able to find plenty of game. But now their hunting privileges were restricted, and game was becoming perilously scarce because of bush fires. Now the white men were taking gold away from the country, and why didn't the Indians get a share of it? And so it went on.

The Doctor listened patiently and sympathetically. He read out portions of the Northwest Territories Game Act, showing that such restrictions as were placed on hunting were for the ultimate welfare of the Indians. He reminded the Chief that there had been fires in the north before the coming of white men, and that fires still broke out in parts of the country where no white man had yet set foot. This prompted the Chief to suggest that the airplanes which were now flying everywhere might somehow be causing fires. The Doctor countered that the Indians themselves were not always as careful with their campfires as they should be. He wound up by telling the Chief that the Indians were free to prospect for gold if they wanted to do so, but that in any case they were receiving revenue from all of the gold that was being mined in the Northwest Territories through the annual Treaty payments, through the rations that were distributed among the sick and needy, and through the schools and hospitals and other services maintained for them. The Chief nodded.

All of this prefaced the giving out of the Treaty money. The Indians liked Doctor Riopel and were not in a too argumentative mood. A predecessor of Doctor Riopel had been so unpopular that the Dogribs refused to deal with him. Now it was different.

The meeting adjourned for lunch. In the afternoon the Doctor resumed his place in the tent, this time having Corporal Carter to assist him. From a large brief case he extracted bundle after bundle of crisp new one-dollar bills, which the Corporal began to count out into batches of five. Starting with Chief Bruneau, each responsible Indian submitted his card of identification and recited the vital statistics of his family for the past year.

Jimmie Bruneau, being the Head Chief, received $25; the lesser chiefs each received $15; all other men, women and children were to receive $5 apiece. All through the remainder of the day and into the evening the Corporal counted the money and the Doctor handed it out, until there were no claimants left. Two hundred and sixty-nine heads of families had been dealt with, 677 individuals had been paid, and the total amount given out was $3,465.00.

The next day the Doctor's time was divided between his clinic and the distributing of rations. Each chief was entrusted with quantities of flour, bacon, tea, tobacco, cartridges, shot shells, gilling and backing twine. Some of these staples he could keep, the rest he was to apportion to his tribesmen. Widows also received blankets and mending wool, but at intervals they would be given certain extra rations by the police. Lumber, too, was made available gratis to any Indian who would use it as flooring for his tent.

Although the gold mining town of Yellowknife was 80 miles to the south of Fort Rae by boat, it was close enough to have exercised an insidious influence on the Dogribs. Of this there were various manifestations. The Doctor discovered diseases that were freshly contracted. Some of the people had gone to camp a few miles from Yellowknife, where they were visited by unemployed miners bringing liquor to sell to the braves; the visitors would then carouse with them and debauch their women. So steathily were such practices carried on that the Yellowknife detachment of the Royal Canadian Mounted Police had so far been unable to check them; but the Doctor planned to submit a recommendation to his department that the detachment be augmented, and that measures be taken to deal severely with all offenders.

Another manifestation of the Yellowknife influence was a half-breed's asking to be taken off Treaty. So long as he received his annuity from the Government he enjoyed the status of a full-blooded Indian. He yearned to become as a white man. Why? So that he could legally frequent a pool hall and drink liquor with the miners. To gain these elevating privileges he would not only lose his Treaty money but, after having been finally paid off with a lump sum of $50, he would never again be entitled to free schooling and hospitalization, nor to any of the other special facilities accorded the Indians.

Still another manifestation was in the Dogribs' tendency to regard Yellowknife as a Mecca to which to take their furs to trade. A few pelts might fetch higher prices there than at Fort Rae, but these would be sold often to independent traders having no personal interest in the well-being of their customers. Meanwhile, the Fort Rae traders who had grubstaked and looked after their hunters would be forgotten.

It all constituted a vexing problem that time alone could solve. Eventually the Dogribs might realize that Yellowknife boded ill for them, and so shun it (many already did). Until then, if an attempt were made forcibly to exclude them from the town, they would think they were being persecuted and would invoke the terms of their original Treaty with the Government, which declared that they would always be permitted to wander through the length and breadth of their land.

As soon as the Treaty money was in circulation at Fort Rae, the traders' stores were jammed with Indians. Having no idea of economy, and with the philosophy of "eat, drink and be merry, for tomorrow we die," each proceeded to spend his $5 instanter. Some of the money went for necessities, but most of it went for foolish luxuries. Many a hunter would soon be coming to Mr. Dodman or to Mr. Darwish begging for a few dollars' debt.

It is becoming increasingly apparent to the traders —who started it—as well as to students that the debt system among Indians should be abolished as soon as possible. This could be done only by means of rigid Government control, which would limit traders'

LUMBER *was made available without charge to any Indian who would use it to floor his tent. A nice trick of canoemanship is being shown below by two Indians transporting their lumber from the Mounted Police barracks. Widows received blankets and mending wool, and were to be given extra rations at intervals*

(Below) THE NEW *sub-arctic gold-mining town of Yellowknife: a source of perplexity to the Dogribs. Too many have come to regard this mushroom settlement as a Mecca for trade and civilized pleasures, yet if forcibly excluded, they might feel abused. Some already recognize that Yellowknife bodes ill for them*

(Below) DOGRIB WOMAN *making a fish net. Native arts are encouraged among these Indians, who, like other people of the wilderness, go through a difficult transition on contact with civilization. The Dogrib tribe originally numbered 1200; today, ravaged by white man's diseases, it numbers about 700*

stocks to necessities and a modicum of luxuries and which would prevent the Indians from buying anything they could not pay for. It would bring hardship to them for a season or two, but then they would begin to accumulate credits at the trading stores whereby they could secure new outfits and miscellaneous supplies, and protection against rainy days and old age. It would be better business for the traders in the long run, and the Indians would regain a measure of their former independence.

The Doctor spent several days at Fort Rae after Treaty time, examining and treating patients. As he was making ready to sail to Yellowknife, to pay Treaty to the Indians in that vicinity, he was importuned by Chief Jimmie Bruneau. The Chief wanted to accompany him, proposing to hold conference with other chiefs with a view to remonstrating with the white men who were taking away the Indians' gold. The Doctor dissuaded him.

Then the Chief came to me. He and his people had received me cordially and had not minded my photographing them. Now he was about to make a speech. Father Nicolas Laperrière, a priest of infinite kindness who had labored among the Dogribs for nearly 30 years, was asked to interpret. The Chief had heard, he said, that my wife and I were soon to leave Fort Rae by airplane.

"Well," commented the Chief, "we will be sorry to see you go. It would be nice to have something to remember you by, though. How about some tobacco?"

That disillusioned me. I had admired the Chief's dignity and would never have expected him to make such a petty request. Father Laperrière was embarrassed. He pointed out to the Chief that I was in no way indebted to him or his people, that I had not inconvenienced them but had filmed them for the Government and, indirectly, for the benefit of the Dogribs themselves.

"Oh," replied the Chief, "I did not quite understand that before. Well, then, how about a few matches?"

Father Laperrière kept a small store in conjunction with the mission, so I asked him if I might purchase some tobacco to give to the Chief. Together we walked to the store, followed not only by Chief Bruneau but also by his six subalterns who had been attracted to the scene. Each man was handed a large plug of tobacco. Father Laperrière firmly refused to let me pay.

"No," he said sorrowfully, "you should not pay, because it is all my fault. I have been so many years with these people, and by this time I should have succeeded in teaching them better manners."

The asking for or the supplying of the tobacco was nothing in itself. But it graphically illustrated the small-mindedness of these Dogribs. My pictures and reports to the Government might conceivably prove of some vague benefit to them in the future—but they preferred to have something tangible from me right now, even if it were only a plug of tobacco or a few matches. The incident made a profound impression upon me, leaving the conviction that all of the traders' concessions to them and the altruism of the missions and the Government were taken as a matter of course, without real understanding or gratitude.

THE DOGRIBS *sojourn at Fort Rae for a month, waiting for Treaty. Soon afterwards, their money gone and their dogs famishing, they strike camp and pack their belongings into their canoes. All have factory-made canvas-covered canoes, most of which are powered with outboard motors. Not more than one or two birch bark canoes can be found in the district nowadays. The last canoe heads northward toward the hunting grounds, and Fort Rae is deserted again until fall. The dogs trail their owners along the shore, but every now and then one takes to the water*

HE BROUGHT THE STARS TO AMERICA

By D. R. Barton

Yet Clyde Fisher's astronomical career is curiously intermingled with a lifetime of reverent inquiry into the natural wonders of our own planet

The recent popularity of books about Leonardo da Vinci might be explained by the fact that his type has been sorely missed in our age of specialization. We seem to dote on "the universal genius" largely because he is so refreshingly different from ourselves, and certainly most of us would go far to meet one like him.

Dr. Clyde Fisher, Curator-in-Chief of the Hayden Planetarium, may not be another Leonardo but he is surely a man of parts. In his time he has been a member of the Sioux Indian tribe, a college president, an astronomer, photographer, botanist, ornithologist, mammalogist, geologist, and paleontologist, and as a dabbler or specialist has been associated with every classification of scientific work conducted by the American Museum.

Out of all this, he has emerged as the man most prominently connected with bringing planetaria to the United States. For astronomy runs in the Fisher family, and indeed, has dogged his meandering footsteps until it finally got him in the end. But the astonishing variety of interests which has made him perhaps the most versatile living natural historian can be attributed only to an enthusiastic personality and an unrestrained appetite for the sweets of knowledge.

Blackstone Studios

This appetite found fertile soil in the Ohio countryside of the eighties and nineties where Clyde Fisher spent his boyhood. Born on a farm, he was accustomed to outdoor life from infancy. The birds of the air and the flowers and beasts of the field were with him by day, while at night heaven's broad expanse opened to his gaze, unsullied by the glow of city lights. Two uncles had taken up astronomy as a hobby and from them young Clyde learned a deal of sky-lore. He set such store by these mentors that he feared all knowledge of the sky would die with them. Filled with consternation, the child insisted on teaching astronomy to anyone who would listen, and was particularly anxious that his own father should sit solemnly while he explained how the earth rotated on its axis.

Before long, Clyde was teaching professionally. Financial necessity forced him to postpone higher learning, and he set out on his own with a country schoolteacher's certificate. A keen eye for evidences of the continental ice-sheet in this glacier drift section of Ohio had made him increasingly interested in geology, and he was one of the first to introduce geological projects into a curriculum almost exclusively dominated by the three R's.

When he had saved enough money, Clyde entered Miami University at Oxford, Ohio, where the professor of astronomy was delighted with his unusual knowledge of the sky and soon promoted him to the role of student assistant. But on a chance visit to the Geological Hall, Clyde noticed a collection of fossils embedded in the Cincinnati Blue Limestone. This sight fired him with the notion of turning paleontologist. The geology instructor promptly recommended a thorough grounding in zoology. Undaunted, young Fisher mastered the subject so readily that he was awarded a summer scholarship for advanced study at the Marine Biological Laboratories in Cold Spring Harbor, Long Island.

Here, new vistas opened before him. His restless intellect found delight in a spare time investigation of sea-weeds, fungi, flowering plants, etc.; and these became such an obsession that he set his heart on learning botany. His botanical ambitions persisted through several post-graduate years of teaching in Ohio schools and in a small

Florida college of which he was once acting president. Finally he was able to work on a doctor's thesis in the Botany Department of Johns Hopkins University.

Meanwhile, he had been appointed to the biological staff at Cold Spring, where, in addition to his regular work, he made a side line of ornithology. At this point his reputation as an extraordinarily well-rounded naturalist reached the American Museum. The late Doctor Sherwood, then Curator of Education, heard of Fisher through ornithological friends and was so anxious to secure his services that he signed him up six months before Johns Hopkins awarded the doctorate in botany.

Museum years

The day he reported, Doctor Fisher entertained high hopes of a tremendous expansion of the botanical collection. With the ink scarcely dry on his diploma, he thought that at last he had found his appointed task, that his scientific wanderings were at an end. But versatility had been the keystone of his reputation, and versatility was what the Museum expected. In short order he became the departmental "trouble-shooter" and Jack-of-all-trades. To him was entrusted the complex task of organizing all the diverse products of Museum research into a carefully graded course of study suitable for school children and their teachers. It was a tax upon scholarship that would have staggered a less flexible mind, but within a few years Clyde Fisher rose to virtual supremacy in the department under the title of Curator of Visual Instruction.

Yet, by sheer intellectual legerdemain, he was able to keep up his astronomy and when, in 1924, Museum President Osborn decided that the Museum ought to have an astronomical department, Doctor Fisher was appointed temporary curator. He showed such adaptability and enthusiasm in this added duty that he was soon dispatched to Europe to investigate the planetaria recently introduced in Germany. He brought back a glowing report of what he considered the greatest instrument of visual instruction ever invented. As the first American scientist to inquire into this new invention, he was besieged by astronomical circles all over the country who sought advice on the building of planetaria in other cities.

It had been Doctor Fisher's hope that New York would construct the first planetarium in America, but previous commitments prevented the Museum from raising the funds until after planetaria were finished or under construction in Chicago, Philadelphia, and Los Angeles. Nevertheless, Doctor Fisher gave freely of his time as a consulting expert for these "rival" groups. Then at long last, ground was broken, and slowly the great Hayden Planetarium arose to take its rightful place among American astronomical centers.

Shortly after the official opening, the management decided to take advantage of popular enthusiasm for imaginary inter-planetary exploration and invited Buck Rogers, that titan of the 21st century, to exhibit his supporting cast at the Planetarium in full regalia.

The stunt was tried as a sort of publicity trade between the hyper-modern theatrical troupe and the slower but surer body of scientists engaged in teaching orderly, scientific astronomy to the public. Such trading illuminates the strange interaction of the spurious and the authentic that seems to crop up wherever a planetarium has been built. Chicago's venture was the signal for numerous astrologers to set up shop on Michigan Boulevard after the manner of hot dog merchants erecting jerry-built stands in the neighborhood of an established restaurant. This is an ironic reversal of history. For orthodox astronomy is well known to have stemmed from the dark roots of astrology, a profession at least as old as Egypt, which has probably been practiced in one form or other since man's earliest attempt to divine his destiny.

Thus astrology benefited considerably by the induction of planetaria into the American way of life. Its practitioners must understand elementary astronomy, particularly the movement of the planets through the signs of the zodiac; and, as Doctor Fisher has remarked with rather mixed emotions, "Some of them know a surprising amount about the sky." This is evident in some astrology magazines which crowd more reputable publications off our newsstands. But it was emphasized in the course of a special Planetarium lecture which Doctor Fisher gave at the New York World's Fair before a national association of astrologers. Feeling rather like a prominent surgeon at a gathering of witch doctors he hastily reminded his hearers that he could, of course, give them "nothing but straight astronomy." But that was perfectly all right with the astrologers, and a slightly puzzled Doctor Fisher soon found himself in unusually close and decidedly unexpected rapport with his audience. The astrologers, it seems, are very anxious to lay a sound foundation for their vaporous superstructure.

Evasions on Mars

But no one who remembers the preposterous effect of Orson Welles's immortal broadcast of 1938 can doubt that the greatest popular rallying point in all the heavens is centered on a single planet—Mars. The spirit of this interest seems to reach as far back as the first great wave of romantic thought which followed the discovery of the new world. Previously people with crack-brained notions like Columbus' concept of a spherical world could gain almost no foothold in the imaginations of their contemporaries. But because so many incredible things have happened in the last 500 years it is characteristic of our enlightened age that almost any flight of fancy with sufficient romantic appeal will gain much more attention than it reasonably deserves.

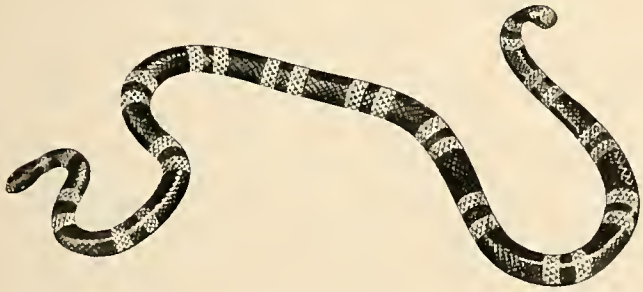
So it has been with Mars. The planet has provided the richest imaginable material for all entertainment media from comic strip to silver screen. In simpler cultures, artistic endeavor was taken up with anthropomorphic imaginings about the processes of Nature—a tendency clearly observable in primitive religions. But since we moderns have stripped most of the mystery from these processes, we now feast our wishful fancies on things that still remain unexplained. Those human relationships most baffling to the social scientist are rendered deliciously simple by popular artists. And these same worthies have stormed the worlds of outer space and exhumed their natural resources before our plodding astronomers have managed to get one good look at them.

Some sociological theorists regard this as a natural outgrowth of popular insistence on escape from the petty aches and pains of civilized life. Mars, at its closest approach, is known to be about 35 million miles away from the earth, which guarantees a fairly safe refuge from a nagging wife, a boring job, a sense of personal inadequacy, or all of these. At any rate, the nationwide stampede brought on by Orson Welles's "newscast" is a startling revelation of the vivid reality of Martians for many thousands of American people.

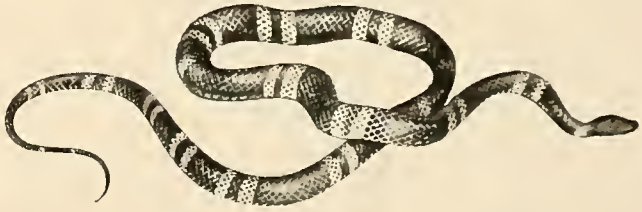
Looks are Deceiving

This mushroom is delicious. It is the common field mushroom, *Agaricus campestris*. From midsummer until October, you can find it springing up almost everywhere among the low grass in meadows, pastures, or lawns.

This mushroom is deadly. It is the *Amanita phalloides*, sometimes confused with the harmless Agaricus. People who fail to notice that it has *white* instead of *pink* gills beneath the cap are poisoned by it almost every year.



This snake is poisonous. It is the famous coral snake, *Micrurus frontalis*, of Brazil. It is ringed with scarlet, yellow, and black bands. When full-grown, it is about three feet long, and its poison is as deadly as a rattlesnake's.



This snake is harmless. It is the *Pseudoboa trigemina* which is so similar in size and in its scarlet, yellow, and black markings that even the specialized scientist has to look closely to tell it from its deadly brother.

This man is worried. He walks, talks, eats, sleeps, even smiles like the man at the right. But he has a haunting worry because his old age is not being provided for and because his family will be unprotected if he should pass away.

This man is not worried. He looks, on the surface, like his troubled friend, but he is at peace with the world. For he has made provision through *life insurance* for his family and his old age. Cast off your financial worries by doing likewise.

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INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 68

Answer to eleventh question in May issue: (Describe the sound made by an earthworm): The sound is comparable to that of smacking lips or a leaky faucet. See page 33

1. The elephants commonly seen in the circus are:
   (a) African
   (b) Asiatic

2. If you cut an earthworm in two, it will continue to live as two separate worms.
   True..... False.....

3. What great modern industry was made possible when early Spaniards watched an Indian ball game?

4. Earthworms eat earth.
   True..... False.....

5. What rare tree in the United States has not been seen growing in the wild state since 1790?

6. Earthworms emerge from their burrows after a rainstorm
   (a) To drink much-needed water
   (b) To migrate in swift running rivulets
   (c) To escape suffocation, since their oxygen supply is reduced

7. Why does a robin have difficulty in pulling an earthworm from the ground?

8. In what way do the antennae of butterflies and moths generally differ?

9. The Ghost Crab passes most of its life on dry land, yet breathes with gills. How does it get its oxygen?

10. Cicada-killers are believed to hunt by
    (a) Eye
    (b) Ear
    (c) Nose

But popular enthusiasms of this sort cannot be blamed entirely on contemporary cartoonists and thrill-writers, both of whom quite often depend upon science for the embryonic form of their brain children. The story begins in the latter half of the nineteenth century with the observations of an Italian astronomer named Schiaparelli. After peering through a telescope, Schiaparelli said he saw a kind of cross-work of *canáli* on the surface of Mars. Now it so happens that this Italian word is perhaps better translated by something like "fissures." But its identification with the English word canals was obviously inevitable. Such a concept instantly gripped the imagination. For if there were canals on Mars, there would have to be a race of beings intelligent enough to dig them. And even if the Italian word didn't strictly mean canal, the fact that those markings proceeded in straight lines was ample evidence of the artificial construction, since Nature is known to hold a straight line and a vacuum in almost equal abhorrence.

The real "villain of the piece" was a Boston Brahmin, Percival Lowell, who turned astronomer at the age of 40 and set out to "prove" the existence of a higher form of life on Mars. This is a rather dangerous thing for a scientist to undertake. For if a man is really determined to "prove" something, he usually succeeds in doing so, at least to his own satisfaction. That is precisely what happened. Lowell devoted twenty-odd years of his life and the greater part of a large fortune to establishing his point, and died firm in the belief that Mars, far older than the earth, was rapidly drying up while its inhabitants strove desperately to husband the meager water supply. To this end they had created an enormous network of irrigation canals, using the glacial ice packs at either pole as sources. It is not difficult to see how far such theories could be carried by an escape-hungry populace and their daydream-manufacturers.

However, it is worth remembering that a number of the well-established facts about Mars fit in with Lowell's hypothetical "canals." For example, the planet does lack oceans and mountain ranges. There is little moisture in the Martian atmosphere, and the polar caps do shrink while the darkening and widening of the supposed canals are taking place. It is true that in the past some well-known astronomers have squinted in vain at Schiaparelli's canals and have pronounced them optical illusions. But now it must be admitted that there are "markings" on the planet and that no astronomer or other scientist has yet presented a convincing explanation of their existence by natural causes.

Lowell observed and mapped over 400 "canals," of which one was some 3000 miles long. He also calculated that they would have to measure about ten to fifteen miles in width to be seen through our best telescopes. But in all fairness, it must be said that he did not believe the canals proper were visible at all. He thought that what he saw were streaks of vegetation growing along the waterways. His observation that the color changes of these streaks indicate seasonal alterations of the foliage seems to be substantiated. Apparently the dark masses show the blue-green of late spring and the chocolate-brown hues are the Martian equivalent of the turning leaves in our own autumn. From this evidence, however, not much proof is forthcoming with respect to man-like creatures. Lowell preached that the contiguity of these belts of foliage with the so-called canals pointed strongly to a system of irrigation. But even though this might once have been the work of intelligent beings, it certainly could continue in operation long after their extinction. Further, there is everything in the history of our own earth to show that trees can exist long before the appearance of higher forms, and finally there is certainly very little in either the known facts or the well-founded hypotheses about Mars to qualify that planet as the abode of a superior race. The natural conditions essential to the growth of anything like a vigorous human culture appear simply too scanty there to produce the eventual conquerors of our far more richly endowed earth.

Amid the welter of speculation about a regular commuting service over the paltry 35 million miles separating Mars and the earth, a few scientists have risen to venture that if the human development of power continues at its present pace, we would have power enough to reach the moon within the next hundred years. The moon is less than a quarter million miles away at the period when it is closest to us; and in a rather wistful way Doctor Fisher feels that Luna has been sadly neglected by the fanciful theorists. The distance, he sighs, is so much shorter. Yet he fully realizes that his profession has given them small encouragement. For despite all our po-

etic tributes to her silvery beauty, the moon offers little of the romance that has glamorized Mars. Astronomers have proved her to be heatless, waterless, airless, and lifeless. They have also placed some doubt on our ability to "hit" this rapidly moving satellite with our potential "rocket-ship," so that, all in all, it hardly seems worth the trip.

Journeys afield

Up to the formal opening of the Hayden Planetarium, Doctor Fisher kept his old job in the Education Department. He had two offices and two secretaries, and kept shuttling back and forth between them. But he soon discovered that the day is only 24 hours long. Of course, the Planetarium won out, and for the better part of a decade our scientific Jack-of-all-trades has been allowed to become master of one.

Though his first love triumphed at last, he has never allowed astronomy to dominate his existence completely. Doctor Fisher's all-embracing interests have always kept him active in ornithological as well as botanical circles, and he considers his long friendship with that beloved interpreter of Nature, John Burroughs, to be one of the most important influences of his entire career.

In recent years, Doctor Fisher's expeditions have tended to be largely astronomical. He has inspected meteor craters in Arizona, Texas, Kansas, and in far-off Estonia, and viewed eclipses in such widely separated places as Siberia and Peru. But in 1930 he was sent to Iceland as official representative of the New York Bird and Tree Club, which had conceived the idea of donating a thousand trees, together with $1000, to inaugurate a reforestation project as a part of the millennial celebration of the founding of the first parliament in the world.

Far less formal were his native American camping trips with that colorful nature-writer Ernest Thompson Seton. The most memorable of these jaunts took them into Indian territory in the company of three or four ladies, one of whom was a dietitian. This particular lady was so serious about her work that she once lectured the members of the party on the eating of salt, predicting for them all an early death via hardening of the arteries. The next evening at dinner, Seton looked around the camp-table and said very gravely, "Where's the salt? My old arteries are sloshing around again."

The hale and hearty Seton had a genius for getting Doctor Fisher into ticklish predicaments. Some time after the salt affair, he persuaded the mild-mannered astronomer to join him in a study of Indian sign language. Although he knew next to nothing about Indians, Doctor Fisher saw in Seton's invitation an excellent opportunity to apply his photographic skill. Movies of this fast-disappearing phase of the red man's life would certainly make a valuable educational film. In fact, it became the only motion picture of sign-talking, with translation, that had been made up to that time.

Shortly after their arrival, the reservation Indians were so won to Seton's jovial comradery that they insisted on adopting him into the tribe. Always the showman, Seton was determined to lose none of the dramatic effect of the naming ceremony. Painstakingly, he learned by rote a complete acceptance speech in the Sioux language and, as the climax of the ritual, led a group of braves through a dance in his own honor. Doctor Fisher, meanwhile, thoroughly enjoyed the situation from the spectator's point of view. But when the Indians turned on him, he found to his consternation that he, too, was to be adopted into the tribe. Shaking with stage fright, he told the Indians that he was "glad to be there," and invited them to come and see him at the Museum sometime. But when he tried to sit down, the interpreter grabbed his arm, "You must lead the dance in your honor!" Doctor Fisher did his best but he fervently thanks his stars that no other camera-man was present. He returned East a full-fledged member of the Sioux tribe, named "Afraid-of-Bear." Since the appellation was originally borne by one of the Indians who killed Sitting Bull, its recipient rather wishes his hosts had chosen something with a less belligerent claim on fame.

". . . the fullness thereof"

As he looks back upon the years, Doctor Fisher does not regret that he took so long in settling upon a single specialization. Internationally famous as a great teacher and a pioneer in the broad field of visual instruction, he feels that his natural talent always has been that of the all-round naturalist. And though his contributions in weighty monographs are small, it can safely be said that he has brought the vast subject of Natural History in all its ramifications to the attention of a greater public than any research specialist could ever hope to do.

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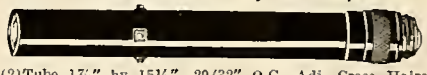

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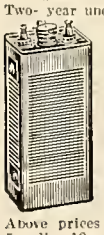

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Anthropology and Religion

- - - - - - - - by Peter H. Buck

Yale University Press, $1.50

THIS is a well written booklet giving the views of a distinguished anthropologist upon the place and meaning of religion in the culture of a people. Three themes are discussed—Man Creates His Gods, The Gods Create Man, and The Death of the Gods—illustrated in the religious history of the Polynesians. Since the author was a Polynesian by birth and early conditioning, he has a right to speak upon the subject. However, as one reads this book he comes to see that what is true of Polynesian religion is almost equally true of every other. Religion evolves with a mode of living which we think of as a civilization and is so completely integrated with it that any particular civilization tends to persist until the religious core disintegrates.

"The Christian ideals that religion has taught us seem to have been cast aside by millions of people. Instead of brotherly love, we have racial intolerance and merciless persecution. Our civilization stands on the verge of a relapse, not into barbarism, but into sheer savagery. I believe that the Christian religion is an integral part of Western civilization or culture and that it is one of the few restraining forces that may guide us back to faith in goodness, truth, and justice. The death of the Christian gods would mean the collapse of the culture to which they belong, just as surely as the death of the Polynesian gods led to the end of Polynesian culture."

Clark Wissler.

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- - - - - - - by Patrick M. Synge

E. P. Dutton, $3.00

THIS a most interesting volume by a British flower-lover, who not only knows the flowers but also is familiar with the history of botany. He knows the great botanical gardens as well as many private gardens, especially of Great Britain, and he has made exploratory trips into mountain, desert, and jungle of many parts of the world.

There is no humanizing of plants here. As the author uses the term "personality," it is an indefinable character—beauty of color or form, or striking structure or function—something that makes the plant unforgettable.

His favorite plant seems to be *Nelumbo nucifera*, the Sacred Bean of ancient Egypt, the Lotus of India and China. Incidentally he relates the story of the finding of seeds of this plant buried two feet deep in a peat bed in China—seeds 120 to 400 years old which germinated later in Kew Gardens—probably the record for proven longevity in seeds. In this chapter on water plants the Victoria Water-lily, "the plant with the largest leaves in the world," is discussed.

In the chapter on magnolias and camellias, the author agrees with Sir Joseph Hooker's statement that *Magnolia Campbelli* is "the noblest specimen of the genus." He says it is possible to have magnolias from February to November; that *Camellia reticulata* is the queen of the camellias; that the ordinary tea plant *Thea sinensis* was formerly called *Camellia sinensis*.

The book includes a fascinating chapter on insectivorous plants, with a description of the author's own wanderings among the marvelous pitcher-plants of the genus *Nepenthes* in Borneo. Linnæus took the name from the *Odyssey*, Nepenthe being the old goddess of sleep and oblivion. And, as the author states, "certainly it is oblivion for the many insects which find their way into the pitchers and are drowned there and slowly digested. The pitchers are beautiful; they are streaked and painted with a theatrical brilliance, their form designed by a Cellini endowed with a Machiavellian and wholly diabolical cunning."

Other insectivorous plants treated are North American pitcher-plants *(Sarracenia* and *Darlingtonia)*, Venus's-flytrap, hornworts, sundews, and butterworts.

Interesting facts are given about giant-Rafflesias, and the giant aroid *(Amorphophallus titanum)* the latter in common language being the largest flower in the world (to the botanist it is in inflorescence). In 1937 this aroid bloomed gorgeously in the New York Botanical Garden. In height the flower (inflorescence) was eight and a half feet, the largest on record. Other plants discussed are the crane-flower or bird-of-paradise flower *(Strelitzia reginæ)*, which is cross-pollinated by the little sunbirds; the Chilean *Puya alpestris*, which is pollinated by hummingbirds; gigantic plants from East Africa; cacti and succulents.

This book has a bibliography for each chapter, and an index. Altogether it is a most readable and informative volume.

Clyde Fisher.

Wild Bird Neighbors

- - - - - - - by Alvin M. Peterson

Bruce Publishing Company, $2.00

IN this well-named volume the author records his day by day experiences with the birds that live about him. In all, he treats of thirty-five species of the birds of garden and farm, giving in some instances as many as twenty-five pages to a subject. Quotations from other authors are almost wholly restricted to Beal's reports on food habits. The author, therefore, writes largely from his own experience and is obviously a close and sympathetic student of bird life. He responds particularly to the influence of bird songs and gives admirable descriptions of them. Each biography is accompanied by one or more original photographs, and the manner in which these excellent pictures were secured very often forms part of the text that accompanies them. We can cordially recommend *Wild Bird Neighbors* to bird lovers.

F. M. C.

Ten Years in the Congo

- - - - - - - - - by W. E. Davis

Reynal and Hitchcock, $2.50

HERE is the story of a medical missionary in a country I am deeply attached to. With pleasant anticipation I took up Doctor Davis' easy flowing account of his life in the forested heart of the Congo Basin, and the promise of its title was more than fulfilled.

Through the decade ending in 1937 the doctor fought disease among natives and whites in the low hot country east of Coquilhatville on the Congo River. Mission headquarters were at Bolenge, but most of the time Doctor Davis lived at the small stations of Lotumbe on the Momboyo River and Wema, still more remote, on the Tshuapa. He had relatively little contact with civilization.

Travel was largely by water, and the Mission had its own little steamer, the *Oregon*. The tours of the doctor by boat, foot, and bicycle are described with a raciness that pulls one deeper into his book. The chapter on planters seems a little incomplete, that on Belgian administrators better and more appreciative. Best of all are the intimate accounts of native life, the rough-and-ready surgery, and the purposes of missionary effort.

Topics of particular interest are the popularity of the hypodermic needle, the plight of lepers, the lack of deaths from snake-bite, and the fact that no one succumbs any more to sunstroke.

Let no one think the old days in Darkest Africa were blissful. Weighted with fears of evil spirits, cannibal neighbors, and sorcerers, plagued by marital squabbles and diseases for which there was no cure, the tribe had a hard time to survive. Much as the native may chafe at having to pay his tax, it can certainly be argued that civilization and missionary medicine are boons to him. As an all-round picture of life in the Congo, Doctor Davis' book would be hard to beat.

J. P. C.

ANIMALS AS FRIENDS AND HOW TO KEEP THEM

- - - - - - by Margaret Shaw and James Fisher

E. P. Dutton, $2.50

AT first glance this book from the London Zoo seems to have little of practical value for the American wild animal fancier. The animals considered are largely Old World species and include many rare tropical creatures not likely to be seen in America outside of a well stocked zoo. However, as stated in the publisher's note ". . . animals are the same all over the world, and the methods of care and handling, the treatment for sickness, the rules for feeding, and so forth, remain the same . . ." and, after a careful perusal, it is obvious that this volume contains a wealth of data extremely useful to the animal keeper anywhere. The files of the London Zoological Society are the source of most of the material and the authentic and tried information on breeding habits, feeding formulas, transportation problems, disease and the like, extend the scope of the work beyond the amateur field and give it a place on the reference shelf of the zoo curator, the animal dealer and the laboratory zoologist.

The animals dealt with make up a large and, in some respects, surprising list. Monkeys of the smaller species commonly kept as pets; small mammals such as squirrels, mice, hedgehogs, otters, badgers, hamsters, and many others; birds of many species; reptiles and amphibians; curious insects and tropical fish are among the groups considered. The section on silkworm culture, an apparently not uncommon British avocation, is one of the surprising items. The abundant literature on cats, dogs, sheep, goats and rabbits seems to me to make their inclusion unnecessary and I regret the authors saw fit to devote such liberal space to these common domestics.

The sections are simply written and each subject is considered under the regular headings of distribution, habitat, description, care and food, housing, cage mates, behavior, breeding, diseases, handling, transportation and approximate cost.

The photographs are many, interesting and well composed and, in most cases, by the inclusion of a child illustrate the title *Animals as Friends.*

ROBERT SNEDIGAR.

I MARRIED ADVENTURE

- - - - - - - - by Osa Johnson

Lippincott, $3.50

"I MARRIED Adventure," writes Osa Johnson and then proceeds to prove it on the pages of an attractive book. Most of the picture-conscious public has seen or heard of the pictures of Martin Johnson and knows of the active cooperation he had from Osa, his wife.

Martin Johnson might be said to have reached the peak of his career when it was abruptly cut short by a fatal airplane smash which also seriously hurt Mrs. Johnson. This biographical account gives an entertaining story of the struggles and experiences of the Johnsons which are far from dull. The average reader will find the book difficult to lay down for it is like the Johnson pictures, unusual and exciting.

Osa Johnson tells of the family backgrounds of herself and her husband, how they met one another, how Martin became an explorer, and all of the intimate, personal items that one expects in a biography. They are not catalogued in a monotonous style but display good showmanship and a keen realization of human interest. Each step in the family's career is taken up in chronological order, nonessentials are omitted, and the story unfolds rapidly. As a matter of fact, there is enough subject matter in the Johnsons' career to supply several books, and the concentration of so much action in one volume is bound to produce a very dramatic presentation.

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Photograph of Mr. and Mrs. Martin Johnson, taken just before one of their last expeditions.

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by Osa Johnson (Mrs. Martin Johnson)

(Published by J. B. Lippincott Company)

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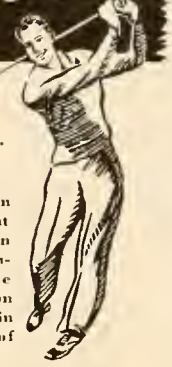

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Martin Johnson pioneered in the field of wildlife photography and roamed over many little-known regions. Plenty of good pictures had been taken before his appeared, but he began to produce better pictures, he organized on a scale hitherto unknown, and his last expeditions, with every mechanical and scientific resource provided, were a far cry from those with which he first entered the field.

As is to be expected, the illustrations in *I Married Adventure* are excellent. The volume as a whole is well constructed. At the conclusion of the reading one will agree with the title and reflect "she certainly did."

H. E. ANTHONY.

THE HOME BOOK OF TREES AND SHRUBS

- - - - - - - - by J. J. Levison

Simon and Schuster, $5.00

HERE is a beautiful book written by a master in his field. A good notion of its scope is indicated by the sub-title: "A Layman's Guide to the Design, Planting, and Care of the Home Grounds, With Information on Lawns, Woodlands, Flower Borders, Garden Accessories, and the Identification of Trees."

This is quite an order, but the book lives up to it. The author speaks from a wide experience of thirty-five years in arboriculture and landscape forestry. He was formerly a staff lecturer on the planting and care of ornamental and shade trees at the Forest School in Yale University, and holds the degree of Master of Forestry from that institution. He has been in the United States Forest Service under Gifford Pinchot, and he served as arboriculturist and forester for the Brooklyn and New York City Park Department for ten years. Since then, for more than twenty years, he has been engaged professionally as consultant in his chosen field.

The introduction to the book was written by the Dean of the Yale School of Forestry, Samuel J. Record. The volume is copiously illustrated with beautiful photographs and a number of drawings. The illustrations add immensely to the printed text and the captions, though brief, indicate clearly the points illustrated.

In his treatment of the subject, the author reveals himself as one of that rare group which might be called landscape naturalists, rather than landscape architects. And he has given us a book that is a thing of beauty, as well as a practical guide to the layman in the care and development of the home grounds.

CLYDE FISHER.

THE BIRD BOOK. Bird Neighbors and Birds That Hunt And Are Hunted

- - - - - - - by Neltje Blanchan

Illustrated by Nellie M. Pairpoint

Garden City Publishing Co., Inc.
New York $1.98

THE art of bird painting has never been more highly developed in this country than it is at present. With the great increase in the number of bird students there has been a corresponding growth in the number of men qualified to paint birds, for be it understood that no one can paint a bird properly unless he knows the bird itself in nature.

Among the first books published by the newly organized firm of Doubleday, Page and Company was Mrs. Frank N. Doubleday's (Neltje Blanchan) *Bird Neighbors.* Mrs. Doubleday knew her birds and she was skillful in the use of words. Her book, therefore, achieved wide popularity and there is every reason for republishing it in the present form in connection with a second volume of hers entitled, *Birds that Hunt and are Hunted,* but there certainly is no reason for illustrating this volume with the type of pictures which it contains. I can recall no current bird book with such poor representations of the birds figured. Commercialism and low standards rather than sentiment have evidently governed the publishers in the illustrations of this volume. One would imagine that out of respect to Mrs. Doubleday's memory and her standing as an ornithologist they would wish to illustrate it with drawings worthy of the text, but apparently they have not been animated by any such desire. Certainly, the reception of the first issue of this reprint in 1932 cannot have left the publishers in ignorance of reviewers' estimate of the character of its illustrations. One opinion reads:

"But the blame for the publication of these plates should not fall on the artist. She doubtless has done the best she can and is probably unaware how bad that is. It is the publishers who should be censured. There are at least a score of artists in this country qualified to produce acceptable pictures of birds. Given the important commission of illustrating this work any one of them would have made a notable contribution to art in ornithology, to science, and to education in a manner which would worthily have honored the memory of Neltje Blanchan."

F. M. C.

BURMA ROAD

- - - - - - - - - - by Nicol Smith

Bobbs-Merrill, $3.50

MANY people will no doubt buy *Burma Road* in the hope of learning more about China's third lifeline, which has been featured so often in news dispatches. Though the building of the New Burma Road from Lashio in Upper Burma to Kunming in Yünnan, is one of the great epics of modern Asia, readers of this book will find little about it in spite of the title.

The first chapters consist of a series of secondhand travelers' tales about adventure on the South China Sea and in nearby Indo-China. It is only fair to say that in retelling them the author has managed to re-create some of the atmosphere of Tonkin, though he errs on the romantic side.

When Mr. Smith begins to speak of Yünnan, the book sinks to a new low even for a travel yarn. Unconsciously continuing in his story-book vein, he makes up an entirely original translation for the name of Tang Che Lake and concocts a fanciful tale to fit it. That is only the opening for a poor and often inaccurate interpretation of the province and its chief city.

His penchant for horror tales leads him

to dwell too long on the inhuman conditions he inferred but did not actually see at the mines of Kochiu, and the pathetic biographies of the girls in the Kunming blind school. He is better at this semi-fiction than he is at reporting, and the meager account of his trip over the Burma Road which follows is something of an anti-climax.

Although his publishers state that the author's hobby is photography, the illustrations leave a great deal to be desired and give scarcely any impression of the varied landscape of Southwest China along the New Burma Road.

S. V. R. CAMMANN.

TWO MEN IN THE ANTARCTIC

- - - - by Thomas W. Bagshawe

Macmillan, $3.75

THE author has accomplished something that is seldom done these days, by publishing an absorbing record of a remarkable experience, which at the same time includes useful data. He has avoided a deplorable tendency of modern writers of expedition narratives to produce works of no lasting merit in attempting to secure a maximum of financial reward at the moment their work is being publicized.

In the fall of 1920 the author, with three companions, left for the Antarctic aboard various Norwegian whaling factories. They expected to be put ashore in Hope Bay at the northeastern tip of Graham Land. From there they planned to make their way farther south to Snow Hill Island, winter in a hut used by the Swedish Antarctic Expedition and with that as a base continue the mapping of the western coastline of the Weddell Sea. Instead, they were landed near the southern end of De Gerlache Strait, on the northwest side of Graham Land. It was then proposed to carry out the survey work by sledging across the peninsula. When this proved impractical, two of the party returned with the Norwegians. Bagshawe, then aged nineteen, and Lieut. M. C. Lester, a few years his senior, volunteered to remain. Both were without experience in the polar regions and for some unexplained reason were apparently very poorly equipped. The record of their year alone on the Antarctic continent, spent in a makeshift shelter, living on seals and penguins, is an enthralling and amusingly told story. It was far more than an exciting and uncomfortable adventure, for they succeeded in keeping detailed meteorological and tidal records and in adding to our knowledge of the geology and natural history of that region. A report on the penguins has already appeared. An appendix to the present volume includes observations on meteorology, ice conditions, tides, and zoological notes.

JUNIUS BIRD.

Continued on page 68

OUTFITS FOR EXPEDITIONS
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SEA SHELL SHOTS

By CHARLES H. COLES
Chief Photographer, American Museum of Natural History

THE endless variety of fascinating sea shells that are cast upon the beaches of the world have enticed many lovers of beauty to make a collection of these exquisite bits of ocean fantasy. The smooth contours, the vivid coloring, the exotic shapes, and the variety of size make a collection of sea shells an intensely interesting study. Taking pictures of these shells affords an excellent opportunity not only to try out your technical skill in photography but also your artistic ability in arranging a background that will match the shell in beauty.

On location

If you are fortunate enough this summer to be near the seashore, try making a series of shell pictures, using the sand of the beach as the background. The later in the day you work, the more effective will the shadows cast by the shell become. Of course sunshine on the shell is required to bring out the delicate details of the surface and show the texture of the sand.

Inasmuch as most shells are relatively small objects, close-up technique will be used almost entirely. There are two ways to tackle nearby objects: either with the camera held in the hand or placed on a tripod. With the fast films available today, it is quite feasible to work "freehand" and still be able to stop down the lens enough to secure adequate depth of field. In order to work without a tripod it is necessary to be able to focus, center, and compose the picture simultaneously. A single lens reflex camera will do this without any auxiliary equipment. A twin lens camera of the reflex type requires a pair of parallax correcting lenses built expressly for close-up work. The Zeiss Contax and the Super Ikonta B, also by Zeiss, will take extreme close-ups freehand when fitted with the Contameter attachment. All other cameras require a tripod and a reasonable amount of patience to make interesting close views of shells on the beach.

Homework

If you care only to pick up the shells at the beach or purchase them to fill out your collection, you will find further pleasure in the endless hours of fascinating work in photographing them under carefully controlled conditions at home. Here you will be able to set up interesting arrangements of several shells, or make the most out of one shell by careful illumination.

First make up the background. When you are returning from the beach sometime, bring home a small box of sand. Spread this in a shallow box to form the "beach" upon which you will place the shell. Have a few pebbles, bits of seaweed, and tiny shells to help make an interesting background, and then add the principal shell. A backlight shining on the shell from the side opposite the camera will produce rich shadows and enhance the texture of the sand.

Although highlights will glare from the smooth surface of some shells, this reflec-

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tion will indicate the texture of the material to the person who views the picture. When, as sometimes happens, this glare hides important surface markings, polarizing screens must be used to overcome the reflection. By adjusting the source of the most objectionable illumination it is possible to have the reflection leave the shell at the proper angle so that a Pola Screen over the lens will absorb the glare.

With tiny shells almost too small to be seen, the real advantages of photography become evident. When the whole length of the shell is only ⅛ inch, it is difficult to see with the unaided eye the wealth of intricate detail and exquisite surface markings, but a picture of the shell showing it enlarged ten or 20 times reveals these details in amazing clarity.

In order to make these highly-enlarged pictures it is necessary to have a camera with a fairly long bellows, at least twelve inches in length. A cardboard tube of this length attached to a camera that has a ground-glass focusing back works well. In the end of the tube fasten a short focal length lens from a movie camera or miniature camera and your "macrographic" apparatus is ready.

Push a pin into one end of a cork to make a stand upon which to fix the tiny shell. A small gob of modeling clay on the end of the pin will hold the shell up before the camera lens. Throw some strong light upon the shell from two sides, slide the camera slowly up to the shell while watching the ground glass, and soon you will see the greatly enlarged image of the shell appear. When it is sharply focused, stop the lens down and allow an exposure of several seconds.

Until you try this type of picture you won't realize how easy it is and how satisfying the results can be. Then, if you are still looking for other worlds to conquer, try these pictures in color.

So if you haven't a collection of shells already, start one now. By the end of the summer you'll have plenty of new material at which to point your camera lens during the long months when it is not so easy to be outdoors. And don't forget the tiny ones. They'll test your technique and may produce some of your most beautiful pictures.

Recent Museum Publications

NOVITATES

No. 1052. A New Subspecies of *Erora laeta* Edwards from Arizona and New Mexico (Rhopalocera: Lycaenidae). By Cyril F. dos Passos.

1053. A New Subspecies of *Erebia discoidalis* Kirby (Rhopalocera: Satyridae). By Cyril F. dos Passos.

1054. New Butterfly Subspecies from Wyoming (Nymphalidae, Pieridae). By Alexander B. Klots.

1055. A Revision of the North American Variants of the Ant *Formica rufa*. By Wm. S. Creighton.

1056. Birds Collected During the Whitney South Sea Expedition. XLI. Notes on New Guinea Birds. VI. by Ernst Mayr.

1057. Birds Collected During the Whitney South Sea Expedition. XLII. On the Birds of the Loyalty Islands. By Ernst Mayr.

1058. A Key to the Known Anthidiine Bees of Oregon, with Descriptions of Some New Forms. By Herbert F. Schwarz.

1059. Report on a Collection of Spiders from Mexico. II. By W. J. Gertsch and L. Irby Davis.

1060. New and Little Known Tropical *Helina* Desvoidy, Allied to *Ariciella* Malloch (Diptera: Muscidae). By Fred M. Snyder.

1061. Notes on the Types of Certain Early Described Species of Monotremes, Marsupials, Muridae and Bats from the Indo-Australian Region. By G. H. H. Tate.

1062. Some Cervid Teeth from the Tung Gur Formation of Mongolia, and Additional Notes on the Genera *Stephanocemas* and *Lagomeryx*. By Edwin H. Colbert.

1063. New Species of Phorocera (Tachinidae) from Africa (Diptera). By C. H. Curran.

1064. A New Genus and Some New Species of Neotropical Hesperiidae (Lepidoptera: Rhopalocera). By E. L. Bell.

1065. The Origin of Ceratopsian Horn-Cores. By Barnum Brown and Erich M. Schlaikjer.

1066. Studies of Peruvian Birds. No. XXXIV. The Genera *Todirostrum*, *Euscarthmornis*, *Snethlagea*, *Poecilotriccus*, *Lophotriccus*, *Myiornis*, *Pseudotriccus* and *Hemitriccus*. By John T. Zimmer.

1067. Notes on Carangin Fishes. V. Young *Trachurus* in the Gulf of Mexico. By J. T. Nichols.

1068. Descriptions of New Gnaphosidae from the United States. By R. V. Chamberlin and W. J. Gertsch.

1069. Report on a Collection of Spiders from Mexico. III. By W. J. Gertsch and L. Irby Davis.

BULLETIN

Volume LXXVI Article VIII. Body Forms of the Black Marlin (Makaira nigricans marlina) and Striped Marlin (Makaira mitsukurii) of New Zealand and Australia. By William K. Gregory and Miles Conrad.

JUNE MUSEUM BROADCASTS

"This Wonderful World" (informational quiz on Natural History subjects), Mutual Network on Saturdays at 11:45 a. m., D. S. T., with Robert Emory and Robert Coles.

YOUR NEW BOOKS

—*Continued from page 67*

LURE OF THE NORTH

- - - - - - - - by Richard Finnie

David McKay Company, $3.50

RICHARD FINNIE, who happens also to have an article in this issue of NATURAL HISTORY Magazine, was born in the Klondike town of Dawson. At the age of seventeen, he began a series of widely ranging journeys, largely under governmental cooperation, which have taken him over about as much of the Canadian Arctic as any living man has seen.

His absorbing book is a personal story of life beyond the Arctic Circle. All that it contains is real, true, and highly interesting. As background to the main narrative, the reader is carried through a wealth of anecdote into the lives of both the Eskimos and the whites.

Richard Finnie's story has fundamental historical significance. Just 25 years ago a party of exploring scientists set up an outpost among the Copper Eskimos, whom he describes most intimately. As the celebrated anthropologist Diamond Jenness says in the Introduction, "Sturdy and independent were these Eskimos, confident of their ability to . . . wrest a living from the only world they knew, a snow-bound land and ice-covered sea during nine months of the year, a world of flowers and birds and running water during three." Then came the sudden change. Richard Finnie's book "faithfully photographs the stupendous 10,000 year leap that our civilization has demanded from the Copper Eskimos." It will stand as a fascinating account of life among primitive Eskimos and among the traders, trappers, missionaries, prospectors, and explorers of the Canadian Arctic. It is well-written and well-illustrated, and is a fine example of the bookmaker's art.

EDWARD WEYER.

Answers to Questions on page 62

1. (b) Asiatic. The African elephant is not as tractable. See page 8
2. False. It is true, however, that earthworms do possess a certain regenerative capacity or replacement of parts, such as growing a new tail. See page 32
3. Rubber. In watching the ball game played by the Mayas, civilized man first became acquainted with the properties of rubber. See page 14
4. True. It swallows earth in great quantities. See page 32
5. The Franklinia tree, sometimes called Gordonia. See page 24
6. (c) It might be said that earthworms are "rained out," for the threat of suffocation within the burrow through loss of part or most of their oxygen forces them to ascend to the surface. See page 31
7. The worm holds its ground by numerous small bristles on its body, and by thickening its body when necessary. See page 32
8. Knobbed antennae distinguish butterflies from moths, whose antennae are characteristically feather-shaped. See page 34
9. The Ghost Crab gets its oxygen from water stored in its gill chamber. See page 37
10. (b) Ear. The victim is nearly always a male cicada, and since only this sex can "sing," the wasp is believed to hunt by ear. See page 4

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Color Photograph of Nias Warrior in Armor, by S. Dillon Ripley

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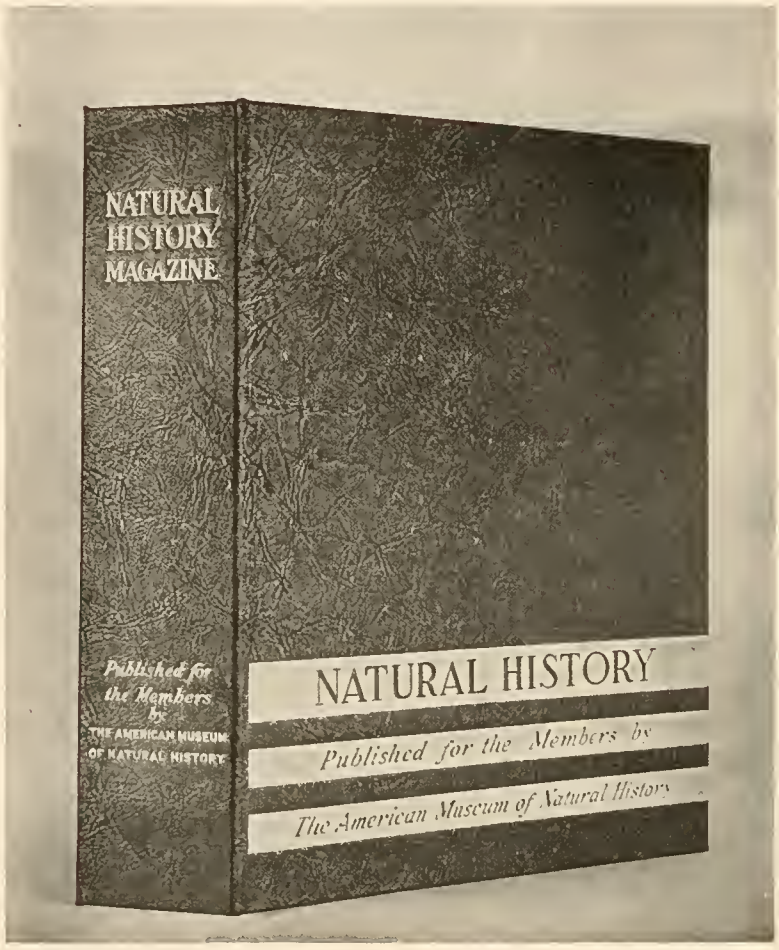

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ILLUSTRATIONS

are printed from photo-engraved plates made by STERLING ENGRAVING COMPANY, 304 E. 45th Street, New York, N. Y.

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Above illustration from Bird Group of Hudson Bay Region in the American Museum of Natural History

LETTERS

SIRS:

. . . May I take this opportunity to congratulate you on the fine articles and pictures found in every issue of your magazine? It is certainly the most enjoyable periodical I have ever seen.

Baltimore, Md. BEVERLY S. RIDGELY.

* * *

SIRS:

Well! You've done it. The two color pages in the June NATURAL HISTORY exceed anything I have ever seen in color photography. The subjects seem to stand out like statues on their pedestals. I want to congratulate you and your printer.

Chestertown, Md. A. C. KENLY.

* * *

SIRS:

Ever since we have been receiving NATURAL HISTORY Magazine, we have felt the urge to tell you how much we enjoy and value it. However, we have hesitated, fearing that our words would not do justice to the superb manner in which the Magazine as a whole is presented.

For a number of years, we have banded birds for the U. S. Bureau of Biological Survey, so naturally every item on ornithology interests us to the fullest. We also study wild flowers, trees and wild life in general, and find your articles on these subjects quite timely and helpful.

Having a camp within a mile of Mammoth Cave National Park, and having enjoyed "crawling through quite a lot of holes" in that rocky, honeycombed region (in addition to studying its birds), we are thrilled by subjects subterranean. We like to dabble in photography, along with our outdoor studies, and each of your splendidly executed pictures is a masterpiece in its particular field. Incidentally we are hoping that you will let us have some color pictures of birds that will be in keeping with that magnificent group of flowers and "Flying Flowers" of the June issue.

Finally, we feel that anyone who is interested in any phase of Nature is missing a truly wonderful and delightfully readable exposition of it, ten times a year, if he misses NATURAL HISTORY Magazine.

Glasgow, Ky. F. E. AND M. L. FREI.

* * *

SIRS:

. . . one of the most interesting and educational publications it has ever been my pleasure to read—and, incidentally, from cover to cover.

Pittsburgh, Pa. THEO. R. FOSTER.

* * *

SIRS:

The last number of the magazine was splendid. I was entranced by the photographs of Chichen Itza, which has always been a fascinating subject. Those great walls all made of stairs! They are the best pictures I have seen. The cover is charming too. The whole magazine was a little respite from the horrors of the newspapers and the radio.

KATHARINE A. LIVERMORE.
Cambridge, Mass.

* * *

SIRS:

I have just gotten around to reading the account of rare trees in the last issue of NATURAL HISTORY. I am also glad to have this number on account of the extremely beautiful colored reproductions in it. Regarding the Redwood, you mention that it may be as much as 28 feet in diameter and 3000 years old. While even larger figures for the age of the Redwood have been published, this tree and the Bigtree have often been confused, and there is possibility of exaggeration. For your information, according to a well-known tree expert of California, old Redwoods are from 1000 to 1500 years old, and he reported one specimen just under 2000. Some of us have felt that 20 feet may be closer to the maximum diameter of the Redwood. Because this is of considerable popular interest, any effort toward exact determination may be worthwhile.

W. M. HARLOW,
Assistant Professor of Wood Technology.
The New York State College of Forestry
Syracuse University
Syracuse, New York.

* * *

GENTLEMEN:

I have just received the June issue of NATURAL HISTORY Magazine containing the article on "Rarest Trees of America."

You have certainly made this an interesting contribution, in text, illustrations, and map. I am sure it will incite many persons to follow your suggestion to go and see these unusual trees. For those who cannot do this your article is an excellent substitute for such a journey. . . .

RALPH S. HOSMER,
Professor of Forestry.
Dept. of Forestry,
New York State College of Agriculture
at Cornell University, Ithaca, N. Y.

* * *

SIRS:

Your exceptionally beautiful and interesting NATURAL HISTORY came to our attention as a gift. . . . May we now make a gift in turn. . . . If possible, please start the subscription with the June number.

PAUL F. CADMAN AND
ETHEL MILLS CADMAN.
New York, N. Y.

* * *

SIRS:

. . . I want to congratulate the Museum Publication Staff on the elegant, first-rate,

Continued on page 132

NOTICE: Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

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The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — ROY CHAPMAN ANDREWS, Sc.D., Director

VOLUME XLVI—No. 2 ★ ★ ★ ★ ★ ★ SEPTEMBER, 1940

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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.

ASSOCIATE: D. R. Barton.

PRODUCTION: 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 DEPARTMENT: Sherman P. Voorhees, Manager.

REPRESENTATIVES:
Frank S. Whitman, Chicago, Ill.
Warwick S. Carpenter, Santa Barbara, Calif.
Howland & Howland, Inc., New York, N. Y.

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The American Museum of Natural History wishes to express gratitude for the assistance in the promotion of the interests of NATURAL HISTORY that has been rendered by the Work Projects Administration.

NATURAL HISTORY is published monthly (except July and August) at New York, N. Y., by The American Museum of Natural History, Seventy-ninth 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.

CLOUDS OVER ATITLAN, *at twilight: a remarkable photograph which captures the strange, unworldly atmosphere of this "lake in the sky," 5000 feet above the steaming jungles of the coast. Two volcanic peaks, Toliman and Atitlan, are seen soaring above the clouds. Small villages, most of them named after Christian saints, cling to the sloping shores and hide in the valleys among the encircling hills*

THE SLEEPING VOLCANO *San Pedro on the shores of Lake Atitlan. The tip of San Maria juts above the skyline at the right. All these volcanoes are heavily wooded to the very summit*

HILL OF GOLD *is the meaning of the native name of this dormant cone, Cerro de Oro, seen here against shafts of the setting sun, across the "molten" waters of Lake Atitlan*

Guatemalan Panorama

By Martin Birnbaum

Photographs by the author

Modern natives develop their colorful culture against a rich background of ancient art, amid scenic splendors unrivaled in Middle America

Even though you do not leave your seat on the platform of the observation car while climbing from the Gulf port of Puerto Barrios to the highlands of Guatemala, you will agree that the little country, which is about the size of the state of Ohio, can be soberly described as a naturalist's paradise.

The humid coast line, known as the *tierra caliente,* or hot land, is a dense forest of graceful palms. Clumps of feathery bamboo struggle for air along the tropical green walls on either side of the railroad tracks, which for a time, follow the valley of the Motagua River. The larger trees are weighted down with lianas, and you long for the opportunity to descend and study the orchids and less beautiful epiphytic or parasitic plants clinging to the branches.

One of my exciting experiences in the virgin growth which encloses the Maya ruins at Quiriguá was the discovery of three species of fantastically brilliant heliconias blooming within a few feet of one another. In similar low regions of the district of Petén, chicle is gathered by the Indians for our chewing gum manufacturers, but at the railway stations along the way, poor natives are content to earn a few *centavos* by selling branches of golden odontoglossum and mauve *candelaria* orchids. Rare cabinet woods, medicinal and industrial plants abound, and the wealth in these forests has only been scratched. Many thousands of acres have been cleared to plant bananas.

Every turn *in the roads which wind along or above the shores of Atitlan offers new and wonderful perspectives. In the morning light the waters seem clear and blue; but almost every afternoon winds whip up whitecaps and clouds gather over the surrounding mountains*

The cultivated patches of coconut palms, papayas, and pineapples around the Indian villages which the train passes, are shaded by beautiful breadfruit, tamarind and mango trees, and are made lovelier by glowing bougainvillea, hibiscus, lantana, lilac jacaranda trees, masses of gaily colored crotons, poinsettias and heavenly blue morning-glories.

Now and then as the panorama unfolds, a gorgeous butterfly lights up a shaded lane, and the temptation is strong to hunt for some of Guatemala's incomparable iridescent morpho butterflies, and its gigantic Thysania moth, which attains the phenomenal wingspread of over twelve inches. Here, bird, insect and animal life is endless, rich and strange. The superb quetzal, pictured on the country's postage stamp, will probably elude you, but there are over 700 species and subspecies of birds to console the ornithologist. Venomous reptiles are also unpleasantly plentiful. Jaguars and pumas, tapirs, peccary and monkeys, deer and rabbits will tempt the hunter. The shy danta, a tapir, whose outline is often mistaken for a donkey or horse when used as a textile design, is found near streams, in which the herbivorous manatee enjoys the protection of the government.

As trestles are crossed and the 200-mile climb continues, the moist, matted jungle gives way to a dusty arid region where the tall candle cactus and the agave are features of the landscape. Then comes the coffee country, and the railroad tracks make abrupt horseshoe curves to reach the cool highlands. The train stops frequently and Indians crowd around, offering tortillas, and poisonous looking delicacies, or they try to sell textiles, baskets and carved gourds. Before night falls, distant volcanoes show their majestic, threatening cones over the noble mountain ranges, and Guatemala City is reached in time to see something of its Indian population. Your attention is arrested by women and children hurrying from the markets back to their distant homes, and color is lent to the clean streets by their embroidered *huipils* or jackets on their shoulders and striking *tzutes* on their heads. I had the additional good fortune to arrive on a feast day, when they carry the image of the Virgin of Guadalupe through the kneeling crowds, and a religious procession in the United States will ever afterwards seem a drab, colorless event by contrast.

Every morning in Guatemala City, the Indians head for the great market place behind the Cathedral, where everything from food and clothing to leather goods and trinkets is sold, but this attractive city is by no means a mere Indian community. It is the sunny, modern capital of a peaceful, orderly country with comfortable hotels and a marvelous climate. Good music is heard in its pretty public parks, and

there are dignified art exhibitions and institutions which are centers of science and culture. The pre-Columbian civilization of the Mayas can be studied in the excellent Archaeological Museum, directed by Señor Carlos Villacorta. It is a pleasant surprise to find that many of the precious fragments exhibited were dug up by scholars who were sent down to our sister republic by the Carnegie Institution, the University of Pennsylvania, Tulane University, the American Museum of Natural History and other American institutions.

Jungle explorers

The patient, quiet students work in the buried cities of Central America often under great physical difficulties in the unhealthful jungle districts, and some of the fruits of their labors are collected in the Archaeological Museum or are reconstructed and preserved in situ in amazing centers like Quiriguá, Uaxactun, Piedras Negras, and at Copan in the neighboring republic of Honduras. The destructive vegetation and accumulated refuse must not only be removed, but the tireless workers must keep incessant watch on this swift, ruthless growth which is forever encroaching on the ruins and threatening the buildings and sculptures already saved from utter oblivion. The contrast between Catherwood's faithful engravings[1] made a century ago for Stephens' immortal works, and the recently restored temples, shows fully the debt we owe to these scholars. Now they are deciphering the strange hieroglyphics, fixing the dates of the imposing temples and palaces, and fitting together the almost hopelessly broken fragments of painted and engraved pottery or jade. The merciless roots of trees which crack the walls of pyramids are cut away, the fallen idols, altars and stelae are carefully raised, and the crumbling frescoes, on which Maya and Toltec priests or warriors are depicted in brilliant colors, are successfully replaced. All the outlines of this mysterious early American civilization, which already ranks with the greatest primitive cultures known, are being re-created for us, and the discoveries of our investigators are as exciting, romantic and valuable as the more celebrated and spectacular achievements of Champollion and Lord Carnarvon in Egypt. The friendly government headed by President Jorge Ubico is not only aware of the importance of such work but is actively helpful in every way. Not long ago, some hitherto neglected mounds on a finca, or estate, at Kaminaljuyú, just outside the capital, yielded marvelous stone altars and treasures in jade, mother-of-pearl and ceramic perhaps fifteen centuries old. No one takes a livelier interest in these than Señor Antonio Villacorta, the Minister of Education, a well-known savant, who, with Don Flavio Rodas, translated into Spanish the sacred book of the Mayas, known as the *Popul Vuh*.

Those travelers who are interested in Spanish Colonial architecture and the history of the Spanish Conquest of Central America will leave Guatemala City and make Antigua, the former capital, their center. In this enchanting, sleepy town of shadows and roofless churches, books were printed before the Puritans ever thought of sailing for Plymouth, and here the celebrated university of San Carlos was established in 1680. Now the wooded slopes of Agua, smoking Fuego and its mate, Acatenango, dominate the city, which has been demolished by repeated earthquakes. Antigua is filled with the magnificent ruins of churches, palaces, convents and monasteries. In its heyday, its wealth was fabulous and its fame world-wide. Now these sacred edifices are often the abode of humble Indian weavers or serve as shops for carpenters and blacksmiths. Markets are held in the great courtyards surrounded by tottering but still impressive walls. The splendid fountains no longer play, but one can spend many pleasant days in dreamy contemplation under the arches of the ruined cloisters they once adorned. What more romantic story can one find than the accounts of the fortunes and astounding conquests of the Conquistadores, led by their proud young leader Alvarado, and the tragic death in 1541 of his widow, the imperious Gobernadora Beatriz, who was the first woman to head a government in the New World. Not all the Spaniards immortalized by the Conquest were soldiers, as the inspiring lives of Pedro de Betancourt, "Servant of God," and Fray Bartolomé de las Casas, unselfish friend of the Indians will serve to show. The adventures of such men and their associates can match in interest similar stories from our own Indian annals. It is surprising to realize how slight has been the attention paid to this period of American history by high schools and colleges in the United States. Merely to touch upon the fragrant romances would require a volume, and one can devote no wiser nor more profitable hour in Antigua than to sit in the quiet patio of the beautiful old house sympathetically restored by the late Dorothy Popenoe and read the poetical tribute and introduction to her beloved adopted city.[2]

Cultural achievements

Such historical and archaeological researches by no means exhaust the cultural and scientific activities of Guatemala. The specialists in the Geophysical Laboratory of the Carnegie Institution, and its Department of Terrestrial Magnetism, may in time announce far-reaching discoveries in the field of volcanic and earthquake studies, attained through delicate instrumentation. In the realm of art, the painters Merida and Guaravito and the sculptor Rafael Gunther are creating original works. Perez de Leon and Hoegg are excellent architects. There are many literary figures whose works await translation. Musicians like Jesus Castillo are making records of old colonial and Indian music. Virtuosos like the pianist Salvador Ley and the soprano Aida Donninelli have already been heard in the States, and the compositions of native composers are becoming known. Recently one of these, José Castañeda, conducted the symphonic works of gifted Latin-American composers and broadcast them through the National Broadcasting Company with marked success. We have reason to hope that we shall become better acquainted with such music during the current year.

However, the topic of outstanding interest to the average traveler in Guatemala is the Indian and his

[1] See "The Strange Story of the Stephens Stones," by Carl C. Dauterman, NATURAL HISTORY, December, 1939, p. 288.

[2] Dorothy H. Popenoe, *Santiago do los Caballeros de Guatemala* (Harvard University Press, 1935).

(Left) THE CHARACTERISTIC white church, dedicated to the patron saint of the hamlet, commands a beautiful view in the Indian village of San Antonia Palopó, clinging to the hillside above one end of Lake Atitlan. Other villages, named after the disciples of Christ, dot the shores of the lake. Each has its distinctive costumes and traditions

(Right) INAUGURATED IN 1680, the University of San Carlos, at Antigua, is said to have been the greatest institution of learning in Central or North America in its day. With its courtyard beautifully restored, it now serves as a Colonial Museum

(Below) BROKEN ARCHES and massive pillars are all that are left of the great monastery of the Recolleccion. They are among the most impressive ruins in Antigua, the former capital of Guatemala, which was frequently destroyed by eruptions of the volcano Agua and earthquakes

(Below right) A RUINED FOUNTAIN and patio which reflect through the centuries the wealth and grandeur that was Antigua's. This courtyard ornamented the Church and Monastery of Merced, built in 1760, just thirteen years before the disastrous earthquake which resulted in the abandonment of the old colonial capital, then called Santiago de los Caballeros

(Right) THE FAMOUS CEIBA, or silk-cotton tree, in the market square of the Indian village of Palin has a spread of 180 feet. The Indians regard this tree as sacred and protect it accordingly. The silk-cotton tree is valuable commercially for its oily seeds and its kapok or tree cotton, frequently used to stuff boat cushions

(Left) WHITE VISITORS are frowned upon in this church in Chichicastenango, which the natives jealously regard as exclusively Indian

FACING the church above across the plaza stands Father Rossbach's celebrated church, on whose steps men are seen praying in clouds of copal incense in the photograph at right

(Below) IMAGES OF THE SAINTS are carried through the streets of Chichicastenango by bareheaded Indians during the great feast of Saint Thomas. The firemakers are marching with hundreds of rockets, the sticks of which are seen bristling above the heads at the left

On the steps of Father Rossbach's active church the bearers return with the gaudy red canopies which serve as backgrounds for the sacred images. The images themselves repose in the *cofradias* or fraternities which guard them

Yet despite all the impact of European civilization through the centuries, the natives have not forgotten the ways of their pagan forefathers. Having prayed at the Christian Church, the family at left makes certain of the efficacy of their prayers by praying at this ancient idol on the hill outside Chichicastenango. The photograph was taken by the author not without personal danger, as the Indians have been known to stone intruders at this shrine. Note the handkerchief containing offerings at the foot of the idol

(Below) Impersonating their conquerors, these Indians, dressed in costumes and masks to represent the Spanish Conquistadores, are preparing for their interminable dance pageant during the feast of Saint Thomas. The dances occur before Christmas, in the plaza of Chichicastenango

contribution to ancient American civilization. Whether you are driving to Chichicastenango in the highlands, and still farther to the lone ruins of Zaculeu, or sailing along the shores of the incredibly beautiful azure Lake Atitlan in its surroundings of awe-inspiring grandeur, the many tribes, each with its own *costumbres,* arts, crafts and languages or dialects, are bound to arouse your liveliest interest. The peaks of San Pedro, Toliman and numerous other menacing volcanoes soar into the clouds above, and on every road grave Indians and their patient wives, guide their tethered, squealing, protesting pigs or carry huge loads of pottery, livestock, textiles or corn from great distances to the trading centers.

You soon learn to recognize the costumes of different towns. The men from Chichicastenango wear black woolen shorts with flaps embroidered in colored designs showing the rank of the wearer; while the men from San Antonio Palopó have white tunics with red sashes. The Indians from Todos Santos, known as "Uncle Sam men," are easy to recognize because of their long, loose trousers of red and white striped material. Those from Sololá have beautifully designed black and white knitted bags hanging from their shoulders. Bright, gay *tzutes,* embroidered by the wearers, adorn the heads of the shrewd fellows from Nahuala, where the sale of liquor is prohibited and white travelers are not allowed to remain overnight. Then there are the women of Coban in their white "shadow work" *huipils,* the attractive girls from Santiago Atitlan with striped double bags on their arms and wearing halos or crownless turbans made of countless yards of colored woven ribands, and the women who sell their wares under the celebrated gigantic ceiba tree of Palin, where white *tzutes* embroidered with red, green and blue patterns are folded on the head Italian fashion. And finally, you will notice the Aguas Calientes natives, whose superlative textiles are among the most colorful and harmonious.

There is no end to this fascinating subject, and soon you will inquire when the market days are held in each district, and buy these textiles, rugs, belts with

(Left) How a modern native *envisages the paleface conqueror who came from over the sea four centuries ago. Note the white moustachios and full-length curls. The gourd he carries is made for a rattle*

(Below) Masked Indians *in the guise of bulls stage mock bull fights with the masked Conquistadores at San Jorge, on the shores of Atitlan. There are Ladinos (persons of mixed blood, not professedly Indian) looking on*

unusual designs, or the charming pottery and excellent leather goods from the Indian vendors, who do not shout the virtues of their wares but sit patiently waiting for their purchasers. I wish someone could persuade President Ubico to emulate the famous Marshall Lyautey, who tried to prohibit the importation of ugly European products into Morocco and urged the Moorish craftsmen to ignore foreign influences and follow their ancient artistic traditions.

Many of the towns are named after Spanish saints, and if the market and feast days coincide, the plaza rings with the music of the marimba, and dancers in grinning masks and pseudo-Spanish costumes go through interminable steps and add to the confusion. At Chichicastenango, a week before Christmas, many thousands of Indians gather from the surrounding country for the feast of Saint Thomas, and the movement and activity are positively overwhelming. The men drink great quantities of *aguardiente* and dance together incessantly. They ignite tubes of gunpowder and send hundreds of exploding rockets vibrating into the air. *Voladores* or flying men, swing in ever widening, descending circles over the market crowds, suspended by ropes from revolving wheels which are attached to 60-foot poles. The huge outdoor kettles are always kept filled with fresh stews to feed the customers. Mock bull fights with masquerading performers are in progress, while the populace parade sacred images from the church to the *cofradias* or clubs, under scarlet cloth canopies, decorated with

WHILE *Indians make merry at the foot of the pole and* aguardiente *is freely imbibed in the spirit of the occasion, daring* voladores *celebrate the important feast of Saint Thomas in a breath-taking aerial act. Suspended by ropes from this dizzy perch, the performers descend in ever-increasing circles, sometimes head downward*

cheap tinsel and mirrors, and built up like alcoves. Although these people do not seem to register violent emotion, the din and excitement of the shuffling, swaying mob gathers force irresistibly, until the sparks from the last rockets melt in the sky, and the dancing light of the torches around the smoking food stands are extinguished. Then the music ends in a dying throb, and only the moon lights up the silvery white walls of the church of Calvary.

Altogether too many tourists are attracted by such festivals, and at one time I feared that these Indians might not be able to withstand the onslaughts of our white civilization; but after all, in their firm quiet way they have lasted since the Spanish Conquest, and when I found that every Indian girl could weave the tribal symbols into her *huipil* and grind maize on a primitive mortar, I felt reassured. The Catholic churches are crowded with devout, barefoot Indians praying earnestly before Christian altars, lighting candles on the stone pavements and sprinkling flower petals before saintly images, but the Sun God and the *duendes* or hobgoblins are still very real to them, and to make doubly sure of the efficacy of their prayers, they leave the church only to climb the neighboring wooded hills where they can be seen offering candles, fruits and flowers to stone idols at the altars of their ancestors. Never have I seen a mass like good and wise Father Rossbach's at Chichicastenango on the feast of Saint Thomas before Christmas. Their faith in some all-powerful divinity is real and visible. Not only is Father Rossbach their beloved, understanding and trusted spiritual guide, but he has collected a great collection of jades, stone amulets, cups and ritual vessels, which deserve a separate permanent museum in that remarkable Indian center.

These people are the direct descendants of the Mayas who were conquered by Cortez' adventurous young Captain Alvarado, and possibly in the lowland jungles of the Petén or in remote mountain fastnesses there may be tribes rarely in touch with outsiders, who still follow the old customs. Such tribes may solve the many riddles presented to us by the ruins at places like Tikal and Piedras Negras, and in the hundreds of still untouched mounds seen in the virgin forests by Colonel Lindbergh in the course of his good-will flight over Central America. There are many places waiting to be explored by coming generations of archaeologists. Only recently I heard of a mountain community where a ball game is being played which may be identical with the one enjoyed by the ancient Mayas in such magnificent ball courts as are to be seen at Copan and Chichen Itza. Indian

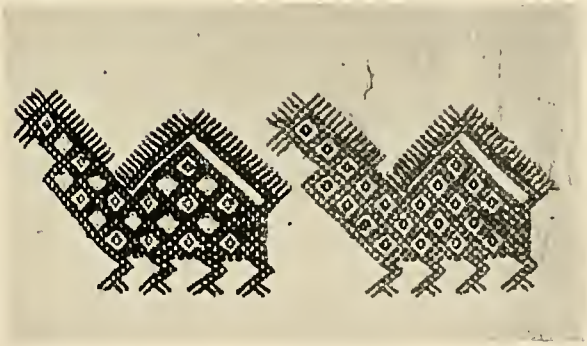
EVEN THE QUIETEST *corner of the market is a lively medley of native types in their distinctive local costumes, which the visitor learns to identify. The man in the foreground is easily spotted for a Sololá merchant. His embroidered woolen coat, checked apron or* rodillero *and loose, striped pants are often seen around Lake Atitlan*

(Left) INDIAN MERCHANTS, male and female, resting after arriving at the steps of Father Rossbach's church on the edge of the market place at Chichicastenango. Note the beautiful *huipil* on the shoulders of the woman in the center, and the strings of mirror Christmas tree heads on the woman to the left. A sleeping baby is concealed within the bundle on the back of the woman on the steps at the extreme right

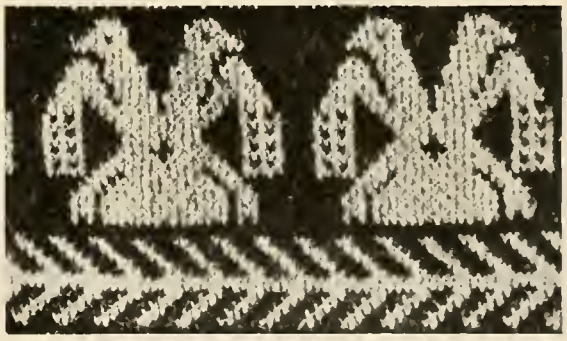
(Right) BENEATH the farther arch, an outdoor barbershop operates at the entrance to the padre's patio

(Left) A BELT woven at Chichicastenango

(Below) HAND WOVEN LINEN from Chichicastenango



Fabric photos: AMNH by Coles



(Above) A WOMAN at her hand loom at Chichicastenango. The little girls learn how to weave from earliest childhood. *(Right)* DESIGNS from bags knitted in black and white by men in Sololá

(Left) Costumed and painted Indian boys, who will join in the parade at Guatemala City on the feast of the Virgin of Guadalupe

(Below) A peaceful-looking but destructive cone: the volcano Agua, which destroyed Antigua, seen through a gate of the church of Nuestra Señora de la Merced

(Left) The author, after having lifted a sadly damaged altar stone out of the mud at Quiriguá, with the aid of Mr. Clark of the United Fruit Company

(Right) One of the great zoomorphs at Quiriguá. These stones are engraved on all sides, and the animals represented cannot always be identified. Professor Hewett is probably right when he says this type of stone is "a conception of a mighty power embodied in an animal form of totemic significance, purely mythical in character." Human heads decorate it

(Above) Once a scene of human sacrifice: the restored "Mam" pyramid at Zaculeu. The platform at the head of the inclined surface between the steps was used as a place to sacrifice human victims; and at its base is a large bowl said to have been used to collect the blood. This pyramid is in the highlands beyond Huehuetenango. Many mounds around it are covered with grass, and cattle wander over them

Two magnificent stelae, or inscribed tablets of stone, at the celebrated archaeological site of Copan, in Honduras, a spot easily reached by plane from Guatemala City

(Above and below) SCULPTURED fragments at Copan

(Above) AN ALTAR niche at Copan

(Right) ATOP A PYRAMID at Copan: the sculptured doorway (restored) of a sanctuary reached by a great flight of stone steps. Central American pyramids served primarily as foundations for temples or shrines on top, whereas Egyptian pyramids were chiefly monuments to the celebrated dead

children are today blowing on whistles and flageolets similar to those which are found buried in the old ruins. J. Steward Lincoln, a young American ethnologist working independently, has been living in the distant towns of Nebaj, Chajul and Cotzal, where about 30,000 tribesmen still calculate time by the old Maya calendar of eighteen months of 20 days each. They add five corrective or supernumerary days known as *Oki*, just as we add a day to February during our leap year. Every day has its special god, worshipped at stone mountain crosses, sometimes covered with banana leaves; and woe to the unfortunate child who happens to be born on one of those five unlucky *Oki* days! Mr. Lincoln knows of at least twelve sites still untouched by scientists. Such discoveries persuade us that the old Maya race lingers on in present generations, and we must study the living people if we may hope to solve the mysteries of the past.

Are we too sanguine to hope that Maya manu-

scripts which escaped the destructive bonfires of the overzealous Bishop Diego de Landa in the sixteenth century may still exist, jealously guarded in remote communities, and that the Morleys of the future may be able to read them? For the time being, when the skull of a great personage is found in a tomb, deeply engraved with strange designs and the teeth inlaid with obsidian, we can offer no explanation. We unearth goblets painted in brilliant colors, showing scenes which mean little or nothing to us. We are carefully preserving amulets buried in sarcophagi, molded in the shape of fearsome mythological animals. Carved jades remind us of the precious fragments found in Chinese tombs. A stone bas-relief shows a miserable, helpless prisoner tied with cords, groveling at the feet of a mighty priest or potentate. Is he about to be sacrificed to a bloodthirsty Maya deity? Were the strange stone axes, shaped like eagles, armadillos and human skulls, used in such dread rituals? There are carved stelae, huge cylindrical calendars and imposing stairways, each step of which is covered with still unread hieroglyphics. The heads sculptured on the stelae at Quiriguá have false beards like the Egyptian Pharoahs. Long balusters are decorated with plumed serpents recalling the Khmer *nagas* in far-off Cambodia. Finely carved stones are exhibited with reliefs of curiously garbed warriors wearing fantastic headdresses and apparently ready to start a ball game.

When shall we know the exact meaning of such evidences of a unique American civilization? The soaring imagination of some future investigator may follow the flight of Guatemala's quetzal, the gorgeous symbolic bird of freedom, and it may lead to a jungle mound or distant tribe which will furnish keys to the intriguing problems puzzling us today in this still unspoilt country. In the meanwhile, the citizen of the United States, be he student or tourist, is warmly welcomed in Guatemala, and our friendly ties are bound more closely than ever at a time when seeds of bitter discord are being sown in Europe.

DECORATIVE SCULPTURE and hieroglyphs on the side of one of the temples at Copan

(Below, left) A RITUAL STONE AXE or *hacha* depicting a skull and an eagle, in the Archaeological Museum at Guatemala City

(Below) A PRISONER bound with cords is shown being brought by his captors before a priest or potentate in this great bas-relief from Piedras Negras, in the Petén district. It is now preserved in the Archaeological Museum of Guatemala City

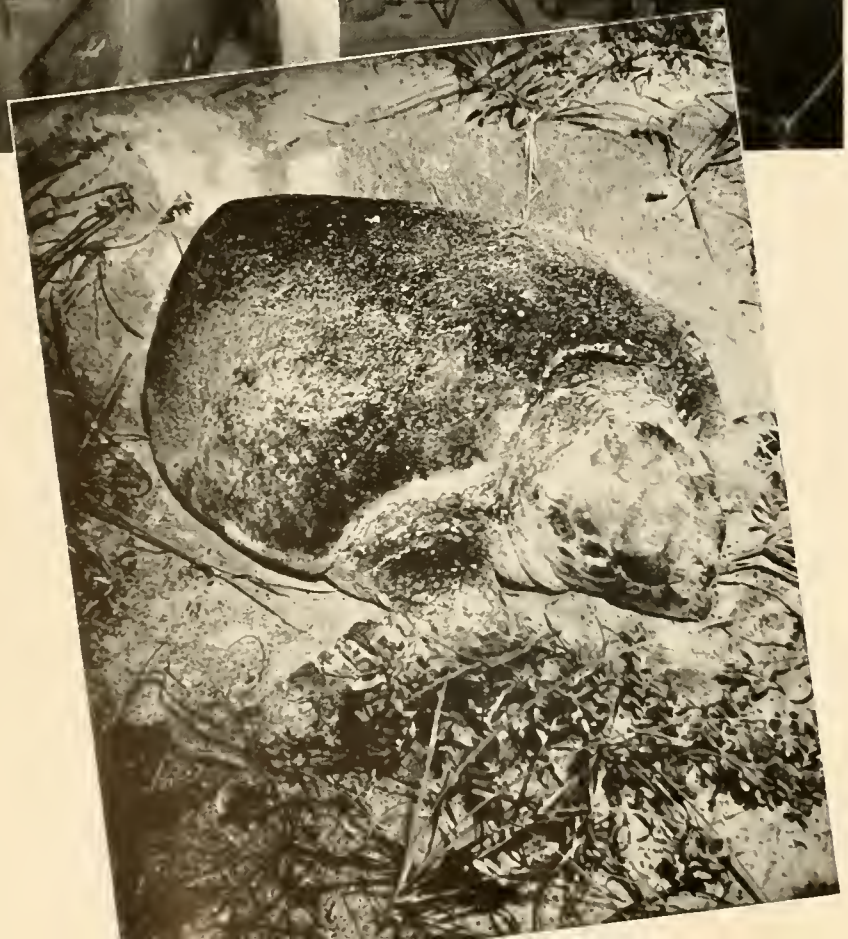
MRS. TURTLE COMES ASHORE

Trailing a turtle "crawl," scientists at Marine Studios discover Mrs. Turtle "at home" and make the most of a rare opportunity to record some interesting observations on how she lays her eggs

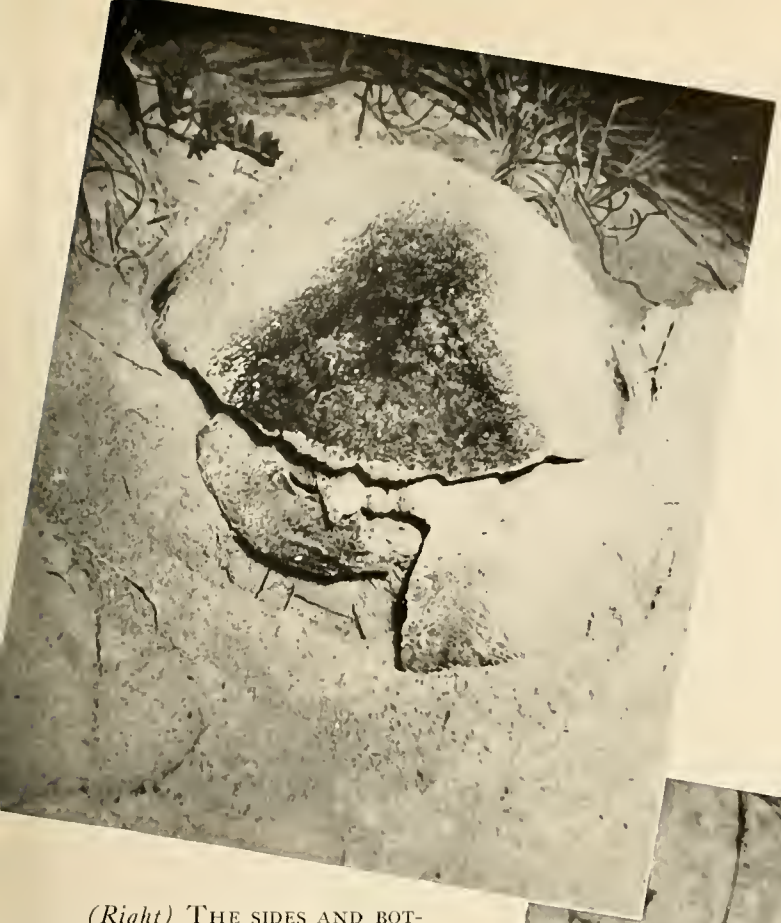
All photographs by
J. Carver Harris

During the early part of May and continuously until August, giant loggerhead turtles move in by the hundreds to deposit thousands of eggs in the warm sands along the Florida coast. The nests are made at night; the eggs are roughly spherical, the shells calcareous, but soft. It is thought that this species of turtle lays three times during each summer: approximately 150 eggs the first time, fewer the second time, and about 80 the third. The incubation period is about two months, but if the eggs are transferred it may be somewhat longer. Recently, the Science Department of Marine Studios, near St. Augustine, Florida, sent out word that they were in need of several dozen turtle eggs for experimental purposes. The result is shown in the following photographs, of which the scene below shows the laboratory at Marine Studios

(Below) In a special truck the turtle hunters drove slowly along the beach between the hours of 9:00 p.m. and 3:00 a.m. and it was not long before the headlights of the car picked up a turtle "crawl." The trail of the sea reptile is clearly discernible in the white sand, but the actual spot where the eggs are buried is sometimes very difficult to locate

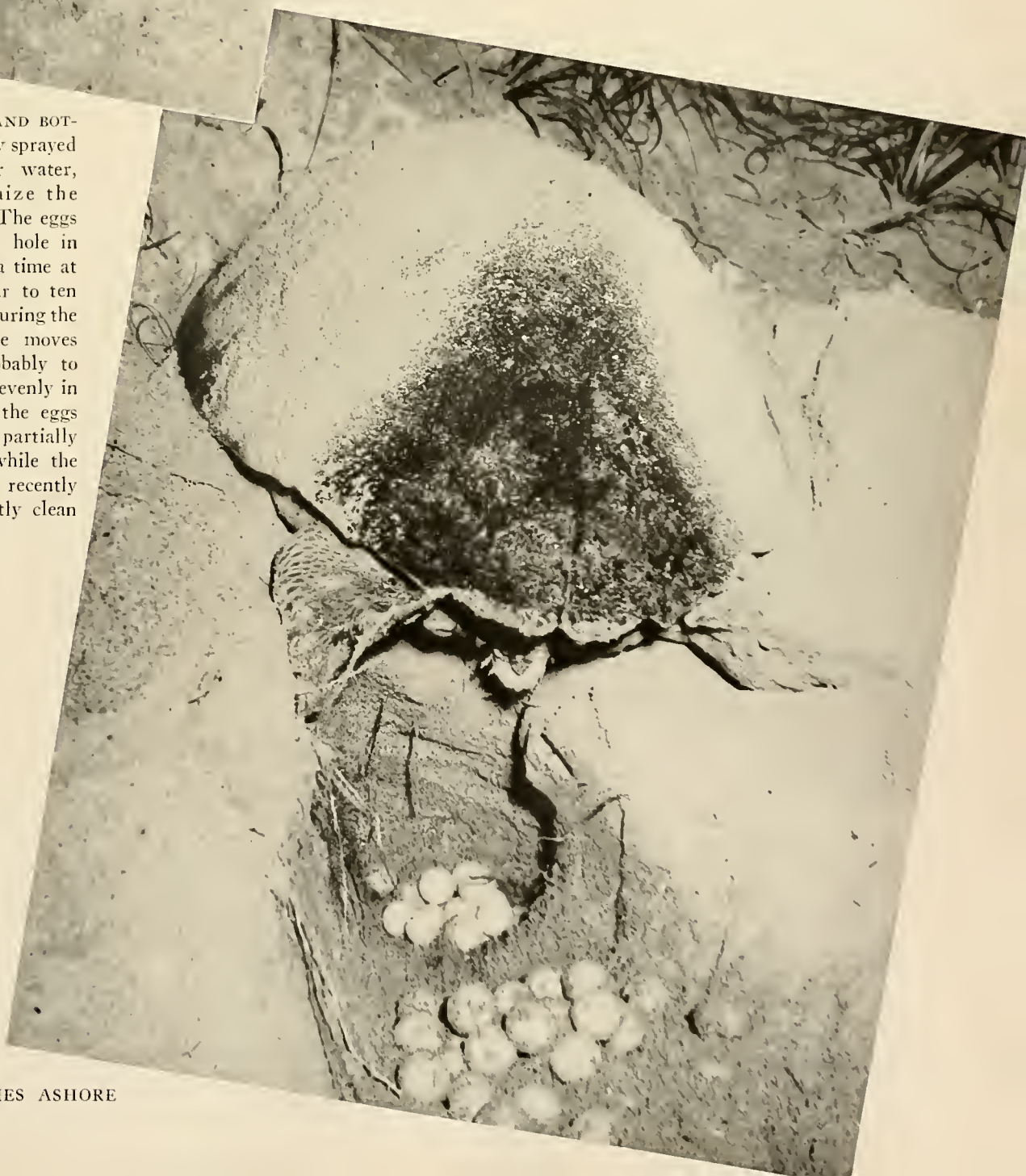


(Left) On this particular occasion, J. Carver Harris, Marine Studios photographer, was extremely fortunate, for at the end of the trail he was rewarded in finding Mrs. Turtle in person. She had just settled down and started the actual digging of her nest



HAVING CHOSEN THE SITE, she proceeds to hollow out a large shallow cavity. The sand is removed from the hole by powerful, alternate strokes of the hind flippers, the foreflippers serving as an anchor to hold her body rigidly in position. By slightly shifting her position, she works her body into the resulting bowl-shaped excavation. Next, she digs the egg pit. This secondary excavation is a cylindrical hole some eighteen inches deep and a foot or more across, the exact dimension depending on the size of the turtle

(Right) THE SIDES AND BOTTOM of the pit are now sprayed with cloacal bladder water, probably to minimize the chances of a cave-in. The eggs are dropped into the hole in series, one or two at a time at intervals of from four to ten seconds. Periodically during the egg-laying, the turtle moves slightly forward, probably to distribute them more evenly in the nest. Therefore, the eggs in the foreground are partially covered with sand, while the others, having only recently been laid, are perfectly clean



FISHERMEN OFTEN SAY that if the turtle begins to lay, it will continue to do so even if roughly handled. This statement is practically proved in this photograph which shows the egg hunter removing some of the eggs from the nest during the actual laying process

(Right) AS SOON AS the laying is completed, the nest is filled in, the hind flippers padding and kneading the sand into the nest. The partially covered eggs can be seen in the rear

THEN FOLLOWS the flinging of sand over the body by the foreflippers, the hind ones piling it evenly as it falls. The animal, still throwing sand, moves forward and soon the original spot is obliterated

AFTER HER NEST has been completely covered, she returns to the water. Here are shown the turtle egg hunters removing the eggs from the nest, while in the background Mrs. Turtle can be seen lumbering her way back to the open sea

THE WHOLE PROCEEDING from the time when she emerges from the sea to the time when she returns to it may take two hours or more

(Right) MRS. TURTLE reaches the surf, her job well done

(Below) THE EGGS are brought to the Marine Studios laboratory

(Below) A. F. MCBRIDE, Marine Studios Curator, replants the turtle eggs in the warm sands near the Marine Studios laboratory for observation

THE MYSTERIOUS

ON NIAS, *bridges are covered to save the wood from the constant rain. This bridge, in course of construction, will look much like an old-fashioned New England covered bridge when it is finished. The open hood of the automobile and the towrope on the bumper suggest that travel in Nias has its difficulties*

(Below) THE AUTHOR, *S. Dillon Ripley, takes his ease while on his way to Orahili with the Magistrate, the car having had one of its frequent fits of temperament*

NEATLY-PAVED STREETS *are a first sign to the visitor that Nias is unique among the East Indian islands. In these villages the houses are built in rows along the main street, raised on piles rather like fishing boats pulled up above the tide*

ISLAND OF NIAS

By S. Dillon Ripley

Far off the beaten path in the Netherlands East Indies, the Nias islanders are perhaps the only people in the world who wear wrought-iron armor. An official visit to Lafau, "Killer of Dutchmen," one of their great chiefs, gives a picture of this island, so puzzling in its unique customs to students of the romantic East

The long street was empty. Down each side stretched the boat-shaped wooden houses with their high-peaked thatched roofs. Under the eaves, the open gallery windows were full of faces, silent, watching. It was a scene familiar enough to those who have traveled in the Dutch East Indies, but with one startling difference, the street was neatly paved—a mark of civilization unique among the islands. The Dutch Colonial Magistrate and I waited, half wondering whether to walk out into the glare of the open street from the sheltering wall of the jungle.

Then the sun glinted for a moment on something bright, and we saw a figure dash out from the Chief's house and come pounding down the street toward us, yelling as he came. It was a warrior in the full war regalia of the island of Nias—short, iron coat, pot helmet, shield and spear. Below the shield his brown legs glistened with sweat. Now he was almost on us, the glittering, wicked point of the spear darting back and forth like a snake's head about to strike. My legs felt stiff and queer. I wanted to dodge behind a tree. Twenty feet, ten feet, too late to move, and then with a final shout, he came to a slithering stop. Panting a little, he grounded shield and spear and began to speak.

Gold Moustachios, *gold antlers, gold neck ornament, and gold trim adorn the great chieftain. No one knows whence this gold came, for the island produces none and none is mined within range of common trade. The "Killer of Dutchmen" is here shown in Orahili, a village in south Nias and one of the last strongholds of an archaic feudal culture. The blunderbuss carried by his guard is of early Portuguese origin*

BACK *from the village palm grove, this man pauses for a moment with his load of coconuts. Next to sago, this is the staple food on Nias*

TEMPTING TO MARAUDERS *are the raised floors of Nias houses. Unless the boards are thick, a careless sleeper may be impaled from below by an enemy's spear*

ONCE SEAFARERS, *the Nias people gradually have become confirmed landsmen, neglecting even to fish offshore. Sago consequently has become their principal food. Here two men* (top, opposite page), *having peeled off the bark, strip a sago palm of its pithy contents*

My companion turned to me smiling. "He is welcoming us to Orahili in the name of Lafau, the great chief, 'Killer of Dutchmen.' "

Of all the chiefs on the island of Nias, Lafau is the greatest; his village, Orahili, the last stronghold of an archaic feudal culture. This morning the Magistrate, having politely offered to show me about the island, had invited me to accompany him to see Lafau —on a matter of business. On the way he had explained how a young subchief had recently been accused of adultery with another man's wife; and for this, the gravest of crimes on the island, he was in danger of his life. In the old days, a pair guilty of this offense was tied together in the middle of the village street. Then the injured husband and his friends stood around and indulged in a little spear practice, the husband having the privilege of the first throw.

"I am glad," the Magistrate continued, "that you will have this opportunity of meeting old Lafau. For years he has been the most powerful and the most feared man in south Nias, where his word is law. No one knows how many people he has ambushed in his time—but many were Hollanders. And now we try to cultivate him and use his power. We are going to pay him a diplomatic visit this morning." The Magistrate smiled. "I want to see him before anything unfortunate happens to Nifoo, the young chief, for it might just occur to the old fellow to resurrect this charming old punishment."

Having heard so much about Nias customs, I had been somewhat taken aback by our first reception at Lafau's village. But now, as we strolled along the elaborately paved street, I began to notice how strange and different the scene about us was compared to other East Indian islands. In design, the village was quite simple. Two rows of houses extended for a quarter of a mile on each side of the cobble paved street. The dwellings were shaped rather like enlarged Malay boats, all packed closely together and raised off the ground on piles as if in dry dock. A certain Dutch scholar has explained this form of architecture as a direct adaptation from the big sea-going canoes which the original settlers hauled up on the shore for shelter. One wonders what we might be living in today if the Pilgrims had chanced to drag the *Mayflower* up on to our "stern and rock-bound coast." At any rate, if this is the true inspiration of Nias architectural design, it is particularly ironic since the present-day inhabitants

ANCESTOR WORSHIP *is a dominating force in Nias life. The natives place elaborate, skillfully carved seats* (left and right) *near their houses, that the pervasive spirits of their forebears may rest in comfort*

Photo by R. H. Volbeda

are among the most confirmed landlubbers in the islands.

Royal welcome

As we approached the great Chief's house, towering high above the others, there was a stir among the crowd. Suddenly there was a flash of bright color among the huge pillars that reared up to support the house 20 feet overhead. Voices were heard, apparently ordering the people to make way. They fell back on either side. Then the amazing figure of the great Chief Lafau, Killer of Dutchmen, stepped forth to greet us.

Even in his old age he was tall, far taller than the average Nias man. And, adding still further to his stature, were great golden antlers rising above his helmet with a palm frond of beaten gold shimmering between them. His face, except for the sparkling eyes, was almost obscured by the huge moustachios, also of gold, which were tied on by a band behind the ears. A bright ring of gold hung around his neck, and a carved gold armor plate was stuck into his voluminous loincloth. He wore a short sword, the hilt wrought in silver and the scabbard ornamented with a great cluster of crocodile and tiger teeth. The upper part of his body was clad in a short jacket of the kind worn by all Nias men, except that Lafau's was edged with gold leaf. Behind him walked two subchiefs carrying seventeenth century Portuguese blunderbusses. No more impressive figure could be imagined than the stately old Killer of Dutchmen standing there in his magnificent costume.

Lafau shook hands with us shyly, it seemed, for a man who all his life had been accustomed to battles and the intricate arts of ambush and the taking of heads. Then, without a word, he turned and led us out of the sun among the dark beams below the house until we reached a point about under the middle of the floor. Here there was a shallow flight of stairs, so designed as to discourage midnight raiding parties. We noticed that the floor boards were very thick. This was a safeguard against a favorite trick of night callers, which was to jab a spear up through the cracks between the boards in the hope of spitting anyone asleep on the floor.

(Left) An Ancestor God, *carved in wood, waits in characteristic pose for homage*

Another family ancestor spirit *inhabits this stone image, or* adu

Photo by R. H. Volbeda

A Crocodile Totem (middle foreground) *guards the seats of spirits in council*

Photo by R. H. Volbeda

In design, Lafau's house was the usual Nias type, only bigger. In the front room the fireplace could easily have taken half a roasting ox. The walls as well as the floor were made of solid hand-hewn boards three and four feet wide over which slaves had toiled for years, endlessly polishing them with flat stones. From the rafters hung many rows of pig jaws, and glass and china plates dating from the early days of the Chinese traders, each one carefully protected by a woven wicker bag.

We sat down on the window seat, which with stools are found in every Nias house, although these simple inventions do not exist on the surrounding islands. The Magistrate began to talk in the strange liquid Nias language, and once or twice I heard the name of Nifoo, the young subchief in whose behalf the Magistrate had come to intercede. But my thoughts wandered from the conversation. Through the window, I could see what appeared to be a little knot of warriors gathering on the stone pavement outside. Perhaps they would dance for us. Contemplating their armor, I fell to musing on the life of this strange possession of the Netherlands Government, which is surely, if ever there was one, a mysterious island.

Probably nowhere else in the world, and certainly nowhere for thousands of miles around, is armor still used in warfare. Next to the chief, the blacksmith is the biggest man in the village. It was he who forged the iron for this armor and wrought it into its astonishing design. Yet no one knows where this art originated. There is no evidence of armor craft elsewhere in the Dutch East Indies, and the only theory as yet seriously entertained claims that this skill was learned from Portuguese explorers of the seventeenth century. Certainly the Portuguese came here, for they have left many relics behind, among them the blunderbusses mentioned above.

I turned from the window to glance again at the chief's golden ornaments. Here was mute testimony of another Nias mystery. For gold is not mined anywhere on the island, nor, until recently, in any of the other islands within navigable range. The source of the metal, as well as the Nias manner of working it, remains an unsolved riddle. Perhaps, at some early time, Chinese traders introduced gold among the islands. No other explanation seems to answer this question.

And so it goes. Almost every phase of life on Nias harbors a riddle or a paradox. Once seafarers, the Nias people live ashore and raise pigs and farm, not even venturing offshore to catch fish, a staple in the diet of every other East Indian tribe. Lovers of war and head-hunting, they nevertheless have developed to a high degree many of the peaceful arts requiring skill and industry.

Ancestor worship

Listening to the Magistrate who was still talking long and earnestly, I glanced at the carvings raised in relief from the polished walls. One of them caught my attention, pointing as it did with silent eloquence at the whole problem of Nifoo, the young chief whose case we had come to discuss.

In the middle of one wall, on a little shelf, rested a strange, carved figure of a man about two feet high. It was a grotesque, stylized little man wearing a tall, carved hat. This was the figure of the supposed founder of Lafau's family, for ancestor worship is the main principle of the religion of Nias. There is a mythical founder of the race, a sort of Adam, called "Lowelani," who is worshipped as a god, and from whom all the people trace their descent. The immediate family ancestors serve as intermediaries with the spirits and also as invisible councilors during tribal meetings.

The family group with its ancestors is the most important single unit on the island. Consequently the supreme function of the family is to produce children. If the number of inquisitive little faces peering around the partitions and between chinks in the walls was any indication, old Lafau had done his work well.

In Nias a childless marriage is a great calamity, for then there is no one to honor the husband and wife when they have passed on. Indeed, this attitude is so strong that imaginary progeny are sometimes evoked. For example, in south Nias I saw a plain, square stone, unornamented except for two small footprints raised in relief above the smooth surface. I asked what it meant.

"There is a woman buried here," they said. "She had no children to preserve her memory and comfort her. Therefore we have placed here the footmarks of the spirit child she might have had."

Naturally, this cult of family worship imposes on the Nias people a strict taboo against promiscuity, and casual love affairs before marriage, prevalent in the other islands, are unheard of here. It is most important to keep the family line intact, and a girl who is not chaste will have no suitors. Marriage, on the other hand, is difficult to arrange. Caste rules limit matches, and then there is the financial barrier. The money of Nias is not so much the Netherlands *guilder* as it is the pig. Marriages demand huge payments of pigs from the bridegroom's family to the bride's, and this, plus the giving of great wedding feasts, for which many pigs must be slaughtered, means that some marriages have to be arranged in childhood so that the boy's family can start paying ahead of time. With this emphasis on marriage customs, it was small wonder then that the Magistrate took so long in his effort to appease Lafau, the supreme arbiter of native law.

Head-hunters

In the old days and up to perhaps fifteen years ago, the young suitor had to prove his skill and courage to his ladylove by taking at least one enemy head by fair means or foul. Neither the method nor the victim was important. He might even ambush a woman or child of an enemy village on the way to the rice fields. Then, as an emblem of his triumph, he was allowed to wear a ring about his neck—leather for an ordinary warrior, gold in the case of a chief.

Nowadays head-hunting is nearly a lost art, due to the efficiency of the Dutch administrators; but one of the exercises preliminary to the more advanced art of hunting heads has come to have somewhat the same importance. This is stone jumping, another unique aspect of Nias life. The hurdle, a block of stone, is nearly seven feet high, set in the middle of the village street where all can watch. Technique is quite

(Continued on page 106)

(Left) THE NATIVES *of Nias celebrate their own equivalent of the Olympic games, an outgrowth of the gentle art of head-hunting. In early days, young warriors practiced leaping so that on head-hunting raids they were able to make a quick getaway over the stone walls which surround Nias towns. Head-hunting was virtually discontinued some fifteen years ago, but the natives astonish all spectators with their skill in jumping*

(Below) "COMING AT YOU!" *Protected by shield and body armor, and brandishing his lance in typical fighting pose, this old warrior presents an ominous figure and typifies the vigor of his extraordinarily independent tribe. The coat in this case is of crocodile hide instead of iron. The ring around his neck indicates success in getting a head from an enemy in past years*

Photo by Fred Ulmer

THE LITTLE BOY *below feels vastly important in his father's heavy metal coat. Strangely enough, the blacksmith's art as practiced on Nias is more highly developed than anywhere else in the Dutch East Indies*

MAMMOTHS AND MEN

By Edwin H. Colbert
Assistant Curator, Palaeontology
American Museum of Natural History

A glimpse of the animals with which our ancestors of the Ice Age had to contend. Unsurpassed in size by any other land animals of their day, the mammoths challenged the course of evolution at the crucial time when early man was first feeling the power of the world's most highly developed brain

Among the animals that appeared at the beginning of the Great Ice Age, a million years ago, were two groups of mammals each of which was destined to occupy a different but a dominant position on the lands of the earth. These two groups of pre-eminent, ruling animals were elephants and men.

Until the beginning of the Ice Age, or Pleistocene period, there were no true elephants or men in the world—only their forerunners. These were the ancestral elephant-like proboscideans, animals of large size, with elongated trunks or proboscises, enlarged tusks and straight, post-like legs; and ancestral man-like apes, or anthropoids. It was with the advent of the Pleistocene period about one million years ago, an age marked by the successive advances and retreats of great continental sheets of ice from the north polar regions, an age which inaugurated a period of increasingly rigorous climatic cycles, that true elephants finally evolved from their more primitive proboscidean ancestors and true men developed from their apelike progenitors.

Having made their separate entrances onto the Pleistocene stage, elephants and men advanced along their distinct but comparable lines of development, the former to attain the maximum of body power among the later land animals of geologic history, the latter to evolve the maximum of brain power. Consequently these two groups of animals were enabled by their heritage to dominate their environment, the one by sheer force of bulk and strength, the other by the less spectacular but more effective use of intelligence.

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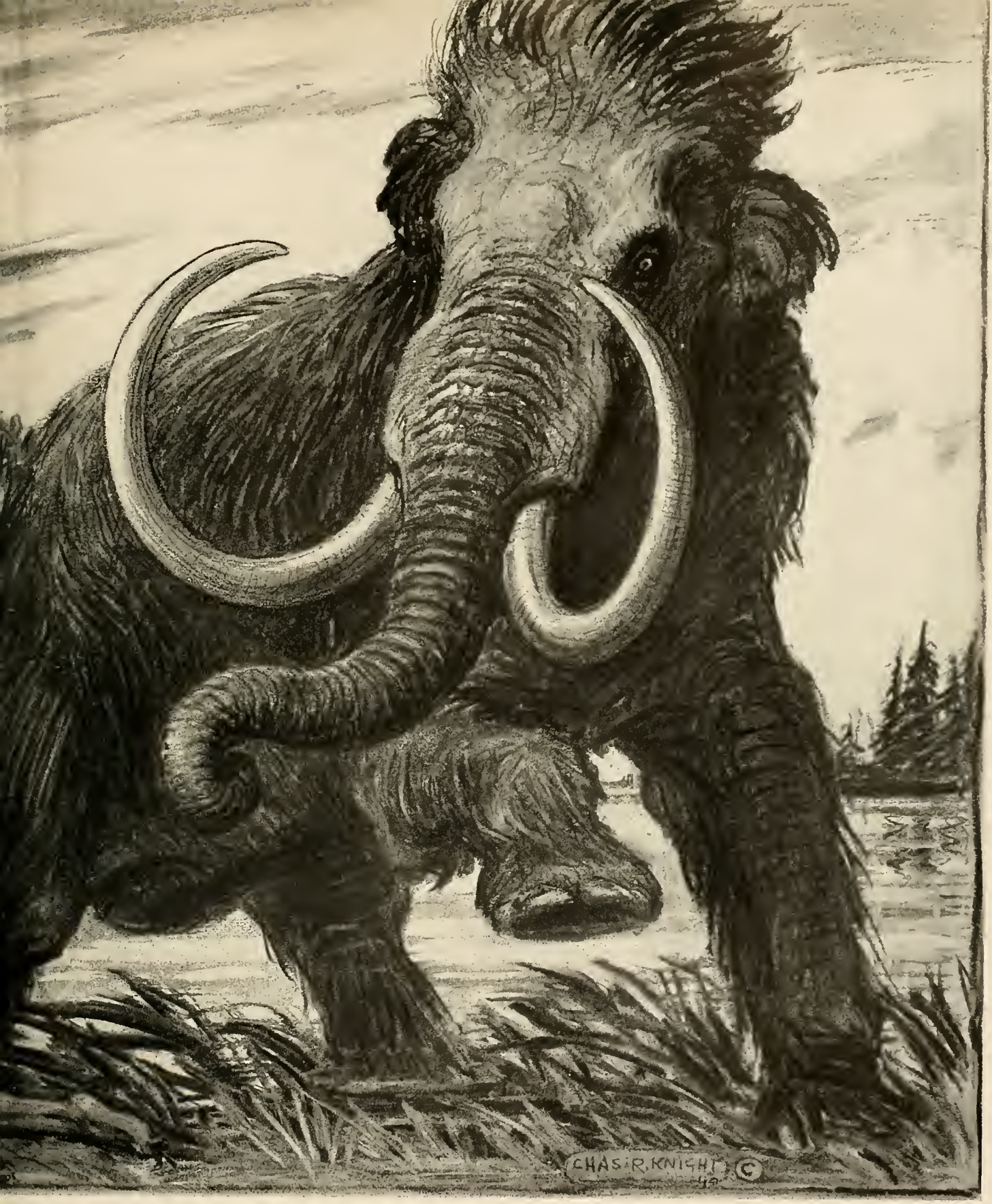
The drawing *above is reproduced for the first time from an original by the celebrated artist Charles R. Knight, whose reconstructions of prehistoric animals are known throughout the world for their accuracy and power. This drawing shows a woolly mammoth in combat with three men of the Ice Age. It was a mammoth of this species, discovered in Siberia in 1900, whose flesh was so well preserved that the sledge dogs of the scientific expedition devoured it eagerly*

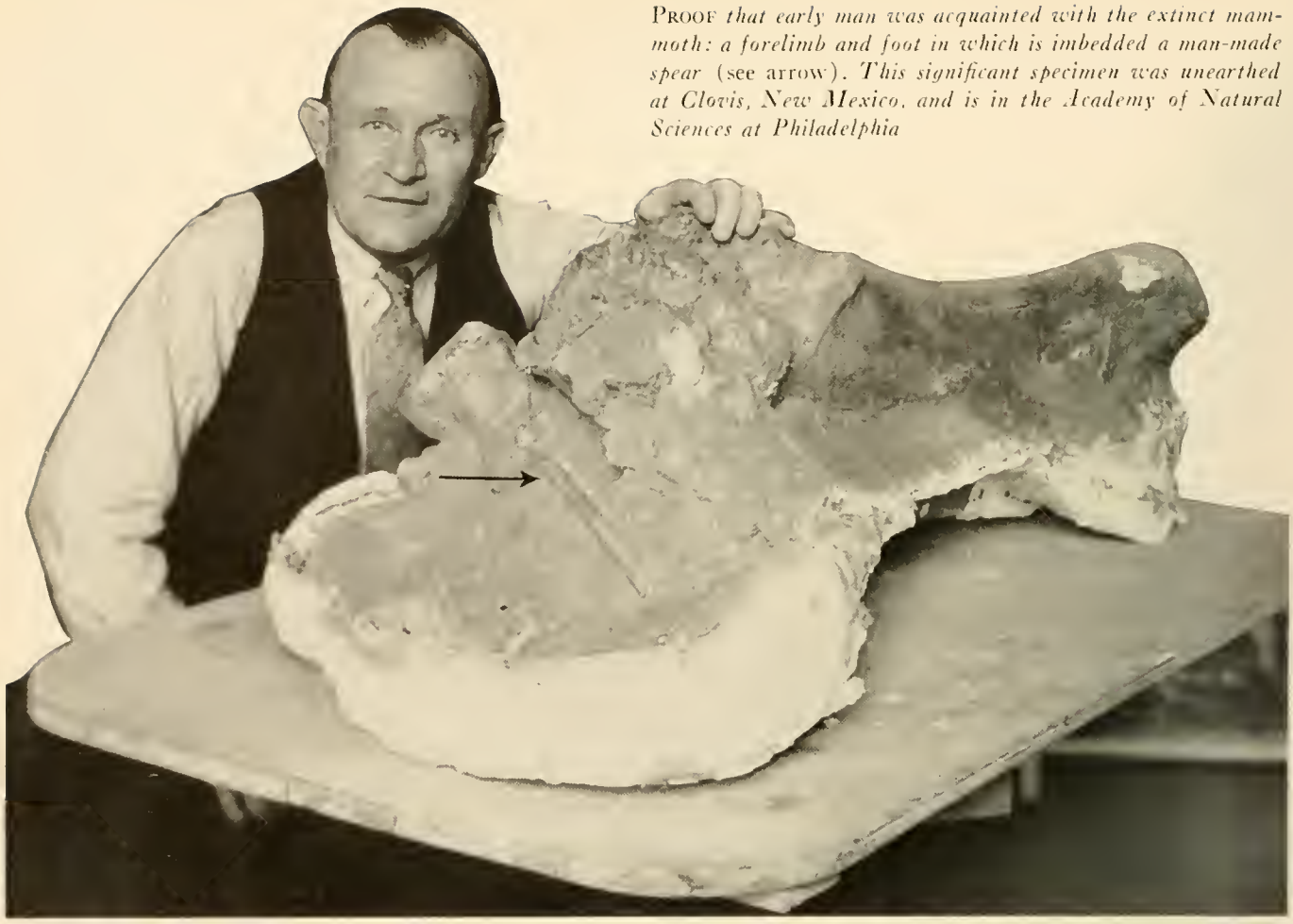
From almost the beginning of the Pleistocene period to modern days, men and elephants have been associated. Man has been, throughout his evolutionary history as a man, first an elephant hunter and more recently an elephant master, while the elephant has been to man first a casual but formidable enemy and finally a surprisingly amenable slave.

At the beginning of the Pleistocene the ancestral



elephants or mammoths made their appearance in the Old World, probably in Southern Asia, possibly in Africa, and from these progenitors various lines of elephantine evolution developed, resulting in the differentiation of several distinct types of specialized mammoths or elephants. These are shown in the accompanying illustrations.

The Pleistocene mammoths made up an impressive array of elephants, particularly when it is realized that most of them were living at the same time during the Ice Age. Great herds roamed over Europe and Asia, across Africa and through the Indies, and into North America, virtually unchallenged by any of their contemporaries and certainly afraid of nothing on their horizon. Only Australia, the isolated oceanic islands, and South America were without them, and even in the latter continent, as in North America, there persisted various kinds of mastodonts (the relatively primitive proboscideans from which the mammoths sprang).



PROOF *that early man was acquainted with the extinct mammoth: a forelimb and foot in which is imbedded a man-made spear* (see arrow). *This significant specimen was unearthed at Clovis, New Mexico, and is in the Academy of Natural Sciences at Philadelphia*

Photo by the Philadelphia Academy of Sciences

Yet at this same time some other mammals, rather unimpressive on the whole, were developing side by side with the elephants. These were the early men, appearing at the beginning of the Ice Age and evolving through the duration of that period.

Just prior to the beginning of the Pleistocene period, the immediate apelike ancestors of the first men were living in North India. This is known from the evidence of fossils discovered there during the past 20 years. And from recent discoveries it is evident that intermediate "man-apes" or "ape-men," bridging the gap between the Oriental ancestors and the first men, were living in South Africa in the Pleistocene. It was from beginnings such as these that the true men of the Pleistocene evolved in the Old World.

Some of the first true men appeared almost simultaneously in China and in the East Indies. These were the men known as *Sinanthropus* and *Pithecanthropus*,[1] living in North China near Peking and in Java respectively, but representing essentially a single human type. These people had characteristically low foreheads and skulls, heavy eyebrow ridges, and probably extremely wide noses; the jaw projected beyond the upper part of the face, and the chin was rather receding.

From such primitive men there evolved the more highly developed Neanderthal Man *Paranthropus*,[2] of Eurasia and Africa, an early hunter using fire and well-made tools, but still preserving many of the ancestral characteristics of the Java and Chinese men. Another early man known as Piltdown Man, although seemingly ancient in age, showed many structural advancements toward the modern type.

Finally there appeared the modern men belonging to the genus *Homo*, an early member of which was the Cro-Magnon Man of Europe, a highly developed human, using bone and stone tools, and noted for his unusual artistic ability. Succeeding Cro-Magnon Man came the recent men as we know them, following different lines of development and showing various characteristics by which we distinguish races. All of these later men were advanced over their more primitive pithecanthropoid and neanderthaloid predecessors in that they had high foreheads and highly domed skulls, a highly bridged nose, and a pronounced chin. The posture was completely upright.

As compared with the contemporaneous mammoths, the Pleistocene men were probably scattered and certainly not very important; yet as they developed with the passing of time, they were destined to become increasingly disturbing to the animals around them—even to the mammoths, then the giants of the earth. For these early men were evolving a new thing under the sun, a giant intellect, which eventu-

[1] See "Our Most Ape-Like Relative," by Teilhard de Chardin, NATURAL HISTORY, September, 1937, pp. 514-517; "The Face of Peking Woman," by Franz Weidenreich, NATURAL HISTORY, May, 1938, pp. 358-360; "Man or Ape," by Franz Weidenreich, NATURAL HISTORY, January, 1940, pp. 32-37.

[2] See "The Fossil Man of Circe's Mountain," by Albert Charles Blanc, NATURAL HISTORY, May, 1940, pp. 280-287.

ally was to overpower all of the beasts with which men had to contend.

With the gradual increase of the primate brain to a point where it became human, there developed a struggle for dominance between man and the animals around him, and not the least important of man's adversaries in this struggle were the elephants or mammoths. For, as has been pointed out above, it was a contest between a giant physique and a giant intellect. Yet there were other factors involved, to make the struggle between man and the elephants of particular interest to us in retrospect. It was not only a struggle involving a maximum of body size against a maximum of brain development, but also one of intellect against intellect. The elephants are and always have been remarkably intelligent mammals, and even though their intelligence was no match for the cunning and the reasoning powers of primitive man, still it was sufficiently advanced to make the struggle between these two adversaries all the more intense.

Not only that, but there was a struggle in manipulation. Man had his two hands, which were not necessary for locomotion and therefore could be used for skillfully manipulating objects to his own uses. On the other side of the picture, the elephant had his trunk, an organ of almost unbelievable mobility, strength and tactile delicacy, with which he could manipulate objects, likewise without regard for the necessities of locomotion. Yet the higher intelligence won, because it could fashion tools as an aid to the handling of objects, while the lesser intellect could use its power of manipulation only for direct contact with things—the tearing down of trees and bushes, or the pulling up of roots.

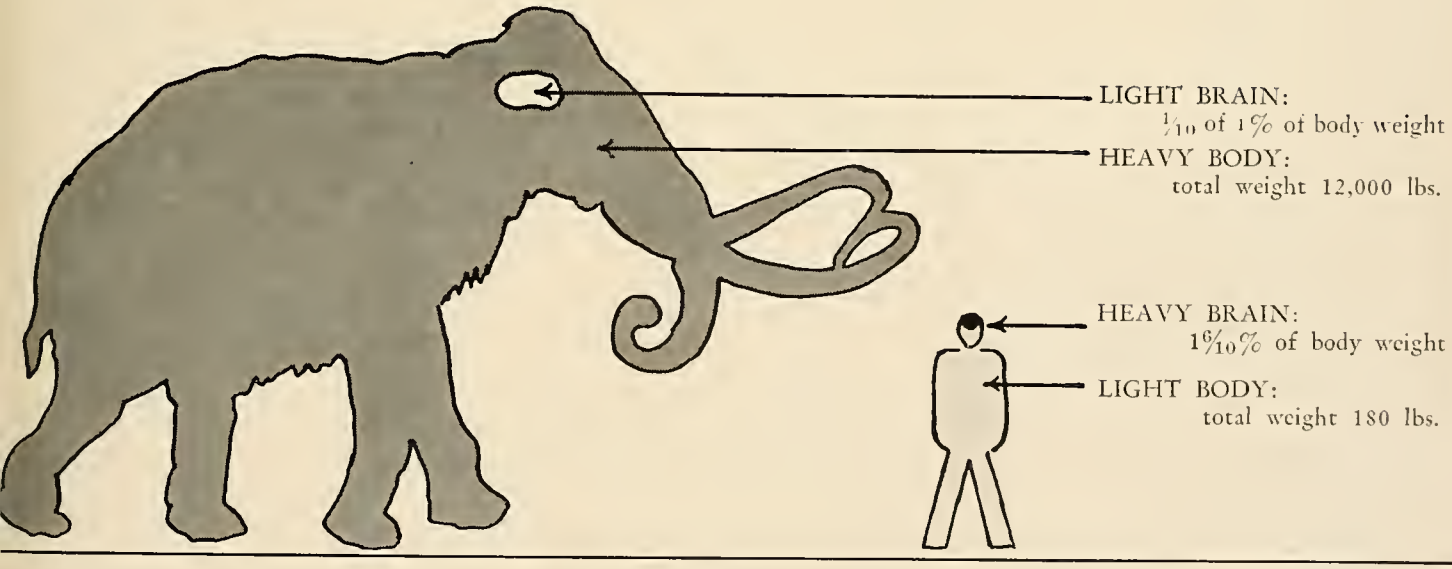
Again, man having fashioned tools or weapons with his hands, could use them to increase his effective strength. As compared with this, the elephants, particularly some of the extinct mammoths, had strong, efficient tusks that served not only as weapons but also as tools for digging and prying. Here again the higher intellect won out—tools in hands directed by a logically reasoning brain were more effective than powerful tusks, directed even in the most intelligent fashion by a brain of lesser abilities.

Man has been a gregarious animal throughout his history. Elephants, too, are and have been gregarious. But because of his superior intelligence, man has been able to use his gregariousness to much better advantage than the mammoths and their kin; for he, even in his most primitive stages, has devised methods of co-operation and a division of labor far beyond anything attained by other mammals.

Two other traits may be cited whereby these contending animals have paralleled each other. Both man and the elephants are slow breeders, and both are long-lived.

To the early men of Eurasia and Africa, the ubiquitous and powerful mammoths must have been formidable adversaries in a difficult and constant

BRAIN vs. BRAWN

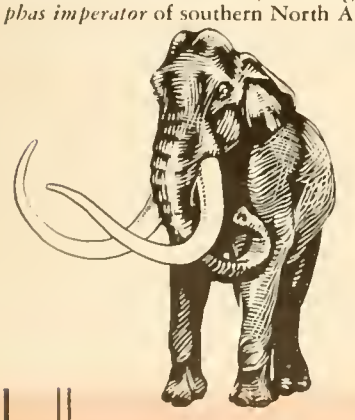


MAN'S BRAIN weighs almost one-fourth as much as the mammoth's, although the latter animal was 66 times as heavy as a large man. This means that, in proportion to his size, the mammoth had only 1/15 as much "gray matter" as man. Brain triumphed over brawn early in human history, which seems simple enough today but might not have been so easy to foretell at the time. By ingenious application of his intellect, man has devised machines by which he can lift many times as much as the largest animals

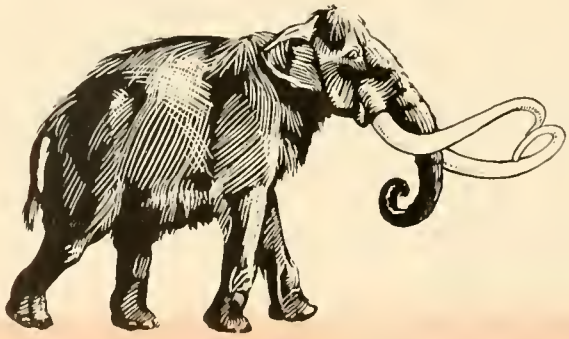
THE ORIGIN OF

A primitive group of mammoths, of which the imperial mammoth *(below)* is representative, gave rise to the varied Pleistocene types, some of which developed into our two existing elephants *(extreme right)*. The African elephant evolved from the straight-tusked mammoth, while the Asiatic elephant had an ancestry in common with the woolly mammoth. All mammoths and the mastodonts from which they were originally descended, are now extinct

IMPERIAL MAMMOTH, the huge *Elephas imperator* of southern North America



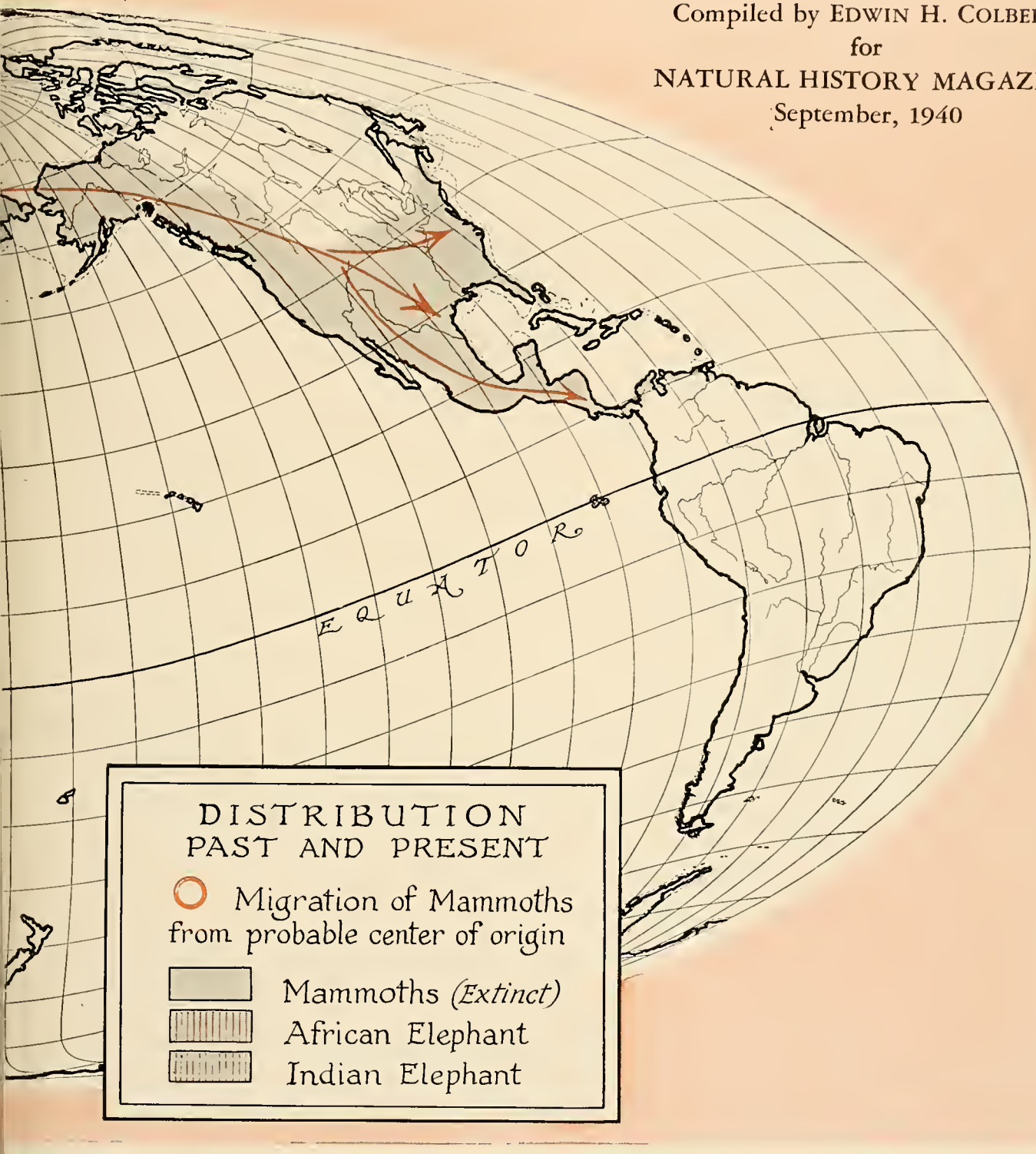
COLUMBIAN MAMMOTH *(Elephas columbi)*, the large mammoth of middle North America



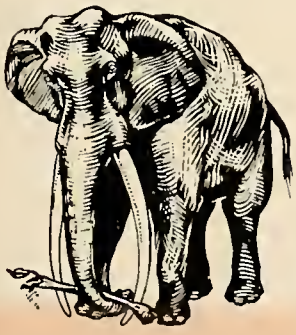
WOOLLY MAMMOTH *(Elephas primigenius)*; north circumpolar, Eurasia and North America

THE ELEPHANTS

Compiled by EDWIN H. COLBERT
for
NATURAL HISTORY MAGAZINE
September, 1940

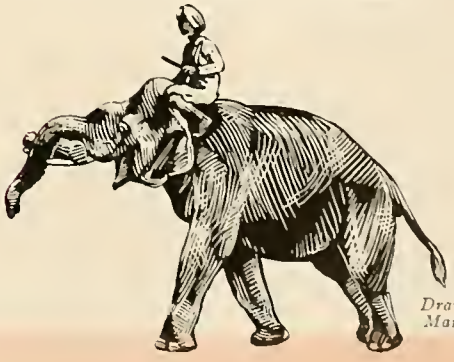


STRAIGHT-TUSKED MAMMOTH (*Elephas antiquus*) of the Old World



AFRICAN ELEPHANT (*Loxodonta africana*); survivor of mammoths of Eurasia and Africa

INDIAN ELEPHANT (*Elephas maximus*); survivor of southeastern Asiatic mammoths



Drawings by Margaret M. Colbert

struggle for existence. Not that the mammoths were particularly inclined to bother their early human contemporaries, because to such great beasts, mere man, lacking powerful weapons of offense and defense, must have been on the whole hardly worthy of much attention. And the mammoths, like the modern elephants, were undoubtedly peaceful and tractable animals when let alone. Yet we know the helplessness of modern African natives, lacking modern weapons, against a herd of elephants that decides to "take over" their village and to raid their gardens. There is just nothing much to be done by these men against a group of wandering elephants, and such must have been the situation for Stone Age men. The mammoths went where they pleased, and the men adapted their activities accordingly.

Unaggressive vandals

Naturally, the large carnivores, the lions and panthers and bears, were a more active and constant threat to the well-being of Stone Age man than were the peaceable mammoths. One had only to stay away from the mammoths to be safe from them. But it must have been bitter medicine at times to the primitive hunter, to see these uncouth beasts wallow in the best fishing streams, or tear apart some selected trees of wild fruit. Every dead mammoth was one less mammoth, and a dead mammoth, moreover, would provide food for an entire village.

Consequently at a fairly early stage in his social evolution, man became an elephant hunter. The first elephant hunts undoubtedly were accidental, as when a mammoth was by chance discovered mired in a bog or disabled in some other way, so that it could be finished off by the use of spears and stones. But with the increase of his intellect, man sooner or later began to devise traps or pitfalls whereby the mammoths could be put out of action at a time and place advantageous to the primitive hunter.

The mammoths spread throughout the extent of their range at the beginnings of the Ice Age, but man, during the greater part of his evolutionary history, was confined to the Old World. Consequently it was in Europe, Asia and Africa that man "grew up" with the mammoths, and wherever we find the remains of primitive man in the Old World, we usually find those of some of the mammoths.

The earliest humans of Eurasia were associated with the ancestral mammoth, *Elephas planifrons*, but as man evolved during the Pleistocene he became well acquainted with all of the various mammoths of the Old World. Of these it was the woolly mammoth, *Elephas primigenius*, of which we have the greatest amount of evidence as to association with man, because the woolly mammoth was unusually abundant during the later phases of the Pleistocene, when man had progressed to such a stage that he was something of an artist. Therefore we know quite a lot as to the appearance of the woolly mammoth in life, from numerous drawings and carvings made by cavemen artists. And there are indications, one case in particular in Moravia, of ancient elephant hunts, where palaeolithic man had pursued, trapped and killed numbers of woolly mammoths.

Here Dr. Carl Absolon of the University of Prague discovered, some fifteen years ago, a large accumulation of mammoth bones, with numerous indications that these were the remains of animals trapped and killed by primitive men. The conclusions of this authority as to the method of hunting are expressed in the following words.

"There cannot be the least doubt that the hunters did not attack these powerful animals face to face, but caught them by cunning, enticing or driving them into large pitfalls. . . . Mammoths trapped and caught were killed by large stones, trimmed to serve such a purpose. I have found one such stone, trimmed like a big pear, or bomb, one meter long, and weighing over 120 pounds. These stones might have been suspended in strong leather straps and thus let down on the animals by the united efforts of several men, in the same way that navvies drive piles into riverbeds by means of rams."

Some of our most accurate knowledge of the woolly mammoth comes from direct evidence. During many centuries the tusks of woolly mammoths have been excavated in Siberian Russia in enormous numbers and the ivory exported for commercial use.[3] Occasionally frozen carcasses of woolly mammoths have been found in various stages of preservation. All of which means, of course, that the woolly mammoth has been extinct for no very great period of time, either from the standpoint of geology or from that of human prehistory.

Eaten by modern dogs

Of the various woolly mammoth cadavers thus discovered, perhaps the most completely preserved and best known is the Beresovka mammoth, found in Siberia in 1900 and excavated by an expedition from the Russian Academy of Sciences. This animal was partially buried in a pit, the result of its having fallen into a natural trap or having become mired in soft ground. The front legs were still raised as they had

[3] The word "mammoth" is of Russian origin, being derived from *mammot*, which in turn is supposed to be derived from the Tatar word *mamma*, meaning "the earth." It may be that the name was first applied to the huge bones which were so familiar to the primitive people of the steppes. By extension, the word has come to be an indication of anything large or impressive.

been at the time of the animal's death—indicative of the vain struggles made by this mammoth in an effort to free itself. The flesh was remarkably fresh—so much so that it was eagerly devoured by the explorers' sledge dogs, although it was not sufficiently palatable to be eaten by humans, despite many popular legends and newspaper accounts of banquets at which "mammoth steaks" were served to ghoulish scientists. The trunk of this mammoth was well preserved, as were many of the internal organs and some of the blood, while a greater part of the skin was intact. The coat consisted of a dense, woolly underfur and a coarse hairy outer covering of a reddish-brown color. And it is evident, from a study of this animal, that the woolly mammoths grazed upon tundra grasses and the leaves of willows and coniferous trees in the northern arctic forests.

The first Americans

Man did not cross the arctic bridge from Siberia to Alaska until a geological yesterday. Perhaps it was as much as 20 or 30 thousand years ago that certain Mongoloid peoples first pushed to the northeast and entered a New World—a date seeming remote to us but representing actually a very late stage in the prehistory of humans, a stage when polished stone implements were in use, and when the bow and arrow probably had been invented and the dog domesticated.

The first human migrants to the New World found a fauna that would seem strange to us in many respects. Among the most numerous of the animals roaming the plains and forests of North America at that time were the three American mammoths, which had arrived on this continent many hundreds of thousands of years before their human followers. These, the Columbian mammoth in middle North America, the Imperial mammoth to the south, and the woolly mammoth to the north (together with the American mastodon, a distant proboscidean cousin which had an origin and history quite separate from that of the mammoths), must have dominated the landscape in all sections of man's newfound home. That the first men in America knew the mammoth is becoming increasingly evident from discoveries of recent years. In the north, man was associated with the woolly mammoth and the mastodon, farther to the south with the Columbian mammoth and the giant Imperial mammoth. Here, as in the Old World, man was an elephant hunter. At least it would seem so, to judge from the numerous spearheads found in association with mammoth remains, especially in some of our southwestern states.

This was the picture near the end of Pleistocene times—elephants and men living side by side, contending with each other, and together dominating the scene throughout the length and breadth of the Old World and in the northern half of the New World. Then, at the end of the Ice Age, when the last of the great continental glaciers was retreating to its present arctic limits, there was a relatively sudden and widespread extinction of mammoths throughout the world. The woolly mammoth disappeared from northern Europe, Asia, and North America, as did the more southerly types in these continents. In the Western Hemisphere the mastodons, too, became extinct. Only two types of proboscideans survived the transition from Pleistocene into recent times, the Indian elephant of the Orient and the African elephant of the Ethiopian region.

The twilight of might

What was the reason for the wiping out of the mammoths? Why should these huge and seemingly successful animals suddenly disappear from a scene which they had so long dominated? Was man concerned with their extinction? It hardly seems probable, for even though at this late date he was a clever and an efficient hunter, he was still rather scattered—certainly not a numerous member of the faunas to which he belonged. Therefore, it is difficult to see how primitive hunters might have prevailed against the mammoths to such an extent as to cause their sudden and almost complete destruction.

The answer to this question may always remain a secret. Something caused the disappearance of most of the elephants from a great part of the earth's surface. The dominance of size and strength came to a sudden end. The dominance of intellect, which had been slowly developing through the millennia, became even more firmly fixed than before, once the giant mammoths had largely disappeared, and when the intellect became established as the most important factor in evolution, it developed at an increasingly rapid rate. Now its dominance is virtually complete throughout the world, with results that are at the same time happy and tragic.

AN ANCIENT DEATHTRAP

Scientists reconstruct the scene of a losing struggle between mass strength and the treachery of quicksand when they uncover one of the largest known graveyards of prehistoric "elephants"

A PRECEDING article in this issue by Edwin H. Colbert tells the story of man's early struggles against the now extinct mammoths of the Ice Age. Here is shown a recent chapter in the scientific search for prehistoric animal remains. But these bones belong not to mammoths but to their more primitive relatives the mastodons, from which the mammoths at one time sprang.

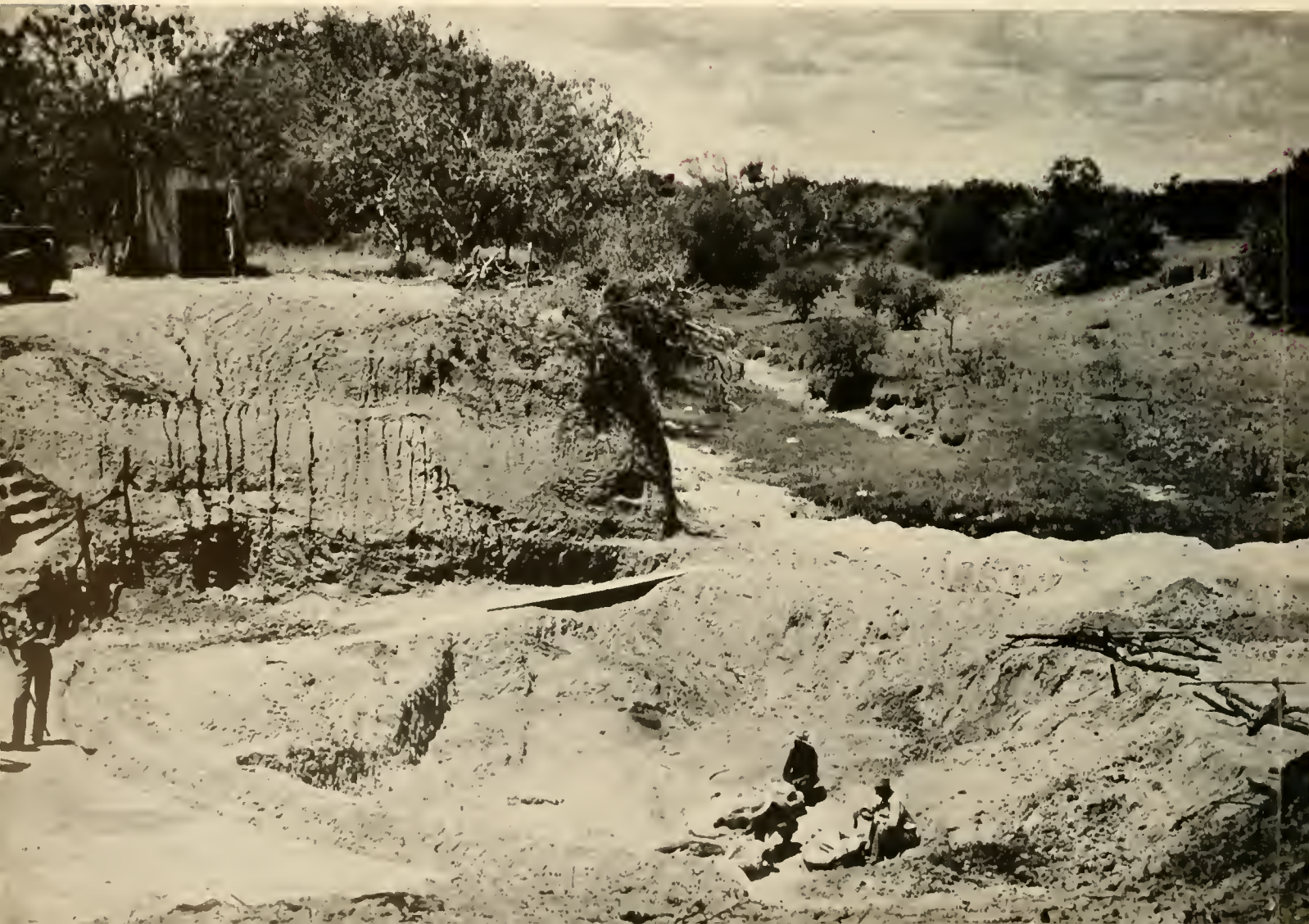
And the evolutionary struggle of brain against brawn which came with the arrival of man on the scene, had probably not arisen in America at the time these animals lived. The struggle which these excavations reveal was against a purely physical danger, that which a quagmire presents to a beast of great weight.

The scene below shows where these ancient creatures died in considerable numbers over a million years ago. The land, which is now a fairly typical tract in the cattle country of southern Texas, is deduced to have been an ancient water hole flanked by bogs, in which these animals became mired and died. In the natural course of events, material accumulated on top of their bodies, preserving them through the ages.

Five years ago Frank Dougherty, a surveyer of Houston, Texas, while surveying twelve miles east of the town of Beeville and about 50 miles north of the Gulf of Mexico, discovered a partly exposed "elephant tusk" and reported it to the Bureau of Economic Geology at the University of Texas.

Only recently has it been possible to excavate the site, and the yield has proved amazing. Under the supervision of Dr. E. H. Sellards, Director of the Bureau of Economic Geology at the University of Texas, workmen of the Works Projects Administration have already uncovered fifteen massive, shovel-jawed matodons inside a radius of 200 feet, besides a wealth of other remains of prehistoric life.

The surroundings here are somewhat different from most of the other fossil country of the West, of which the typical site is in more mountainous terrain where the sparse vegetation of a semiarid climate leaves outcroppings of rock exposed. Here the excavators have removed 22 feet of overburden from a pit measuring nearly 400 feet long and 70 feet wide.



(Left) Giant graveyard. Three of the gigantic mastodon skulls lie so close together here that they might conceivably have belonged to the same herd. Even singly, the losing struggle which these enormous animals no doubt made in their effort to escape from the sticky mud or quicksand must have presented a dramatic scene. Weighted down by their massive bodies and heavy tusks, they sank to form this fossil-hunter's treasure; others, presumably more cautious or stronger, escaped this fate.

In the center foreground lies a complete skull, with tusks intact. Across it lies an isolated tusk. Behind are two other skulls with various assorted bones just showing. The Y-shaped bone at the left is a segment of the spinal column

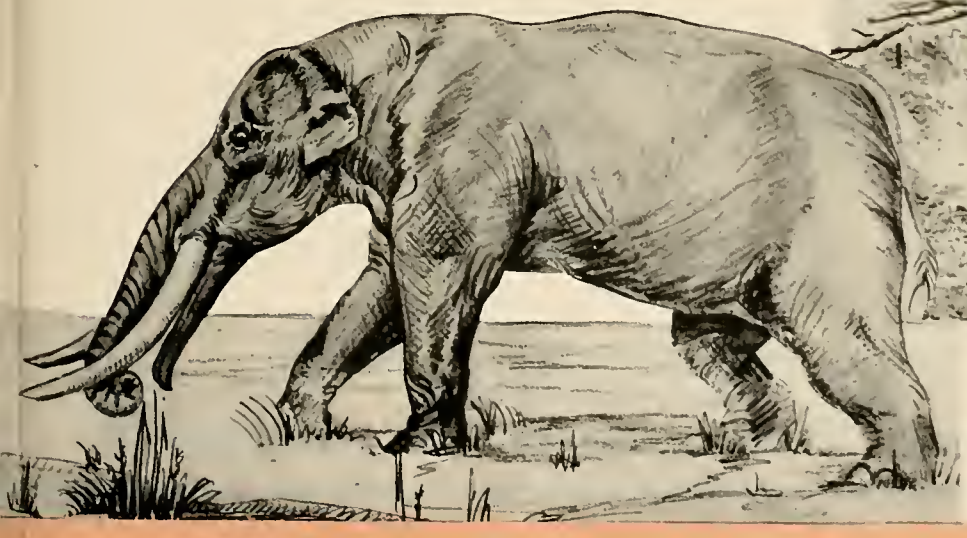
Graphic Features photos by Payne

(Below) Their teeth distinguish the mastodons from the mammoths as clearly as anything else. The high, enamel-covered ridges project in the molars of the mastodons, whereas the space between them is filled with cement in the case of the mammoths. Teeth also distinguish this genus of mastodons from all others. As Doctor Sellards points out in this photograph, the teeth are very large and have four or five lobes or ridges

(Right below) Thigh bone of a Mastodon on its way from the million-year-old fossil bed to preparation laboratories at the University of Texas, in Austin. Each bone is treated with hardening solution and encased in plaster and burlap as soon as uncovered, to prevent disintegration, which is often rapid upon exposure to the air. The key number on the bone records its exact position in the pit

(Below) As it appeared in life: the shovel-jawed Buckner's Mastodon used its elongated lower jaw to scoop up vegetation from ponds. This hitherto unknown species of mastodon *(Gnathabelodon buckneri* Sellards) is named after E. H. Buckner, on whose land it was discovered and who encouraged the excavations. Skulls brought in to Austin so far have weighed between 400 and 500 pounds. The assembled remains will be exhibited in the Texas Memorial Museum on the campus of the University. Other animals of the period also found on the site include alligator, rhinoceros, camel, and three-toed horse.

At this same locality, nearer the surface and in later deposits, are found remains of other animals, including elephant, horse, bison, peccary, and sloths, and, most remarkable of all, flint implements, camp sites and hearths, showing that in these later times early man had arrived on the scene and lived and camped at this place. It thus appears that the locality was a resort for animals in Pliocene time, possibly a million years ago, and of both man and animals in late Pleistocene time, 25,000 or more years ago



THE MYSTERIOUS ISLAND OF NIAS

(Continued from page 94)

elaborate and the audience never fails to boo a badly performed jump, while a good one draws loud cheers. The jumper makes his take-off from a low stone set in the ground just in front of the stone hurdle. This gives him a strong upward thrust. Quickly he doubles up his legs and, turning on his side, literally rolls over the jump in what is pretty close to approved Olympic style.* One suggested explanation of the origin of stone jumping is that the early Nias towns were surrounded by a low stone wall for protection and that the warriors practiced jumping so as to be able to make a quick getaway after a midnight hunting raid in an enemy town.

At this moment the sounds of the growing crowd of warriors welled up from the street below, and I turned to inquire about them from the Magistrate. But he had just stopped speaking and was evidently waiting for the Chief to answer. Lafau remained quiet for a while. Then suddenly he nodded his head vigorously once or twice, tossing the golden leaves of his headdress back and forth. Behind his moustachios I could see his mouth crinkled into the set smile of politeness of host for guest. Meanwhile under the rim of his helmet, the sharp black eyes never left the Magistrate's face, as if measuring the strength of this white man and all his kind who had come to rule his country. If he felt rebellious at the thought of giving up his old customs, Lafau never showed it. His head continued to nod approval and his smile was as broad as ever. But I wondered what thoughts were going on behind those eyes.

Finally the Magistrate turned to me. I thought he looked slightly relieved.

"Now," he said calmly, "that is settled. Our guilty man can walk abroad without fear. His case will wait until I can try it in court. There will be no unpleasantness," and he looked thoughtfully at Lafau.

I asked about the men in armor.

"Yes," he said, "they are going to do a little dancing for us."

Lafau stood up and went over to the corner where a great war gong hung from the rafters. Pushing it once or twice he started it swaying back and forth, and then as it came toward him each time, he struck it with a cloth-covered hammer. The room seemed to swell and eddy back and forth with the dull reverberations. It was the signal for the dance.

The Magistrate rose and beckoned, and we started down the stairs. I turned for a final look at the Killer of Dutchmen, latest and perhaps last of a long line of primitive despots who had led their people on this mysterious island. He was rocking back and forth with his gong, lost in its slow rhythm. I wondered how often he had signaled thus to his warriors to join him for the war hunt, and how many skulls were hidden in the rafters overhead.

*Compare this with the high jumping of the Watussis, discussed in "Reception in Ruanda," by Martin Birnbaum, NATURAL HISTORY, December, 1939.

DO NOT MISS

Autumn is a season of migrations. Bird fanciers everywhere turn out to watch the gathering flocks above the yellowing trees. Many a sigh marks the departing of favorite song birds, but few lament the passing of the last hawk as he planes over the hill. Fewer still comprehend the mystery of his motionless flight. He is truly a master of the air. He has known how to gauge and utilize the shifting of its currents since the dawn of time, and he has much to teach us. If your eyes are sharp, you may have the thrill of spotting this master of the art of flight. Richard H. Pough's **HAWKS ALOFT** tells where to go and what to look for, and will be accompanied by an illustrated chart on some of our leading birds of prey. The article neatly punctures many fables of hawk villainy and, by giving the truth, compensates for the calumny that has been heaped upon some of our most useful birds.

In **WILD DUCKS FOR THE ASKING**, S. Dillon Ripley tells how anyone with an acre or two of suitable rural land at his disposal can do his bit toward the conservation of our wild fowl, develop a highly rewarding hobby and, mayhap, add greatly to our knowledge of social behavior in birds. Building your own duck pond is surprisingly simple, and from a few pairs, sizable flocks of semi-tame fowl can be bred, banded, and studied at will.

If you hear the dreaded warning of a rattlesnake—do not run, don't even walk to the nearest exit. Stand still! Nature gave snakes the instinct to strike rapidly moving objects. Don't move and you are not apt to be bitten. So says Ross Allen who milks rattlesnakes for a living. In his forthcoming article he shows how **A SNAKE IN THE HAND** is worth two in the grass from the viewpoint of medical research because of the valuable humanitarian purposes the venom can serve. His job of capturing and keeping these unjustly hated creatures sheds much light on their habits and peculiarities.

In an early issue, NATURAL HISTORY will present another of Herbert P. Whitlock's renowned articles on Chinese jade. This latest work, **GODS AND IMMORTALS IN JADE** will appear in conjunction with a short biography of its noted author.

Among the many photographic subjects shortly to be displayed in NATURAL HISTORY is Guy S. Peckham's **SEVEN STAGES OF A RED-TAILED HAWK**, showing intimate glimpses of the first 42 days in a young hawk's life.

Human Sacrifice in Ancient Mexico

By George C. Vaillant

Associate Curator of Mexican Archaeology, The American Museum of Natural History

This picture, *drawn a generation after the Conquest, shows the classical method of dispatching a victim and offering his heart to the Sun God. This and the other paintings illustrating this article were drawn by Aztec artists for Father Sahagun's* History of Mexico *about 1560 and are from the* Codex Florentino

The strange cult of death which the Aztecs developed to appease their pantheon of bloodthirsty gods caught in its meshes friend and foe alike and thus came as close to spelling self-destruction as any creed in the history of man

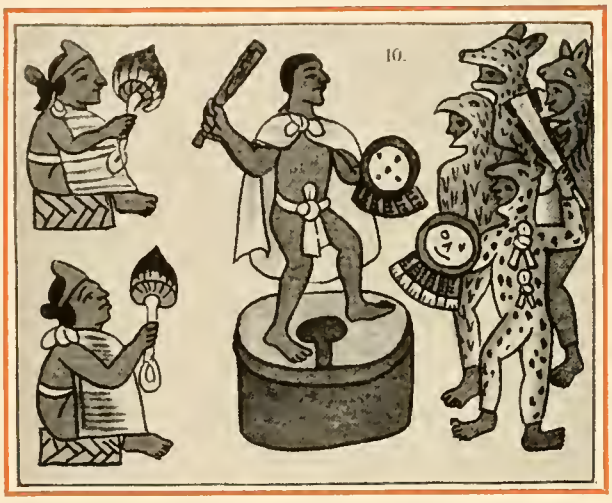
The idea of sacrifice goes back to the dawn of religion. It requires two beliefs: that the supernatural forces are motivated by much the same thoughts and emotions as man, and that a bargain may be struck whereby man may pay either in advance or c.o.d for a benefit bestowed by the divine authorities. Offerings of food or valuable possessions, the erection of temples, the performance of penitential rites, are the more common types of sacrifice. The greatest sacrifice, the most valuable gift, however, is that of human life, for that is what man is most ardently striving to preserve. This conception, in a less commercial form, persists in our own culture in the idea of martyrdom, a voluntary or involuntary self-sacrifice for the benefit of mankind.

In Indian Mexico, the people were intensely aware of the strength of nature and the weakness of man. The aspects of their culture that were not directly concerned with the technique of supporting life were largely directed toward religion, toward the propitiation of the natural forces which controlled everything from the growth of a stalk of corn to the birth of a baby or to the cataclysmic upheavals of a volcanic region. The highest cultures in Mexico were true theocracies, wherein the tribal rulers acted as intermediaries between the gods and the members of the tribe. It is not surprising, therefore, that human sacrifice should have its place, or, as in the Aztec civilization, should become a dominant part of the national economy.

Other Mexican tribes, like the Mayas, Toltecs, and Zapotecs, occasionally sacrificed people. Among the Mayas, skulls are sometimes found buried, perhaps the trophies of military raids. At Teotihuacan, the great Toltec religious center, bodies were found as foundation deposits for one of the most imposing temples, the one supposedly dedicated to Quetzalcoatl. My wife found a large bowl containing a man's hips and thighs, his most succulent portions from a culinary point of view, buried with the debris from a feast, at the large Toltec town of Azcapotzalco. However, it was in the later times of the Aztecs that human sacrifice really became a general practice.

The Tenochca, the best-known branch of the Aztecs, have left us a full documentary record of their history. At first, they seem to have been nomadic farmers, wandering from place to place in search of good land for permanent settlement. A picture manuscript shows the sacrifice of three people during this migratory period. The victims were stretched out on

maguey plants while a priest cut out their hearts. This performance was always done in the same way. The victim was laid supine over some raised object, his arms and legs being held in such a way as to tauten the skin and stomach muscles. The priest was thereby enabled to open the visceral region by a simple longitudinal cut with a chipped stone knife which would otherwise have been too dull to perform this function. The priest then thrust his hand into the body cavity



IN GLADIATORIAL SACRIFICE, *a victim armed with dummy weapons fought warriors armed with obsidian-edged clubs, until his heart was torn out and offered to the gods. Note chiefs seated at left, and four Ocelot and Eagle Knights at right*

and tore out the palpitant heart, which was then burned as an offering to the gods.

In the first recorded instance, the circumstances of the sacrifice are not clear. The drawing shows ritualistic sacrifice, but the legend, quoted by Torquemada, suggests that the victims had revolted against the tribal rule. It is quite possible that two purposes were accomplished simultaneously: the gods were honored and evildoers punished—a combination of motives by no means unfamiliar in our own culture pattern.

Several other instances of this type of sacrifice were recorded, but it is not until over a century later that we have a record of the fully developed Aztec religious practice, the sacrifice of military captives taken in wars primarily for that purpose. The Tenochca had at this time reached the Lake of Mexico and had made a settlement at Chapultepec, now the site of a beautiful public park. They had made themselves so disagreeable to their neighbors by raids and land seizures that the latter banded together and defeated them. Some of the Tenochca escaped to islands in the lake where Mexico City now stands; the main body were moved to Tizapan and became a tribal fief, subject to the advanced city-state of Culhuacan. As such, the Tenochca had to do military service and took part as shock troops in the war which the chief of Culhuacan waged against Xochimilco.

Whenever they took a prisoner, they cut off an ear with a long blade of volcanic glass and sent him back to the rear, while they charged on into the battle. Their impetuous assault won the day, but the chief of Culhuacan in good Aztec fashion delivered himself of an oration in which he congratulated his own Culhuas on having taken so many prisoners (80 in all) and upbraided the Tenochca for coming back empty-handed. The Tenochca, perfectly delighted, pointed to the captives and put the rhetorical question as to why each one lacked an ear. Thereupon they opened their pouches and dumped out their trophies as proof that they were the true heroes of the battle. This rather ridiculous little story is emphasized so strongly in the history of the Tenochca, and the virtue of taking captives is insisted on so repeatedly, that it is clear that prisoners were at this time sought for sacrifice. Indeed in the picture manuscript referring to this event, one can see the captives being tumbled down the steps of the temple after execution.

Another event in this same period throws additional light on human sacrifice and indicates that the underlying spirit was not pure brutality but the wish to give to the gods something valuable and hard to obtain as a sign of gratitude for benefits received and about to come. While the Tenochca were living as vassals at Tizapan, the Culhuacan people held them in contempt and considered the religion centering on their war god Huitzilopochtli (Humming Bird Wizard) extravagant and ridiculous, just as we look down today on minority sects different from ourselves. The Culhua used to go into the Tenochca's temple and defile it while they sneered and made jokes about the congregation.

However, after the war with Xochimilco the Tenochca had gained such prestige that they were respected again, and when the Tenochca petitioned the chief of Culhuacan to let his daughter marry their chief and found a royal lineage, he accepted. The Tenochca were so impressed and so grateful that they sacrificed the daughter and removed her skin, which one of the priests put on to symbolize Toçi the grandmother of the gods. Having made so supreme a sacrifice, the Tenochca naïvely thought they would please the chief of Culhuacan by inviting him to the temple to see his daughter as a goddess. According to the stories, he thought he would see her honored and alive. When, however, he saw her skin draped on a sinister-looking priest, he was horrified. He rushed

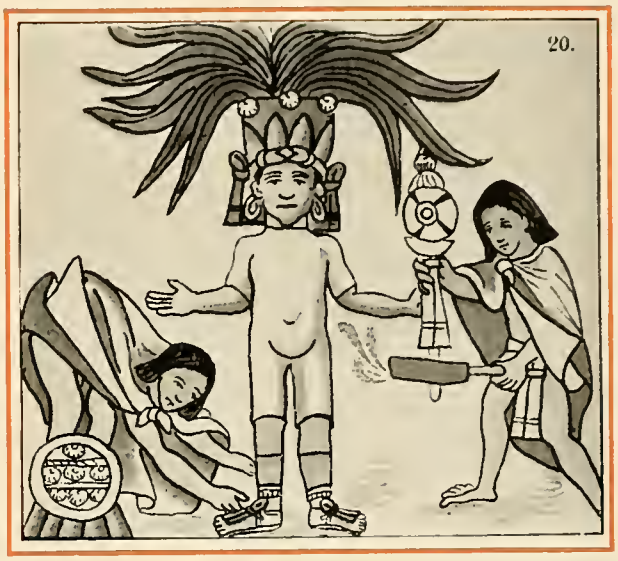
back to Culhuacan and summoned his tribe to drive the Tenochca forth. Hurt and amazed, the Tenochca retired and joined the refugees out on the islands, where eventually they created Tenochtitlan, the mightiest city in Middle America. The underlying idea was quite noble, since the Tenochca offered to the gods the thing that made them a free and important people. The lack of humanity indicates rather a complete absorption in the tenets of their religion than a heathen brutality. Similar acts are not unknown to religious conflict at all times.

Once on the lake, the Tenochca, after various vicissitudes, finally prospered and became powerful. They began to develop a highly formalized theological and philosophical attitude toward human sacrifice. Man could only live well if the gods were strong and could do good things for him. The gods, however, had to be well nourished, and the food that sustained them best was human hearts, preferably those of warriors. The determined student, probing behind the ritualistic involution of Aztec religion, can see the motivating forces. The chief gods were sky gods concerned with the sun and the rain, and with night and drought as evil antitheses. Fire and the sun are readily associated in the mind, and the burning of hearts led directly to the idea of their consumption by the heavenly bodies.

This idea was linked to conditions on earth. The Tenochca settled in the Valley of Mexico when it was well populated. They had sufficient land and food only when they conquered additional territory and levied tribute. Conquest and booty were signs of divine favor. Divine favor could be gained by obtaining war captives, an act which implied at the same time the acquisition of tribute. Their system was as completely designed for empire as was Mohammedanism or the more ethical concept of the "white man's burden." Yet strangely enough the Tenochca and their neighbors rarely absorbed a conquered town, but left it usually free and autonomous and demanded only tribute.

Religion was more important than conquest. A case in point is the War of Flowers, which was waged between groups of warriors chosen from two confederacies, Tenochtitlan-Texcoco-Tacuba on the one hand, Tlaxcala-Huexotcingo-Cholula on the other. These tribes were of equal strength, and neither group could risk warfare against the other. When there was a lull in the conquest of weaker districts, they would declare a formal war, not unlike a knightly tourney, and chosen warriors would battle to take each other prisoner for sacrifice to the victor's chief god. A special heaven for sacrificed warriors tempered greatly any personal regrets at leaving this earth.

Only one case of individual reaction has come down to us. A Tlaxcalan chief, Tlahuicol, was captured in a battle with the Tenochca. His bravery was notable, his rank was high, and he was induced by Montezuma to enter his service as a troop commander. Finding, however, too little honor in this recognition, he asked to be sacrificed and his request was granted. Tlahuicol was tethered to a large stone disk, carved to represent the sun, and, equipped with dummy weapons, had to defend himself against the successive onslaughts of warriors, whose clubs were



DRESSING *the victim chosen to play the part of the solar god Tezcatlipoca for a year's time, thereafter to be sacrificed. The headdress, magical mirror, and shield are part of the special costume of this god*

edged with obsidian and whose lances were pointed. The Tlaxcalan killed eight of his adversaries and wounded 20 more before his heart was torn out and offered to Huitzilopochtli, the Tenochcan war god.

Another sacrificial ceremony has captured the interest of romantic European writers. This was the sacrifice of a young warrior who impersonated the solar god Tezcatlipoca (Smoking Mirror). It took place in the fifth month. A year before the ceremony, the bravest and handsomest of the captive warriors was chosen by the priests to be taken away to special quarters, where he was richly dressed as the god and taught the most elegant ceremonial behavior. Whenever he walked abroad, playing his flute, all the passers-by made reverence as if to the god Tezcatlipoca himself. A month before the day of the feast, the captive was dressed as a warrior-chief and received as brides four beautiful young girls, who assumed the clothing of four goddesses. Five days before the feast, a solemn banquet and dance were held in honor of

this man-god. Then for the next three days similar ceremonies were enacted at different points in the valley.

On the last day, the day of the sacrifice, the man-god said farewell to his brides,—you see where the romantic interest lies—, and departed with eight attendants. He went with them to a small outlying temple, bearing with him a bundle of those very flutes with which he had whiled away the hours of his incarnation. Slowly he ascended the steps of the temple, at each one breaking one of his bundles of flutes. At the top the priests seized him and bent him over the block to tear out his heart. The final ignominy was spared to this Tezcatlipoca-incarnate. The husk of

THE SACRIFICE *of the captive warrior impersonating Tezcatlipoca shows the technique with an operating crew of four. Note the broken flutes strewn along the temple stair, discarded there by him according to ritual*

his body was not thrown down the steps, but carried. His head, as usual, was spitted on the skull-block. We can speculate in terms of our own psychology as to the victim's sensations as he ascended the temple steps after his year of heaven; his regrets, his fears, his hopes. Probably he was so completely impregnated with the spirit of a religion that the last day was like the first, an experience on an ultrahuman plane. He lived in the role of Tezcatlipoca and in dying merged with the god himself.

A god of spring and fertility called Xipe (Flayed One), combined a pleasingly poetic symbolism with a peculiarly revolting sacrifice. His cult embraced the idea that every spring the earth assumed a new skin, a lovely image invoking the fresh green that covers the tawny bareness of a Mexican winter. In the ritualistic expression of this function, captives were skinned and their hides, donned by priests impersonating the god, were worn for 20 days, an Aztec month. The preliminaries involved the offering of the victim's heart and blood to the sun, after a death in ceremonial combat. The body was eaten by the family and friends of the priest, according to the widespread custom of ritualistic cannibalism, whereby the virtues of the victim are acquired by consuming his flesh.

Excruciating ceremonies attended the monthly festival in honor of the God of Fire. The victims were brought in by their owners or captors and turned over to the priests, who had prepared in advance a huge, glowing bed of hot coals. With a humanity rare in the accounts of Aztec religion, the priests drugged their victims by sprinkling them with a narcotic made from a plant called *yauhtli*. The victims were hurled into the furnace, but, before death could mercifully relieve them of their agony, they were snatched from the coals and sacrificed upon the block.

Individual women were sacrificed in certain specified monthly ceremonies where they impersonated goddesses. Children likewise were offered in planting ceremonies, where they were considered as the most

HERE A PRIEST *is being vested to represent Xipe, the Flayed God. He is dressed in a human skin, a costume which challenged the skill of the native artist*

precious first fruits. But these occasions were rare. It would seem that an affinity existed between war and sacrifice in the Aztec mind.

Aztec civilization grew up at a time when population expansion entailed the conquest of peoples. The previous periods had seen the growth of population moving out into thinly peopled lands. The dependence of agricultural tribes upon the beneficence of natural forces had brought into being a polytheistic nature worship, but little in the previous history of Indian Mexico had made it necessary to set up war patterns or techniques of conquest. This cult of human sacrifice was an attempt to reconcile a new war technique with an old religious practice. We have seen similar anomalies in Western culture when, to the old established military techniques of Greece and Rome, people tried to adjust the gentleness of the new religion of Christianity.

The high point of the sacrifice cult of the Aztecs came with dedication of the great temple in Mexico reared to the glory of the Rain God, Tlaloc, and to Huitzilopochtli, a war god who had the same functions as a sky god. The confederacy of Tenochtitlan, Texcoco, and Tlacopan campaigned for several years to amass enough captives for the dedication. At least 20,000 men were brought in from successful raids in southern and eastern Mexico, and the whole countryside came to Tenochtitlan for the dedication. The great chiefs Ahuitzotl of Tenochtitlan and Nezualpilli of Texcoco, who were priests as well as governors, led the sacrifice. When they were exhausted, lesser dignitaries succeeded each other according to rank, until the last victim had been slaughtered. The skulls were strung on poles which were set up in the great rack called the "Tzompantli" (Place of Skulls), where one of the Conquistadores in 1519 estimated the number of such grisly trophies at 60,000.

CEREMONIAL CANNIBALISM *has occurred at rare intervals up to now. The practice was more common before the Conquest, but the artist who drew this picture had never taken part in such a feast, as may readily be seen*

The sacrificial cult killed Aztec civilization. Indirectly the conquering of other tribes and city-states, with the constant demand for victims, may have made eastern Mexico ready for revolt when the Spaniards came. Actually, I think, the sacrificial cult was so widely spread that this fact in itself was taken as a matter of course. The desire for independence, the will to receive rather than pay tribute, the lack of a governmental system to cover wide geographic units, made the presence of proven warriors like the Spaniards, an excuse for a general uprising against the people of Tenochtitlan. What really defeated the Aztecs was their own devotion to their religion. They did not fight to the death in the European sense. Rather they tried to take the Spaniards prisoners and even their horses, that they might find favor in their gods' eyes by so marvelous and costly a sacrifice. This conservation of the Spanish forces, added to the superior weapons and technique, led to the obliteration of a people who combined passiveness and political pacificism with an incredible bloodthirstiness. Yet it was not the Aztecs, according to their belief, but their gods, whose thirst could not be slaked. Thus in Aztec religion we have a striking example of how a society adjusted under one set of conditions may change under new ones from Pygmalion's maiden into Frankenstein's monster.

THE SKULL RACK *or Tzompantli was employed to store the heads of the sacrificed victims. Here are heads of Spaniards and their horses taken and offered to the gods during the Spanish Conquest*

MEXICAN ART

From the earliest beginnings Middle American art reflected the religious thoughts of its people, culminating in a cult of flowers and blood, which prepared the way to quick defeat at the hands of the white man

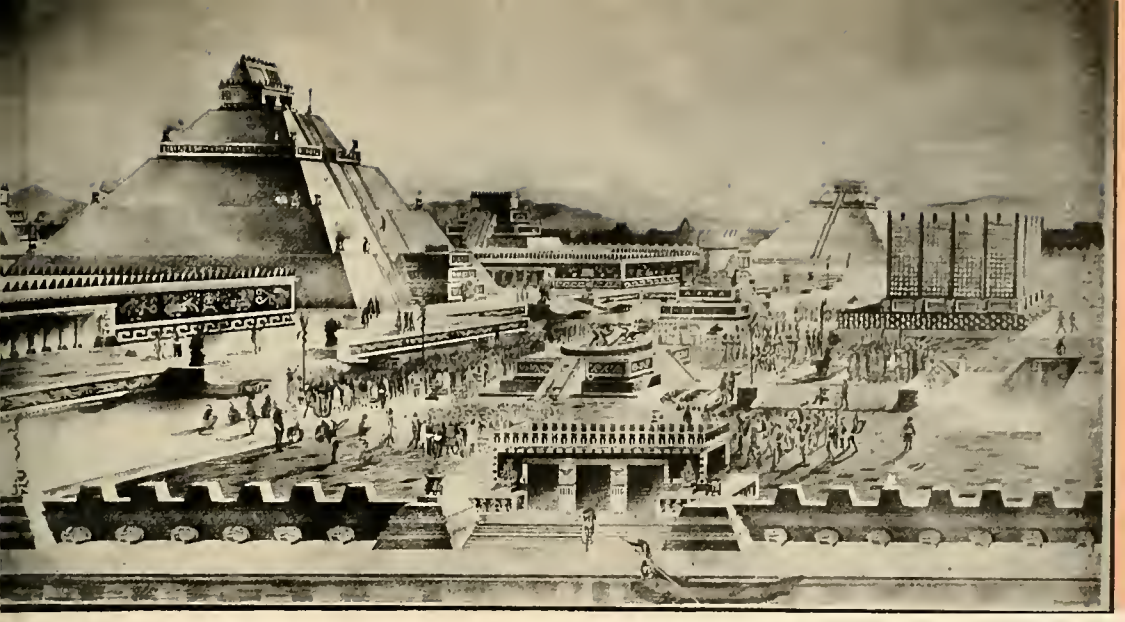
UNTIL SEPTEMBER 30TH, the modern American citizen can make his discovery of ancient America right in mid-town Manhattan. To this end the Museum of Modern Art has devoted all available space to a display of the greatest continuous artistic heritage of this continent—that of Mexico during the 20 centuries of her cultural existence. For the first time the earliest revelations of the archaeologist's spade, the grim sculpture that greeted the covetous eyes of Cortez, and the best Colonial and Modern work are all gathered within four walls. The earlier categories are of particular interest to readers of NATURAL HISTORY Magazine, since they include the cream of the American Museum's pre-Columbian collections as well as the pick of the National Museum in Mexico and the Peabody Museum at Harvard. These are the native masterpieces of long-forgotten artists—magnificent relics of the only 100%-American civilization, whose story, unsurpassed in dramatic power, was left for its conquerors to write.

A gold labret, or lip ornament, from a private collection

From Prescott's Conquest of Mexico, *Chatto and Windus, Publishers*

"Aztec Ambassadors," by Keith Henderson

OUR OWN IDEAL MAN is daily projected on myriad silver screens. Contrast with him the paragons of Aztec elegance shown above and observe how wide is the cultural barrier that hinders our modern discovery of ancient Mexican art. Beneath ornate feather headdresses, straight black hair is worn sometimes long, sometimes like a stiff brush (B). Two front teeth are filed to points and conspicuously inlaid with green jade. "Buttonholes" cut in the lower lip accommodate large labrets (in all three figures), of which an actual example in the form of a golden serpent is shown at lower left. Other gold figures jut from the ear lobes. These are tokens of valorous deeds. So is the stone sliver driven through the nose (A). Feather capes were in vogue (B), and sometimes parts of the body itself were tarred and feathered. But this too was a symbol of high station. At worst, our movie hero submits to a shave and a manicure, whereas the ancient Mexican would suffer much for a beauty that is to us strange and sometimes revolting. For their gods demanded suffering—and death. And whether their art be expressed on living flesh or massive stone, it is the outward show of their religion.



The Plaza in Mexico City: a reconstruction by Ignacio Marquina showing the architectural magnificence of the native Indian capital

BEAUTY dwells in this city, capital of the mighty Aztec Empire. It has grown rich on the tribute of many vassal tribes. Founded on marshland, these edifices are flanked by canoe-dotted canals *(foreground)*. Floating islands, riotous with tropical flowers, sweeten the air. Lush gardens surround the terraced homes of nobles. But high above the plaza towers the majestic temple of gods that live on human sacrifice. It is they, not the priest-king Montezuma, who rule the city; and on appointed days the exposed altars of this temple stream red. Death pervades this city and underscores its beauty—a cult of flowers and blood.

Museum of Modern Art photo by Elisofon; other photos by AMNH

The Tuxtla Statuette: an early jade carving of both historical and artistic significance, shown in this collection for the first time outside the Smithsonian Institution at Washington

SUCH WAS MEXICO in that hushed moment before the Spaniards struck. But behind the barbaric splendor of this city and its people lay 2000 years of civilized history. Great cultures rose, exerted their influences, and fell, scattering their handicrafts and arts as a cultural loam upon the land. The charming, almost Oriental figure shown below survives a nameless people that vanished untold centuries before the early Aztecs fought their way down from the north. Even the artist who made it came late; for before him, crude, prehistoric man himself roamed the intercontinental corridor of Mexico and Central America.

At left is shown one of the oldest dated carvings from Mexico, the so-called Tuxtla Statuette in jade. The well-drawn numerical inscriptions date this piece at probably 162 A. D. or 98 B. C.

Archaic clay figure found under conditions indicating considerable age

CORN was the foundation of the Indian's civilization. Wherever he learned to cultivate it, he personified as gods the forces that made it grow, and his religio-artistic skills expanded with his crops. By 500 A. D. city-states began to dot the Mexican Valley, while to the south a magnificent empire flowered into the greatest native art culture ever to grace our New World—the early Maya. This people made cotton clothing, created a fine architecture and sculpture, and sent trade argosies northward along the coast. Their livelihood from crops and navigation required astronomer-priests, who communed with gods of weather and seasonal change, and developed calendars and writing. They propitiated their gods in elaborate rituals but with little of the bloodiness that obsessed more warlike tribes constantly trekking into Mexico from the north.

(Left and below) Clay figures from the state of Vera Cruz, dated tentatively between the tenth and fifteenth centuries, although all record is lost of the artists who created them (Specimens from the American Museum of Natural History, photographed by Ward Montague)

(Below) Maya terra cotta figurine from Campeche (From the Peabody Museum, Harvard University)

Museum of Modern Art photo by Sunami

AMNH photo

Figure from Mazapan culture, clad in flayed human skin

TRADING BY SEA AND LAND, the early Maya and Mexican cultures cross-fertilized each other. In this process the Zapotecs were one of the main intermediaries. They adopted some Maya art forms but cast them into the rigid shapes of a heavy and often macabre religion. The figure below is an incense burner in the form of a god. The blank face is conceived as covered with the skin of a victim, whose head is held in the god's hand. The standing warrior at left is also clad in a flayed human skin, the stipple effect being a conventional rendition of wrinkled, dead skin. His tribe, the Mazapan, helped displace the Toltecs in the eleventh and twelfth centuries, and were cultural forerunners of the Aztecs.

Museum of Modern Art photo by Sunami

Gray earthenware incense burner of Zapotec civilization (From the collection of the National Museum, Mexico City)

A warrior holding a club: a Tarascan figure from the collection of the National Museum, Mexico City

YET NOT ALL ancient Mexican art celebrated the grisly compulsions of violent gods. The Tarascans, a little-known people, have left behind these delightful caricatures *(above and below)* clearly expressing the human side of their daily life.

Tarascan hunchback with heavy cane (From the National Museum, Mexico City)

Museum of Modern Art photos; right above, by Sunami

(Above) Toltec marble mask from Teotihuacan (From the collection of the National Museum, Mexico City)

(Below) Part of a Totonac yoke

AMNH photo

GAIETY is also found in some Totonac carvings, like the reclining figure below, which may be secular rather than religious in tone. But by 1000 A. D. the main current of Mexican art still flowed in religious grooves. The earlier cultures represented a fusion of increasing technical facility with a growing domination of religious over secular ideas. Out of this mingling may have come the legendary Toltec Empire (725-1070 A. D.), whose impact was felt throughout the Mexican Valley. The stone yoke at right weighed heavy on many a sacrificial victim, whose life was dedicated to hungry gods so that corn might grow and the tribe prosper. The detail *(left below)* from another yoke shows a consummate mastery of design embodied in this interlocking pattern.

(Above) A Totonac stone yoke representing an owl (From the collection of the National Museum, Mexico City)

A highly decorative Totonac whistle (From the American Museum of Natural History)

Museum of Modern Art photos; below, by Sunami

AMNH photo

A sculptured Maya lintel found in Chiapas

TO THE LATER MAYA, the snake was identified with all that was worthwhile in his culture. His people now (1000-1200 A. D.) lived principally in Yucatan, whither they had migrated after their Guatemalan empire collapsed from causes unknown. Maya legends claimed that the Chanes, a mythical, fair-skinned "serpent people," had taught them agriculture and the arts. Perhaps this myth was crystallized in their culture god, Kukulcan, although he was not theirs exclusively. The Toltecs adopted him as Quetzalcoatl. As such he was inherited by the Aztecs.

The later Maya had lost the gentleness that characterized his earlier southern homeland. Grim religious rites practiced by invading northern neighbors changed his view of life until he, too, clad himself in barbaric splendor. At left, a priest holds a torch above the head of a kneeling suppliant. His penance is to thrust thorns through his tongue. The thorns are arranged rosary-fashion on a rope. Spanish priests marveled that these people practiced baptism and confession of sins. Also conspicuous are the puzzling, squarish hieroglyphics, whose profusion in stone carvings annoys our modern eye. Yet, for the Indian, they recounted great events.

Museum of Modern Art photo by Sunami

Head of an Eagle Warrior (From the collection of the National Museum, Mexico City)

PICTOGRAPHIC legend records that when the Aztecs entered the Valley of Mexico (1250-1519) they were, like their predecessors and contemporary migrants, a crude hunting people. Fur-clad and armed with bows and arrows, they shot down the softer, corn-growing defenders, who had only clubs. Warrior-priests predicted that future greatness awaited them at a place where an eagle would be found with a serpent in its bill. This came to pass. Two centuries later, most of Mexico was in their grasp. Ingrained in the Aztecs was an unprecedented severity of spirit that typified their peculiar religion and its artistic expression. Note the forbidding countenance of the "Eagle Warrior" at right.

WHEN a nomad tribe becomes an agricultural empire, it must add weather gods to its pantheon. Some of these were grim before the Aztecs adopted them, but they became grimmer. The figure at right is the mother of all Aztec deities, the Goddess of Earth and Death, with the accent on the latter. Her skirt writhes with the sacred symbol of the snake. Bright inlays of jade and obsidian in nose, eyes, and mouth made her even more terrible to a people whose fascination with death is perhaps the most disturbing record in the annals of early religious sentiment.

Goddess Coatlicue of Earth and Death (From the collection of the National Museum, Mexico City)

Museum of Modern Art photos; right and bottom by Sunami

(Below) Aztec sculptured box, lent by the Mexican Government

SURROUNDED and preceded by highly religious cultures, the Aztecs surpassed them all in ceremonial intensity. Gradually their whole life became a ceremony. The ignorant archers who slew to capture rich cornfields gave way to warriors whose sole motive was the capture of victims, alive and unscathed, that they might better please the gods of war and rain. These captives later died under the priestly knife, and their steaming hearts were enclosed in the offertory box at left.

(Below) Feathered serpent; pre-Spanish (From the National Museum, Mexico City)

THIS INCREDIBLE religious specialization proved fatal. The Aztec ruler became a priest-king. He thought of his gods first, the Empire second. Revolt was actually invited as an excuse to raid for victims, and the hatred of his subjects grew intense. When Cortez came, they often took his side. The witchcraft of ancient Mexico was powerless to stop the white conquerer, and with the odds sometimes a thousand to one against him, he prevailed. For the gods had trained Mexico's armies to capture victims alive, not to defend their territory. It was false strategy and the Indian civilization died.

But its art remains immortal. The individual styles have frequently offered scholars the only means of dating the cultures that produced them, and there is every indication that continued excavation will greatly enrich our already large treasure house of native American art. Nor did the Spanish Conquest completely obliterate its influence. The creations of the Colonial and Modern periods which followed belong neither to Europe nor to the Indian. They are, like the character of the Mexican people, a unique and colorful blend.

THE HOME LIFE OF THE BIG WOLVES

By VERNON BAILEY

Formerly Chief Field Naturalist, United States Biological Survey

How a wolf deliberately risked his life so that his family might remain hidden and safe—an instance of the devotion, bravery and intelligence of the big wolves

My skis slid silently over the frosted crust of old snow still lying two feet deep over the upper Green River basin in early March of 1906. I was headed for the nearest badlands east of Big Piney, Wyoming. The temperature was near zero as I left the little log hotel half an hour before daylight, munching nut meats and candied ginger to keep me going for a three-hour run before breakfast.

Big wolves had been reported killing cattle in the Green River country, and the Forest Service, then new and generally opposed by local stockmen, was accused of breeding wolves on the national forests to eat up the cattle outside. The attitude of the ranchmen was understandable, for slaughter of their stock could mean economic disaster to them. Wolves are meat-eaters and so is man; and there was not enough meat to go around. It was inevitable that the wolves should be hunted down. They were entering their twilight in a country being converted from wilderness to pastureland. When an effort was made to check burning off the timber to make grassland, and a policy was suggested of charging a small fee for grazing cattle on the newly designated forests, friendship became very strained between cattlemen and a "tyranical bureaucracy"; even the local papers clamored for removal of the latter.

Buttes and badlands

The Forest Service had appealed to the Biological Survey for information and investigation, and that was why I was out on skis in the wolf country. I had been there before and knew where to look: I headed straight for the low line of buttes and badlands east of the creek valley in time to be in good wolf country by daybreak.

A dim winter light was breaking as I came in sight of the first round-topped butte. I was headed into the side gulch when, to my amazement, a gruff bark followed by a long, deep-throated howl came from close by. There on top of the butte in plain sight stood a big wolf watching me. I did not stop for fear of scaring him but, swinging spirally around the butte, drew nearer and nearer until close to the base. He gave another long howl and disappeared over the top. When I came close to the top so I could just peep over, I saw him standing facing me on the next summit only 150 yards distant. We watched each other for some time. I covered him with the sights of my .30-30 carbine, just to see how easily I could collect him for a specimen, but that was not what I was after. I wanted to learn something about wolves.

A strange game

After a few minutes he trotted down the other slope and reappeared on a ridge a quarter of a mile away and howled again. I followed. When I arrived he was out in the valley beyond, sitting down waiting for me. I howled and he answered, then trotted on out of sight over the next ridge. I was puzzled. For nine years I had been in wolf country every summer and had found these big fellows as shy and unap-

proachable as grizzly bears. But here was one coaxing me to follow him, deliberately risking his life to attract my attention. What could it mean?

I gave up following him and swung back on a wide circle through cattle pastures to watch for tracks. Moreover I wanted to get back in time for breakfast. Soon I struck a wolf track going to my right, then another close to it, and a little later two tracks going the other way. Farther on were others in pairs or single, all going toward or from a deep gulch off to my right. In summer, fall, and early winter, wolves hunt in packs or family groups of generally ten or a dozen, led by the old male, the father of the family. But here were tracks in pairs or single. During midwinter, the mating season, a pair will desert the pack and keep close together until the young are born in early March. For the rest of the year they give their whole attention to the new family. It began to dawn on me that there must be a wolf den here, for the tracks radiating from the gulch located it as accurately as beelines to a bee tree. This big fellow was just leading me away from it. Never before had I found a wolf den and here was a chance to learn something of wolf habits and wolf nature.

The rest of the day I skied over the valley and among the cattle browsing in the willow thickets to see how extensively they had suffered from wolves. A few had been killed and many had died of cold and starvation during the winter, but no fresh kills were found. All dead animals were frozen hard and would be good cold-storage beef for a month or more. Just now there seemed to be a truce of plenty while the pups were in the dens.

Next morning I was out at daylight again and found my old sentinel wolf on top of the same butte. In fact his beds showed that he had slept there part of each day and night for some time. As soon as I came in sight, he stood up, gave a few hoarse barks, then his long, deep howl as before, and waited till he was sure I was coming. He greeted me from the top of the next ridge and on as long as I wanted to follow. Knowing his game, I enjoyed it and we called back and forth with mutual interest.

For six mornings this old fellow led me over the

(Below) ON THE TRAIL. *Big wolves such as these once frequented our West and Northwest. Attacking sheep, calves, and colts, they were a constant source of worry to ranchmen, and it was inevitable that such meat-eaters should be hunted down. But even ranchmen will give credit to their unusual intelligence among animals*

(A group of timber wolves in The American Museum of Natural History; *AMNH photo)*

same route away from the den where mother wolf and her puppies were well hidden, voluntarily risking his life every morning for their safety. More and more I grew to admire his courage and devotion as well as his wisdom. He was just about my size, about 135 pounds, but he knew from generations of experience that he was no match for man-made guns and traps and that the only safety of his family lay in well-planned strategy. It is just what Kipling puts in the laws of the jungle—"And seven times never kill man." The ranchmen in the valley might have had less tolerance if they had known that I was playing with their archenemy, but they were restricted to the few open roads and the wolves and I had the whole valley to ourselves.

On the seventh morning I went around and came into the den gulch from the other side. Far across I saw just a glimpse of my old wolf on his watch tower, but he said not a word and quickly disappeared. Then I saw mother wolf slip out of a low cave in the steep bank across the gulch and vanish around the point and up the next gulch. Neither came in sight again. In a few minutes, however, they were both calling from behind me, trying to lead me back and away from the den. But I had much to find out.

Nine puppies

Heading rapidly to the little cave where all the tracks centered, I found an opening large enough to crawl into. Back some fifteen feet I found nine little black wolf puppies with blue eyes just opening, all cuddled in a nice warm bed of clean sand where mother wolf had left them. They were probably eight or nine days old as their eyes were not wide open, and they were almost coal-black except their brown heads. They were not afraid and were evidently obeying their mother in keeping still and cuddling close together in the warm nest hollow.

Outside on the clean snow were a dozen dead jack rabbits, the big white hares of the north country. Some were partly and some wholly eaten, and one freshly killed and untouched. Apparently a six or seven-pound rabbit was just a meal for mother wolf, and the hunter of the family had kept the larder well stocked while she was busy caring for her babies. Since there was no other visible food supply, father wolf had most likely eaten his rabbits where they were caught, or had dined on frozen beef. I could not find any freshly killed cattle for miles around, but he may have gone far beyond my range when he wanted a warm meal. In the next valley a pack of nine bachelor wolves was reported killing calves or colts every night.

Just beyond the entrance of the den a big, plump cottontail jumped out of the sagebrush, and I saw him there several times later. He could easily have been picked up by either of the old wolves, but perhaps they were saving him close by for the puppies' first hunting lesson.

The old wolves did not return while I was there, but I knew they were just hoping that I would not find their home. It hurt me to break it up, but I had to take some of the young for further study and to prove that wolves were breeding in the valley right among the ranches and not in the high mountain forests. I left one little wolf for the mother, and before morning he was carried away to some distant den where he would be safe. I never saw him or either of the old wolves again.

Two of the young I gave to the ranch boy and his mother for taking care of the others until I was ready to ship them to Washington, where they lived long and safely in the National Zoological Park. When I returned from Wyoming six months later, I found the two puppies nearly full grown. Although they were playful and friendly and climbed all over me, I could not make myself believe that they remembered or were glad to see me. It was well that they did not know how I had broken up their devoted family and sent their parents away with only one young.

Sterling virtues

Their behavior is one of many examples of the affection of a pair of wolves for each other and for their young. At one ranch I was told in touching reality of a female wolf shot in winter near the cattle pasture and how the lonesome calling of the male could be heard from the hilltops night after night for weeks. There are many such records.

Few animals are more devoted in their home life, braver, or more intelligent. Yes, they were cruel killers, but not half as cruel as we have been. The more we see of some wolves the less we think of some men. The big wolves are practically gone from the whole United States, though the coyotes are still with us. Occasionally a few wolves stray across the borders from Mexico or southern British Columbia but they do not last long among the ranchers, who are always on the watch for them. But even ranchmen will give them credit for their unusual intelligence among animals. Let us give them their just dues for the sterling virtues of affection and devotion. They are an enemy we can well admire.

CHAPIN OF THE CONGO

The colorful career of an ornithologist who spent years in malarial jungles, explored cannibal territory, and ran a German submarine blockade in order to enlarge our knowledge of a once dark continent

By D. R. Barton

In the 45 years since its initial publication, Frank M. Chapman's *Handbook of the Birds of Eastern North America* has, with varying force, affected the minds of several million human beings of all ages and degrees. Some it has touched only lightly; but others have found within its pages an apostolic appeal which has led them to a devoted and lifelong study of Nature. We know that Roy Chapman Andrews* channeled his aggressive energies into museum work largely because of this book and that he became "suffocated with emotion" at first sight of its author. He is perhaps the most famous and probably the most demonstrative convert. Yet we do not know how many "mute inglorious" Andrewses, similarly inspired, may lie beneath the sod of country churchyards.

About the same year that Andrews, the adolescent taxidermist, first applied Chapman's avian gospel to his observations in the Wisconsin woods, the book came into the hands of another budding naturalist who made his home on prosaic Staten Island. Within a decade, these youths were to meet at the Museum, then wander afield, one aboard an Alaskan whaler, the other to the heart of the Belgian Congo.

But in 1903, this future was beyond the imaginative ken of either Roy Andrews or James Paul Chapin. The latter had grown up in the middle of New York harbor at a time when Staten Island had not yet been tunneled with water mains and converted into a gridiron of suburban streets. Farms, marshes, and natural woodlands lay on every side, and altogether it made nearly as good a breeding ground for bird men as Chapman's own Englewood of the '80's.

Feathers

Young Jim Chapin's interest in ornithology was first stimulated by the curious combination of chickens and Indians. Like other urchins, he played at being a redskin and chased indignant hens through the barnyard to snatch out tail feathers for his Sioux headdress. Most boys would have let it go at that. But young Jim paused to inspect the feathers for their own sake.

Blackstone Studios

James P. Chapin

Soon he was examining undomesticated plumage. Whenever he felled a sparrow with his slingshot, it was not simply another ill-starred aborigine biting the dust; curiosity led him to make crude, amateurish attempts at stuffing his prey, and he even carried out experiments in taxidermy on deceased mice which he found in the household traps. Then Dan Beard's *The American Boy's Hand Book* yielded a recipe for stuffing an owl. As applied to sparrows this technique was not a howling success, but at least the results were a distinct improvement over the earnest mangling of a yellow-billed cuckoo "mounted" some months before.

Under the aegis of more comprehensive guides, Jim had become a relatively proficient taxidermist by the time his high school principal lent him two books by that rising authority Frank M. Chapman. New horizons opened before him and on that day, "Chippy," as his boyhood friends called him, was pledged to ornithology for life. With Frank Chapman's text in one hand and Mother Chapin's two-power opera glasses in the other, Chippy made an almost daily pilgrimage into the outlying districts in hopes of identifying all the birds native to the island. Presently he fell in with other nature-minded residents, particularly Mr. William T. Davis, author of *Days Afield on Staten Island,* who conducted young Chapin and other aspirant naturalists on cross-country collecting rambles. Davis specialized in botany and entomology, Chapin kept to his predilection for birds, while their companions favored small mammals and anthropological materials. Thus Jim learned a little of everything, unaware that his growing versatility would be tested in the steaming forests of equatorial Africa.

Likewise unforewarned of his destiny, Mrs. Chapin had encouraged her son in the study of birds and took pride in his keenness, although she worried a little lest so impecunious a calling might keep him a financial burden on the family. But he was different. She had taken hikes with her other children and not one of them had ever displayed more than a languid and very fleeting interest in the sights and sounds of the out-of-doors. To them, Brother James was queer, and they professed a certain revulsion for him because he actually enjoyed handling snakes.

This distaste for Nature on the part of his siblings may have prejudiced Chapin's later thinking. Unlike Doctor Chapman, who was an only child, he does not believe that ornithology lurks in the blood. Chapman's* contention is that a strain bearing the essential ingredient of an ornithologist has passed through his ancestry since primitive times. He believes that this is true of all genuine bird lovers and that whosoever makes of ornithology his life work has been fated to do so by an innate drive that cannot be turned successfully to other purposes. Chapin will not go so far. What is inherited, in his opinion, is a characteristic temperament, a certain "irritability"

* See "Gambler on the Gobi," by D. R. Barton, Natural History, February, 1940, p. 118.

* See "Apostle of the Birds," by D. R. Barton, Natural History, January, 1940, p. 48.

toward the surrounding world that makes for the disciplined curiosity of the scientist or the free imagination of the artist. Even so, chance and environmental factors may "pervert" this quality into a number of fields beyond the scope of the arts or the sciences.

Chapin points out how seldom the children of a naturalist follow the parental footsteps and that the son of an ornithologist is just as apt as any other boy to prefer the fascination of dismembering a model T Ford.

This thoroughly reasonable opinion stems from a factual cast of mind. Both Chapman and his illustrious convert, Andrews, have a tendency to feel first and analyze afterwards. They were never outstanding students in their school days. And although Chapin makes light of his achievements in classroom and laboratory, the records show an unusual scholarly competence. He graduated from high school at the age of sixteen and, considering himself too young to go to college, he undertook a year's work in the American Museum's Preparation Department before matriculating at Columbia. Once there, he attracted attention by his disarmingly easy-going thoroughness as a researcher and particularly by his remarkably clear and aesthetically gifted laboratory drawings.

He had been drawing bird pictures and other sketches since childhood and at the Museum he developed a water-color technique which later served him well in making field sketches for proposed Museum habitat groups of African fauna.

Young Chapin continued his association with the Museum during the first two and a half years of college. His opportunity for adventure occurred in the course of his apprenticeship to an experienced Museum taxidermist of the 1900's, the capable and energetic Herbert Lang.

Shortly after Chapin commenced his sophomore year, King Leopold II of Belgium presented the Museum with an ethnological collection drawn from his territory in the Congo Free State. Favorable relations having thus been established with the Belgian Government, the trustees decided to dispatch a Museum expedition for the purpose of collecting animals of all sizes, from insects to elephants, accessories for a few groups, and such anthropological material as seemed desirable from this wilderness, which at that time had been penetrated by few scientific expeditions. Lang, largely because of his recent experiences in Africa, was chosen to take charge. But Lang did not wish to go alone. Chapin was approached. The Columbia junior, then only nineteen, hesitated, listened to the horrified exclamations of those who called the newly established colony of the Belgian Congo a "sink hole of the universe," and finally decided to postpone his college course and sign up for one to three years in darkest Africa.

But no one at the Museum knew exactly what the Congo was like in those days. The difficulties of collecting, preserving, and transporting were far greater than at present, with the result that the Columbia junior spent the equivalent of his undergraduate semesters plus four post-graduate years in the midst of a malaria-infested jungle. He was second in command, "But," he explains, "there was no third."

A willing hand, Chapin played the role of secretary, remembrancer, and general Man Friday to Lang. The natives referred to him as "Mtoto na Langi" (Lang's son) and, indeed, the fondness of each for the other could have been no greater if he were. Meanwhile, Chapin fulfilled his regular duties as an ornithologist, botanist, mammalogist, ethnologist, carpenter, and tinsmith on the longest single expedition ever dispatched by the American Museum.

They covered much of the route that Stanley had traversed 20 years before, and even met one chief who remembered the great explorer. After the long trip up the Congo River had been completed, they marched a safari of 200 natives from Stanleyville, through the Rain Forest to establish a base camp far up the Ituri River. From this spot they deployed to carry out their immense assignment of preserving, for all time, specimens of the zoology of equatorial Africa.

For Chapin this was a strange new world. Insects crawled on the flesh and not only attacked collections but even the boxes in which they were packed. The atmosphere was filled with the reek of decaying vegetation and one commentator has compared it to Miocene times, an age that would have been hardly endurable by man. Yet Chapin found it no worse at any time than a summer heat wave in New York.

"Even after about eight years in Africa," he writes, "I find that 80° F. is the point where I begin to feel discomfort from heat. Yet during the evenings in the Ituri Forest I was usually quite comfortable, and only seldom does the temperature in the shade exceed 95° in the upper Congo.

"My nose is not delicate enough to be annoyed by the smell of decaying forest vegetation. But the insects I did not relish. Mosquitoes in the Congo are seldom very troublesome by day, but in some places very abundant by night. In the lowlands one always sleeps under a mosquito net, and to avoid malarial fever I have had to take eight grains of quinine every night after dinner.

"So by day, although there may be midges, black flies (locally only), golden-eyed flies, tsetse flies (local but dangerous), stable flies, and a few other kinds of blood-sucking Diptera, the menace is not so great as might be expected. Ticks are nowhere so abundant as in Central America, and of land leeches there are none. The jigger flea, on the other hand, is everywhere in lowland villages, and to avoid it one must never walk barefoot, even in a cement-floored house. In the forest, numbers of tiny, black, stingless bees often alight on hands and face to lick perspiration. They are a bother, but cause no pain.

"My first attack of malarial fever came just three months after I entered the Congo—and it was my worst. But I believe I was carrying malaria germs for the next five years, because we took eight to ten grains of quinine only every other day. If I forgot the quinine for four days I was apt to come down with fever."

It was in the Congo that Chapin formed his habit of drinking six or more cups of strong coffee a day. Originally he took the stimulant to buoy himself up after one of these malarial attacks but presently he found that he did better work "under the influence," and today he likes to brew what he calls "the luscious brown infusion" made on a little filter brought from his favorite café in Belgium. Once, while applying insecticide to bird skins, Chapin was reported to have been seen sprinkling arsenic, now on a specimen, now into his coffee, which he continued to drink without ill effect. If you ask him about this incident, he is apt to philosophize on the vast number of ailments for which certain arsenical compounds are indicated.

Cannibals

Apart from the zoological mission, Lang and Chapin were to secure numerous items of native handicraft—a

quest which took them to the kingdom of the long-headed Mangbetus. Up until the preceding generation, this tribe had been noted as cannibals. And neighboring natives, in whose territory the expedition roamed for months, had almost certainly devoured an American named Thornton seven years before.

As Chapin and Lang drew near the Mangbetu borders, messengers greeted them at what seemed every ten paces on the road. These tall blacks would rush up breathlessly and announce to a perfectly agreeable Chapin that there was no king so great as Okondo. Presently, Okondo himself appeared and, surrounded by a large throng, greeted them with appropriate ceremony. In their honor, he wore a European uniform, doubtless the gift of some white officer of the Belgian army. But they preferred his barbaric majesty holding levée in the full splendor of his native robes. Chapin was especially interested in the headress, which was topped off with a remarkable bunch of dark eagle and red parrot feathers.

Readers familiar with Mr. Birnbaum's article in NATURAL HISTORY on this region,* will recall the amazingly long Mangbetu dance halls. Within such as these, Chapin and Lang gazed in wonder at the contortive dancing of great hosts of blacks, including 80 of Okondo's reputed 165 wives, assembled in their honor. In true medieval fashion, mimic battles were staged. Afterwards an elaborate ceremony of gift exchanges took place at which Lang secured, for a price, many of the truly outstanding carved ivories now ensconced in this Museum. Indeed, so many of the beautifully wrought tusks went into expedition packing cases that Okondo ruefully observed that he would have to set his artists to work again immediately.

The "bag"

The Belgian Congo has a great central area of heavy forest, limited on three sides by grasslands, which lies right across the Equator. Within this rather isolated region lived an abundance of strange birds and beasts, few of which had been adequately studied by the scientists of that day, and some of which were little more than legendary. In order to collect as many as possible, the two young men worked all day long in the damp heat. Not infrequently they kept on all night developing photographs or safeguarding their specimens from the ravages of the climate. Two months after they had reached their base of operations they had captured, "salted down," and packed a list of 291 mammals, 472 birds, and more than 2000 smaller specimens. Nor did they slow down thereafter. The size of their total collection was in reality more than two white men with unskilled native help could handle and it entailed complex problems of organization and transport as well as preservation.

Most eagerly sought of the larger mammals was the rare and mysterious okapi. Although this animal is comparatively well known today, the first clues to its existence had come into scientific hands less than a decade before Chapin embarked for Africa. One or two expeditions had previously set out into the Congo without catching so much as a glimpse of this inordinately shy member of the giraffe family which keeps to the deepest recesses of the jungle and feeds mainly by night. Nevertheless, Lang was determined to secure specimens for the Museum and the expedition stalked this prey for nearly six months. In the end, their perseverance was rewarded. Complete skins and skeletons of the rare creature were taken, in addition to the necessary photographs, botanical specimens, and other accessories for its habitat group.

But Chapin's special interest was reserved for the winged creatures. To his surprise, he found it somewhat more difficult to approach African birds than those of America. He is not quite sure why. Perhaps the latter have become more accustomed to the presence of man. On the other hand, life for the African bird is, if anything, less secure. They are so hedged about with predatory enemies that their fears are sharpened and they have to be constantly on the alert.

Balancing oneself upright in the bow of a small canoe to collect water birds was "a ticklish business," but from boyhood Chapin had been a good shot, capable of bagging a swift-flying bird on the wing. Native helpers were trained to give valuable assistance, particularly in the trapping of specimens, even though they had acquired the disheartening habit of pulling out the choicest feathers to decorate their hats. However, this apparent detriment to the best interests of ornithology yielded valuable dividends. For it was a feather taken from one of these hats during this first Congo expedition that put Doctor Chapin on the track of that

Continued on page 129

* See "The Long-Headed Mangbetus," by Martin Birnbaum, NATURAL HISTORY, February, 1939, p. 79.

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 132

1. What famous Central American bird has been worshipped as a deity, has given its name to a unit of currency, and is represented on a postage stamp?

2. Are the Mayas to be regarded as a vanished race, which disappeared without descendants?
   Yes..... No.....

3. A mammoth is
   (a) The same as a mastodon
   (b) The ancestor of the elephant
   (c) A purely mythological animal

4. What is a labret?

5. The preserved flesh of what prehistoric animal was tasted by a living animal?

6. The Aztecs took prisoners primarily to
   (a) Weaken the enemy
   (b) Provide victims for human sacrifices
   (c) Gain cheap labor

7. How do we know positively that primitive man was acquainted with mammoths before the dawn of recorded history?

8. Ritualistic cannibalism is practiced in the belief that
   (a) If human flesh is eaten knowingly it will counteract the evil of eating it by accident
   (b) The virtues of the victim are acquired by eating his flesh
   (c) Death from too much cannibal food will bring special happiness in the future life

9. Which civilization came first, the Aztecs or the Mayas?

10. What is the difference in purpose between Egyptian and Central American pyramids?

YOUR NEW BOOKS

THE LOST HISTORY OF MAN • ADVENTURES OF A BIOLOGIST
O. C. MARSH • ASTRONOMY • THE WANDERING LAKE
ARCHAEOLOGY AND SOCIETY • HAWAIIAN MYTHOLOGY

THE ATLANTIC MIGRATION

- - - - - - by Marcus Lee Hansen

Harvard University Press, $3.50

WE have come to think of immigration as a characteristically American phenomenon, and yet it would be difficult to find any nation or people that has remained unaffected by it somewhere or sometime in their past. It is the scale and the tempo of our particular immigration history which is distinctive. Never in the history of mankind has a mass movement assumed such magnificent proportions or overcome such formidable barriers as the one which arose in Europe and peopled this country, in the course of 300 years, with millions of settlers. The colossal shift of population which this movement brought about deserves close study and sympathetic understanding in all its phases. Only certain ones, however, have received anything like adequate research. The early settlements, naturally enough, have always attracted serious consideration along with much romantic attention. The migrations of various national groups have also frequently served objective history as well as purposes of pride and glorification. And in most migration accounts, the emphasis has mainly rested on the point of view of the United States as the receiving end of the movement.

In this posthumous work, Professor Hansen has explored a neglected section of our immigration history—the first half of the last century. He has viewed the movement not only as an immigration but as a part of a much larger emigration of which we received only a part. And he has integrated the movement with economic as well as social and political conditions, thus providing a sound motivation for the process.

The settlements of the seventeenth and eighteenth centuries, usually of paramount interest, here serve only to set the stage and clarify traditional patterns. The nineteenth century, from 1815 to 1914, was the period of the great migration. During this epoch 35 million newcomers landed on these shores in three principal waves of which the first constitutes the main subject of discussion. From 1830 to 1860 the migration was predominantly "Celtic," coming mainly from Ireland, Wales, Scotland and the former Celtic regions of Germany. Agricultural readjustments, famines and social unrest arising from economic causes combined with the loosening of ancient feudal bonds and restrictions, started thousands of families on their great adventure. For the most part the settlers were carried along helplessly in streams of traffic over which they had no control. Their eventual distribution in the New World was governed by lines established through commerce in cotton, tobacco and other commodities. Wars in Europe and economic depression in the United States finally slowed down this first wave. The story as unfolded by Professor Hansen is not only an extremely important phase in our history; it is also admirably told.

H. L. SHAPIRO.

THE DISCOVERY OF MAN

- - - - - - - - by Stanley Casson

Harper, $3.00

THIS is a book we can recommend to every reader of NATURAL HISTORY interested in what we know about the lost history of man and the methods by which his lost history was recovered. We are shown how, step by step, logic has penetrated the past by a hard common-sense appraisal of the traces of man to be found in and upon the surface of the earth; how the illusive shadows of mythology were displaced by reality, beginning with the transition from the belief that a stone ax fell from heaven in a thunderbolt, to a recognition of the successive stone and metal ages of pre-history, in what may be considered as great a scientific achievement as the geological conception of the world. Following through the successive chapters of the book we meet with many familiar names of scholars each of whom contributed his bit to the accumulation of the history of man; thus, the Egyptians who faithfully depicted the faces and mannerisms of the Old World races; the Greeks, Anaximander, Herodotus, Aristotle; the Romans, Pliny and Tacitus; later scholars like da Vinci, Vesalius, Ashmole, Stukeley, Linnaeus, Boucher de Perthes, Darwin, Pitt-Rivers, Tylor, Schliemann, Evans and Petrie.

It is an inspiring sketch, a clear brief demonstration of the power of the intellect to interpret the past and to make the career of man real. The reader closes the book with an easily remembered framework in which the fascinating, buried cities of the ancient world, the pyramids of Egypt, the ruins of temples in Middle America and Peru take their true places along with the cave dwellers of western Europe and the cliff dwellers of Arizona. The first scientific explanation of stone implements found deep in the ground was offered in 1797 by an English antiquarian, Frere. In 1832 an English Catholic priest discovered stone implements and the bones of an extinct rhinoceros in the same cave deposit. The authorities of the time said such statements were impossible, but the retort of the finders was, "We had not said they were possible, only that they were true." This is given as a sample of what is in store for the reader of this engaging chapter in the history of learning.

CLARK WISSLER.

The New Noah's Ark

by

ANDRE DEMAISON

Entertainment for young and old will be found in this charming, amusing, instructive account of the experience of a young man who skippered his own schooner along the Ivory Coast of Africa, collecting rare beasts of all sorts.

The intimacy and color of his style are well preserved in the translation by Eric Sutton.

all bookstores $2.50

THE MACMILLAN COMPANY
60 Fifth Avenue New York

THE RATTLESNAKES, GENERA SISTRURUS AND CROTALUS

A study in Zoogeography and Evolution

- - - - - - - by Howard K. Gloyd

The Chicago Academy of Sciences, $2.50

NO New World serpent has attracted more interest in myth, fable, or scientific circles than the rattlesnake. Possibly no snake, excepting the cobra, is more universally known. Few people realize, however, that there are many kinds of rattlesnake. This monograph describes and depicts no less than 45 species and subspecies. Of this number 43 are North American and two are South American, one being found only on Aruba Island. Only incidental attention is given to habits, but the work includes an excellent key and maps indicating the distribution of each form. Discussions of the evolution of pattern and scalation of rattlesnakes are of fundamental interest.

C. M. BOGERT.

Modern Camping Guide

- - - - - - by George W. Martin

D. Appleton-Century, $2.50

An ever growing multitude of American campers, numbering more than four million in 1939, spend one or more weeks in woodland and seashore areas each year. Mr. George W. Martin's *Modern Camping Guide* will find its way into the hands of many of these campers, young and old. Numerous organizations, including the Young Men's and Young Women's Christian Associations, Boy and Girl Scouts, Campfire Girls, innumerable hiking and outing clubs, and public and private camps have been steadily building up generations of citizens who have learned that camping offers one of the best possible ways of enjoying a vacation. Educational institutions, intent on keeping pace with modern trends, have followed the people out-of-doors to assist, instruct and guide, especially in connection with natural history and related, essential conservation education. This widespread woodland activity has to be seen before its growing significance may be appreciated. The great and relatively new field of organized, group and individual, camping has accomplished more for the mental and physical health of our people than almost any other single movement in the United States.

The *Modern Camping Guide* is exactly what its title implies. It is a sound, well-written volume containing expert advice on a variety of subjects including information on automobile camping, camping afoot and canoe camping. Sensible and carefully illustrated advice will assist the novice and the "old timer" alike concerning up-to-date knowledge of tents, shelters, packs, bedding and sleeping equipment, camp stoves, open fires, provisions, cooking utensils and other vital details, the absence or inclusion of which may spell success or failure of any camping expedition. This well-balanced book has had many notable predecessors including those of Beard, Kephart, Seton and Wallace. However, this is 1940 and Mr. Martin is fully aware of the fact. He has steered his way very carefully between the old and the new and the result is decidedly worth while.

William H. Carr.

Rocky Mountain Trees

- - - - - - - by Richard J. Preston

Iowa State College Press, $2.00

The amateur, as well as the botanist and forester will find this new manual a most satisfactory guide to the trees of the Rocky Mountain region. Full page plates, maps of distribution, and detailed information on the botanical and silvical characters of the 129 more common trees supplement the excellent keys to all of the trees of this region. An introduction containing a brief discussion of the ecology and botanical characters of the trees, a check list by states, a glossary, a bibliography, and an index all contribute toward making the new manual well-rounded and easy to use.

J. W. Thomson, Jr.

-FROM TAXI-DRIVER TO CHAUFFEUR OF AN ARCTIC DOG-SLED!

He deserted his taxi-cab—gave up City Lights for Northern Lights!

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by Osa Johnson (Mrs. Martin Johnson)

(J. B. LIPPINCOTT COMPANY Washington Square, Philadelphia)

HAWAIIAN MYTHOLOGY

- - by Martha Warren Beckwith

Yale University Press, $5.00

MOST modern collections of folklore tend to be either so scholarly that they are beyond the interest of the average reader, or else so slight and literary that they fail to convey very much about the people whose unwritten literature has been recorded. Miss Beckwith, in this survey of the folklore of the ancient Hawaiians, has escaped both horns of the dilemma and written a book that is readable and continuously interesting, but which rests upon a scholarly foundation. The Hawaiians share with other Polynesia people a mythology which in its majestic sweep and poetic treatment of cosmic forces has often been compared to the mythology of the Greeks. The chants have a sweep which loses remarkably little in translation:

Kane-of-the-coral,
Kane-of-the-long-coral,
Kane-of-the-quaking-coral,
Kane-of-the-steadfast-coral,
Kane-of-the-sharp-pointed-coral
Kane-of-wafted-coral,
Kane-the-swift-runner,
Kane-the-slow-runner,
Kane!
Kane! Lono!
I will live through all of you, my gods.

The tales are arranged within their context, with discussions of the Gods and Chiefs who are the heroes, of the style of story telling into which each type of tale fitted, and of the religious background against which the tales must be understood. It is a voluminous work packed full of vivid detail.

MARGARET MEAD.

A MANUAL OF AQUATIC PLANTS

- - - - - - - by Norman C. Fassett

McGraw-Hill, $4.00

PROFESSOR FASSETT has presented us with a book which has a new approach to the problem of identifying plants. The entire book is a series of keys, copiously annotated, and with each of the plant structures used in the key illustrated in the accompanying plates. There are 220 of these excellent line drawing plates, each presenting a series of plants and their important key characters. Thus even an amateur can, with comparative ease, distinguish the plants which grow rooted in the mud or floating in the waters of ponds and streams. Bogs and saline habitats are excluded from this volume which covers the middle western and middle Atlantic states as well as the northeast.

The aim is to make possible the identification of aquatic plants in sterile as well as flowering or fruiting condition. By referring in the key to the illustrations which emphasize the important parts of the plant, including the vegetative characters, Professor Fassett achieves this aim. This method has not previously been used on the same scale or with the thoroughness of this book.

The first part of the book is devoted to a general key to the various groups, and the second, major, portion is devoted to keys to the species. The border line between the aquatic and low ground or marsh plants is rather indefinite so that it is frankly admitted by the author that the list is highly subjective and that no two individuals would make the same list of species. However, most of the higher plants which are likely to be found along the edges of lakes and streams are included. In the highly concentrated appendix are summaries of the available information on the use of aquatic plants by birds, mammals, and fishes. Bibliographies in the appendix, and references throughout the book for special groups, together with a glossary and an index complete this important contribution.

As an invaluable aid and as a model of its type of presentation, this volume should be on the shelves of botanists, conservationists, game managers, and biologists in general.

J. W. THOMSON, JR.

ASTRONOMY

- - - - - - - by Clyde Fisher and Marian Lockwood

John Wiley, $2.00

"ASTRONOMY Without Tears," would be an appropriate subtitle for the new book, *Astronomy*, by Dr. Clyde Fisher and Marian Lockwood. In its two hundred odd pages the authors have served up a menu of easily digestible facts pertaining to the science of the stars. Here, indeed, is an appetizer that should stimulate the most sluggish mind to further conquests of this fascinating subject.

Although offered as a textbook to be used in a science survey course for colleges, it is also well suited to the requirements of the layman. In ten well-planned chapters the essential facts of astronomy are presented clearly and without confusing detail. There is an excellent balance of material, arranged in such a way as to give a general view of the subject. The first five chapters (about half of the book) deal with the earth and the solar system. They include concise information on the sun, moon, planets, comets and meteors. Past and recent theories concerning the origin of the solar system are also explained. Chapter VI describes the precision instruments that the astronomer uses to study the stars.

Chapters VII, VIII and IX introduce the reader to the universe beyond the solar system. The various types of stars are described with special reference to many of the more important individual stars. Star clusters are discussed and special attention is given to our Milky Way and other galaxies. The last chapter is devoted to the constellations, describing them as they appear each month.

The book is well illustrated with photographs and numerous diagrams that help to explain the text. The latter were done by Miss D. F. Levett Bradley, under the direction of the authors. Star charts and a map of the moon by Hugh S. Rice enhance its value for field study.

We know of no better volume for the beginner who desires an introduction to the stars.

ROBERT R. COLES.

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THE WANDERING LAKE

- - - - - - - - - Sven Hedin

Translated from the Swedish by F. H. Lyon.

E. P. Dutton, $5.00

THIS is the final volume of a series of three by Doctor Hedin about his journey to west China and Sinkiang in 1934, a trip made at the request of the Chinese Government for the purpose of determining the route of a modern highway from China across the Province of Sinkiang (Chinese Turkestan).

The first two volumes were called *The Flight of Big Horse* and *The Silk Road* and dealt largely with difficulties of motor travel over roads never meant for motor cars, and with the warfare and political intrigue, at white heat at the time, between different racial and religious groups in the Province. Sinkiang in 1933 and 1934 was an extremely difficult place for exploration.

The Wandering Lake, known as Lop-nor, occupies a part of that great, almost level, barren plain in Central Sinkiang at an elevation of about 2,500 feet. Into this plain flow the great Tarim River from the west and southwest and the Konchedaria which drains the southern slopes of the Tien Shan Mountains to the north and northwest, and which at present is receiving much of the water from the lower Tarim River.

Historical records of this lake go back to the Han dynasty in the first century B. C., and its wanderings over the great plain are thus partly known. The important Chinese City of Lou-lan on the Old

Continued on page 130

Continued from page 125

rarest of birds, the Congo peacock. How he ran his quarry to earth 24 years later after a 7000-mile quest is a piece of scientific detective work which has already been related in full.*

On this first expedition, it was Chapin's fervent hope to capture a specimen of the rare crowned eagle and to observe the bird in its natural setting. The wings of this giant hawk often stretch more than six feet, and its three-inch talons are the terror of Congo monkeys. Planing through the tree tops, the eagle snatches its prey, dismembers it on the ground, and carries a tasty joint to its nest deep in the jungle fastness. As Chapin tramped about in the welter below, he kept scanning the sky and foliage for a glimpse of the yellow-eyed predator. But he saw no sign of its presence anywhere. Finally, in the latter stages of the expedition, a friendly native led him on a five-hour march to a remote quarter of the forest where one solitary nest had been discovered far aloft in a tree measuring a good twelve feet in circumference. On a bough near the nest squatted an eaglet, huge in itself, but not the mature specimen Chapin desired. For three days he sat at the base of that tree, hopefully awaiting the return of the parents bearing food to the offspring. The eaglet was fed all right. But either the older birds arrived under cover of darkness or craftily slipped in while Chapin's attention was diverted elsewhere. At any rate, he never saw them.

Then at sunset on the third day, the mother bird glided noiselessly down carrying the foreleg of a monkey. A native guide shouted. Chapin drew a bead. The reverberating crack of a Winchester, and the great bird dropped—not at his feet but plumb in the center of that inaccessible nest way up in the tree. The husky eaglet, who had evidently been leading the life of Reilly at mother's expense, promptly flew away on perfectly capable wings. He had probably been looking forward to golden years of panhandling and doubtless cursed Chapin to his dying day. The latter, meanwhile, stood gazing in dismay at the unscalable bole of the tree. Nothing could be done till the next morning. But the natives were old hands at tree climbing. Constructing loops of fiber rope made on the spot, they managed to give one of their number a gradually ascending series of footholds which, after four hours of persevering toil, brought him within reach of the coveted eagle.

Homeward bound

At about this time, Lang suggested that Chapin start for home, taking with him a part of the collections it had taken them five years to assemble. The idea was to return to Columbia for the spring semester. But this was 1914 and World War I had been going full blast for three weeks without Lang or Chapin hearing a word about it. They were then at the post of Avakubi with just two Belgian officials. Being a German, Lang felt rather uncomfortable when the postmaster called them all over to his veranda and read aloud the telegram announcing the invasion of Belgium. Everyone looked grave, and there was a long pause. Then one of the Belgians said, "Look here, *you* didn't start this war. We'll go on being friends." And Lang was shown every consideration by the Belgians while he remained still another year within their borders.

So Chapin went down the Congo River with the first shipment, a bearded man of 25 trying to get back to college for the last half of his junior year. His first delay came when he ran afoul of sand bars in the shallows of the upper Congo. But worse obstacles lay ahead. In the jungle they had not realized how the war had disrupted ocean shipping. Chapin waited a month before he could get passage on the little English cargo boat *Bornu,* bound for Liverpool. For several weeks the ship nosed in and out of sleepy ports along the coast. At Libreville, in the Gaboon, a horrified Chapin was notified that the port of Liverpool had been blockaded by German U-boats. Frantically he tried to have the virtually irreplacable Congo bird collection transferred to another vessel. But that was impossible. There was no way out. Both this scientific treasure and its guardian would have to run the blockade and trust to luck. Would the fruit of the expedition's labors be sent to the bottom? Young Chapin passed many an anxious day on deck peering across the waves expecting at any moment to see the fateful upthrust of a German periscope or the boiling wake of a torpedo. Worse still, the *Bornu* was a slow boat making only ten knots an hour. It was six weeks before they sighted Tuskar Light at the entrance to the Irish Sea, where the submarines were supposedly concentrated. But no U-boat appeared. The blockade was not as airtight as the Germans had hoped to make it, and the voyage ended safely at the docks of Liverpool.

Chapin stopped over in England long enough to visit the British Museum and chat with the world-famous ornithologists at that institution. England made a tremendous impression on him. After five collar-less years in Africa where he had gone weeks on end speaking only Bangala or Swahili, he was overjoyed at the sight of so many people of his own race speaking his own language and living the kind of life whose existence he had almost forgotten. But this was March, 1915. The streets and restaurants were crowded with uniforms, and Chapin was so carried away that he almost enlisted. However, it was only a momentary burst of enthusiasm, and he saw that his duty lay with his collection and the completion of his education.

Returning to Liverpool he made explicit arrangements to have the bird cargo shipped to the Museum in an American boat. He took passage himself on the United States liner *New York,* smugly confident that his collection lay safe below. But on his arrival at the Museum, he discovered that, owing to a last-minute change in cargo distribution, only half the birds were in the hold of the S.S. *New York.* The rest followed later aboard a White Star liner flying British colors. In this way, at least half the Museum's treasure of Congo birds succeeded in running the submarine blockade twice. Then with the last hectic leg of his transcontinental wanderings completed, Chapin set about covering an entire college semester in six weeks. He squeezed through somehow and then settled down to continue his undergraduate schooling at a more leisurely pace in the peacefully cloistered world on Morningside Heights.

Over there

However, this comparatively quiet interlude was not for long. When the United States entered the war, Chapin enlisted and shortly was dispatched to an officer's training camp. But he had no sooner arrived than the recurrence of a peculiar shoulder injury, sustained years earlier in the Congo, forced his withdrawal. Since many officers from the first camps later fell in France, this mishap may well have saved his life.

* See, "In Pursuit of the Congo Peacock," by James P. Chapin, NATURAL HISTORY, December, 1937, p. 725.

Oddly enough, the injury occurred when he rolled over in bed. Lang and Chapin had set up their canvas cots in a hut from which the native stilt-supported beds had been removed. But some of the sharp, notched stilts were left behind and one of these was evidently sticking up right under Chapin's cot. Lurching in his sleep, he received a hard bump on the shoulder, awoke, and then went back to sleep. The shoulder troubled him acutely for a few months and was aggravated by the kicking of his gun during bird hunts. Deep in the interior, he was unable to consult a doctor until the end of the expedition. Even then, no satisfactory treatment was forthcoming. Nor did the X-ray examination following his relapse at the training camp disclose a flake of bone broken from the scapula and embedded in the tissue. But subsequent surgery finally revealed the encysted body. Thus Chapin survived malarial fever, the constant threat of wild beasts, even a submarine blockade. But one night in a native hut was almost too much for him.

Once the shoulder had healed, he went back to Plattsburg and was sent to France as a billeting officer or Zone Major. There he became, as he puts it, "Peacemaker between the American Army and the French civilian." An auto went with the job, and after the Armistice, he drove around to see the fauna of France and collect European specimens for the Museum.

Globe-trotter

During the years between world wars, his bird studies were by no means limited to Africa. He served on expeditions to the Canadian Rockies, Panama, and in 1934 sailed with Templeton Crocker on the celebrated South Sea cruise of the yacht *Zaca* to gather material for habitat groups in the Pacific section of the Whitney Wing.

But his name will always be linked with Africa. His monumental volumes on *The Birds of the Belgian Congo*, the fruit of three long expeditions to that region, are classics in their field. This work won him the Daniel Giraud Elliot Medal of the National Academy of Sciences, and for the entire span of his activities as an international scientist, the late Albert of Belgium bestowed upon him the *Ordre de la Couronne*.

Today, he is an outstanding authority on the zoology of the Congo territory wherein he passed so much of his life. What will become of this colony in the course of the present upheaval of Western civilization, Chapin can tell no more than you or I. But if the criteria and the values of that scientific spirit which transcends national boundaries are to continue, the Congo will always remain a province peculiarly his own.

YOUR NEW BOOKS

Continued from page 128

Silk Road was, until 330 A. D., watered by the lower reaches of the Konche-daria, known as Kum-Daria. Suddenly, however, the stream channel shifted to the southward and Lou-lan was abandoned and became buried in sand.

In 1921, the river shifted back into its old channel and formed the present Lop-nor. It was this newly adopted channel of the Konche-daria and the new lake at its delta which the author explored with dug-out canoes, supported by his motor cars. Later on, his party approached in motor cars from Anhsi in western China, through the wild camel country, almost to within sight of the eastern shore of Lop-nor. Of the proposed highway between Anhsi and Corla all but 75 miles was explored.

The story of this region, so interesting to the historian and the physiographer, is told in Hedin's brisk, entertaining narrative style and is illustrated with 32 photographs, 84 pen sketches, by the author, and two maps at the back. It is one of the most interesting and important of the great explorer's many works on Central Asia.

W. G.

GREAT WINGS AND SMALL. Bird Stories of Our Day.

- - - - Compiled by Francês E. Clark

Macmillan, $2.50

BEYOND the subtitle, the compiler gives us no clue to the basis on which she selected the 29 articles here presented. While several are ornithological, the greater number recount individual biographies showing the intimate relations that have developed between birds and man. Jack Miner's chapter "Our Model Canada Goose" is of this type.

The authors quoted include such well-known writers as Beebe, Burroughs, Hudson, Olive Thorne Miller, T. Gilbert Pearson, Seton, and Mabel Osgood Wright—we regret the absence of Bradford Torrey—and other makers of standard American bird literature. The remainder are less well known, at least to ornithologists, and their contributions sometimes approach the field of fiction. But all are readable and all illustrate the part that birds may play in our lives.

F. M. C.

O. C. MARSH, PIONEER IN PALEONTOLOGY

- - - - - by Charles Schuchert and Clara Mae Le Vene

Yale University Press, $5.00

WHATEVER may have been said about the personality of Othniel Charles Marsh of Yale, he was the greatest collector of fossil vertebrates of his generation. As with Leidy and Cope, his work was of a distinctly pioneering sort. For two decades he carried on the work of discovery and exploitation of the great fossil fields of the West. The early expeditions were financed by Marsh himself but later he had the support of the Geological Survey in Washington. Today the Marsh collections form the very foundation of the Peabody Museum at Yale and constitute no small part of the great collection of the National Museum.

As a farmer's boy in Lockport, N. Y., Marsh exhibited both a love of nature and an acquisitive spirit. These two traits, accompanied later on by the generous financial support of his uncle, George Peabody, and bolstered with a sound scientific training and a great singleness of purpose, resulted not only in the great collections but in placing Marsh among the first rank of American scientists, culminating in his presidency of the National Academy.

The authors have been well equipped to write this biography. They have been most diligent in their search for documents bearing on this subject and they have not only done a remarkable biography of Professor Marsh but have given an interesting history of Marsh's time and of the various people at Yale, in the field, and elsewhere, with whom he came in contact throughout his eventful life. There are detailed accounts of the western expeditions in the early seventies when hostile Indians were a hazard. There are also stories of his relationships with his scientific assistants, many of whom became famous in later years, and there is, of course, the story of the bitter quarrel with his more brilliant but less canny contemporary, Professor Cope of Philadelphia. Throughout the book it is evident that the authors have tried to give a true picture of the man, making the most of his virtues but not ignoring his shortcomings and they have made a most readable volume of it.

The 500 pages are interspersed with highly interesting photographs and drawings. All paleontologists will read this volume. It should be read by all others who are interested in American pioneers.

WALTER GRANGER.

ADVENTURES OF A BIOLOGIST

- - - - - - - - - by J. B. S. Haldane

Harper and Bros., $2.75

PROFESSOR HALDANE presents in *Adventures of a Biologist* 27 essays covering almost as many subjects. Among other things he discusses the factors controlling the weather, the structure of the unplumbed depths beneath our feet, the nature of life and death, hemophilia, race, the effect of poisonous gases, city planning and politics. To each of his themes he contributes not only a wide learning and frequently an exact knowledge but also the speculation and play of an exceptionally alert intelligence. The amateur will find

Continued on page 132

UNDERGROUND WITH YOUR CAMERA

By CHARLES H. COLES

Chief Photographer, American Museum of Natural History

TAKING photographs in the dark recesses of subterranean caverns is a novel branch of picture-taking that has been left more or less untouched except by a few. The difficulties under which these pictures must be made seem to discourage most snapshooters from even attempting to record the amazing forms and complex structures that cave interiors present. The

Photos by C. H. Coles

very weirdness of the formations should excite the experimental urge that most camera fans possess to try the unusual in picture-taking.

Illuminated caverns

The larger and more frequently visited caves in the Shenandoah Valley in Virginia, and in Carlsbad, New Mexico, are equipped with electrically lighted chambers, so that the taking of pictures is really similar to a problem of photographing the interior of a huge hall. Most of the lighting is of the concealed type so the danger of the lamps shining in the lens is quite remote. Several of the caves are installing colored lamps to improve upon Nature in coloring the formations. From the photographer's point of view this procedure prevents a large percentage of perfectly good light from reaching the stone by absorption in the colored glass of the lamps, thereby decreasing the amount of light useful for picture-taking.

The use of panchromatic film in the camera would be prescribed when colored lamps are used for illumination. The film should be of the fastest type available so that the exposures may be reduced as much as possible. The value of this speed is readily appreciated after it is noticed that to conserve electricity the lamps are usually turned out immediately after the group of visitors has passed each formation. The few precious seconds of illumination must be utilized to the best advantage. It is a good idea to be among the first of the party to arrive at each formation so that as much time as possible is available to set up the camera.

A tripod is essential for this type of cave photography. Even with the fastest film, a few seconds are required to expose the film. A small aperture is recommended because of the depth of some of the formations. Sometimes several lighted rooms or galleries are photographed one behind the other. This arrangement requires even a smaller stop. An exposure meter is useless in a cave because of the dimness of the light and the extreme contrasts that are encountered. As a trial, f:16 aperture with an exposure time of fifteen seconds on the fastest film will secure fairly well-timed pictures of the brighter formations. The exposure figure suggested was for a 3¼ x 4¼ plate camera. Miniature cameras may use a much larger relative aperture and still retain sufficient depth of field for most purposes.

Well composed close-ups of details of some of the formations will sometimes yield more interesting pictures than long views of grander structures. Without humans in the picture, there is nothing to indicate the size of the stalactites so a small niche may be made to look like a vast and complex cavern with the use of a little imagination in choosing a good point of vantage.

Unlighted caves

If a more exciting visit is being planned to one of the numberless caverns that have been unexploited by the electrical illumi-

nating engineer, some type of illumination must be carried in to provide light for photography. The development of the photoflash bulb has simplified the illumination problems enormously. A known package of light in each bulb is a fixed factor for calculation. The manufacturers give the precise exposure data for each bulb size and diaphragm combination. All that is left is to determine the distance of the formation from the bulb.

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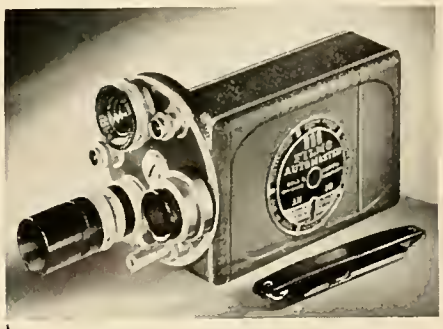

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LETTERS

Continued from page 69

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(MRS. E. E.) GRACE S. ORCUTT.

New London, Conn.

* * *

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* * *

SIRS:

I am enclosing a check for another year's subscription to NATURAL HISTORY, which I believe is the finest magazine of its kind in the country.

Keep up your good work. I have no suggestions except to keep up your section of nature photographs.

Your magazine is the only one which I think worth keeping for future reference. May your organization keep on growing and serving America.

GEORGE M. CHESTER.

Milwaukee, Wisconsin.

HONOR—Mr. Wayne M. Faunce, Vice-Director and Executive Secretary of the American Museum of Natural History, has recently received the distinction of election to the Board of Trustees of Brown University, of which he is an alumnus.

A synchronizer to couple the action of the bulb to the shutter is unnecessary. All that is required is a battery case and reflector to fire the bulb. The camera is set up in the cave upon its tripod and the shutter opened. The flash bulb is then shot off to one side of the camera, the camera shutter closed and the film changed. The darkness of the cave makes hurry unnecessary.

If the camera is pointed toward a rather complex formation, flash bulbs may be set off behind several of the stalagmites to produce a much more spectacular result. An electric hand torch may be used freely to find your way about while the shutter is open on the camera as long as its beam is not directed at the lens. Its spot of light will be too dim to record on the film.

When carrying cameras and flash bulbs on an exploratory trip in a cave, it is wise to have them well protected from dampness and crushing. A waterproof knapsack in which there is a well padded camera, wrapped in a sweater or two, makes a convenient bundle to drag along a cave bottom. The roughest treatment can be expected, so pack the outfit accordingly.

Flash powder belongs to a past age. It is dangerously explosive and produces a foul smoke. Its compactness does not outweigh its danger. Flash bulbs, especially the baby size, are by far the best source of light for pictures.

Try taking pictures of these subterranean wonders. They will have a novelty and interest all their own.

Answers to Questions on page 125

1. The quetzal. See page 73
2. No. Descendants of the Mayas survive today in certain sections of Central America. See page 80
3. (b) Certain mammoths gave rise to our elephants of today. They are by no means mythical animals, and they differ from the mastodons not only in having a separate origin, but also in the form of their teeth and in other ways. See pages 97 and 105
4. A stud or plug of hard material worn in the lip as an ornament. See page 112
5. The mammoth. The flesh of the so-called Beresovka mammoth, discovered in Siberia in 1900, was so well preserved that the sledge dogs of the expedition ate it eagerly. See page 102
6. (b) To provide victims for human sacrifice. See pages 108 and 119
7. By the discovery of human implements in association with the remains of mammoths. See pages 98 and 102
8. Ritualistic or ceremonial cannibalism is practiced in the belief that the virtues of the victim will be acquired by eating his flesh. See page 110
9. The Maya civilization came first, beginning with the so-called Old Empire in 200-600 A. D. and culminating in the so-called New Empire, 1000-1200 A. D. The Aztecs came from the northwest and after several centuries of wandering entered the Valley of Mexico about 1325 A. D. See page 115
10. Egyptian pyramids served primarily as tombs or monuments to the celebrated dead; those in Central America were chiefly foundations for temples or shrines on top. See page 84

YOUR NEW BOOKS

Continued from page 130

in these brief essays solid bits of significant information, the expert will discover a novel treatment of familiar facts, and both will be stimulated by a fresh, vigorous mind that is unafraid to face the future which science can create if given the chance.

If these diverse essays, dealing with such a variety of topics, may be said to possess a fundamental coherence, it lies in Professor Haldane's point of view. His insistence on the need for greater application of the fruits of science to our daily living forms a leit-motif which emerges from each subject that engages his attention. With the faith of the scientist he sees the salvation of society not in the abandonment but in the increased application of science.

Professor Haldane does not write as a scientist pure and simple. He is a scientist interested in society as well as in his field of research, and wherever he can, he seeks to apply his social and scientific philosophy to the conduct of society.

This delightful book is in the noteworthy British tradition of scientific popularization by distinguished men of science.

H. L. S.

ARCHAEOLOGY AND SOCIETY

- - - - - - - - by Grahame Clark

Methuen & Co. Ltd., London, 7 *s.* 6 *d.*

THIS well-prepared volume can be recommended to all laymen with an interest in archaeology. The author does not attempt to tell the story of research in any one area, or to summarize the general results achieved. Instead, he has described "the processes of archaeology, its aims, its limitations and its social value."

He shows how our knowledge of mankind's past has grown, not only through directed research, but from discoveries made in the course of such varied activities as fishing, warfare, and a desire on the part of the Chinese for pills made from dragons' bones.

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He concludes with a discussion of the present status of archaeology in various countries; how in some it has become a political tool to prove everything from racial solidarity to Marxian theories. The author, however, takes a liberal attitude toward such methods, for the study of archaeology is bound to teach the fundamental unity of human history.

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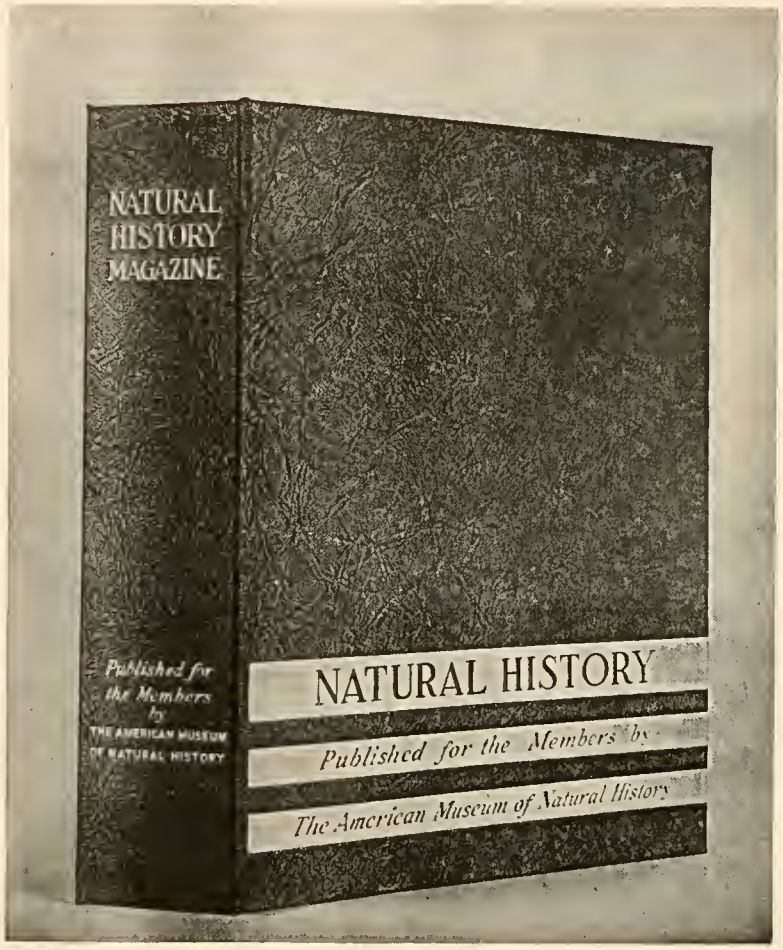

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ILLUSTRATIONS

are printed from photo-engraved plates made by STERLING ENGRAVING COMPANY, 304 E. 45th Street, New York, N. Y.

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Above illustration from Bird Group of Hudson Bay Region in the American Museum of Natural History

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Cambridge, Mass.

* * *

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. . . I congratulate you sincerely on the great work which NATURAL HISTORY is developing among enthusiasts and friends of culture, and it is very pleasing to me to thank you with my greatest consideration and appreciation.

ALBERTO E. J. FESQUET.
Buenos Aires, Argentina.

* * *

SIRS:

In his interesting account of the Neanderthal skull from Circe's Mountain in your May issue, Professor Blanc was faced with the problem of solving apparent cannibalism in the case of a person who had evidently been ceremonially buried by the cannibals (his relatives)!

An obvious explanation might be that the removal of a portion of the base of the skull was part of an embalming process, were it not for one's diffidence in suggesting that the practice of mummification was known to a supposedly extinct human species dated between 130,000 and 70,000 B. C.!

I forward, however, an illustration of two examples from the Maoris of New Zealand. On the left is a typical dried Maori head, in which much of the base of the skull and inner facial bones have been removed as part of the normal process of embalming. (It will be recalled that the fossil skull from Circe's Mountain had been given a somewhat similar opening at the base.) The skull on the right had been so treated and then buried in an elaborately carved wooden casket in late pre-European times. In this case apparently the preserved head did not keep, and when found was as shown here. When opened, the box contained the skull, two ear pendants, and a curved piece of wood around which the scalp, left gaping by the brain excavation, had been gathered and sewn. A drawing of a skull showing how the skin was sewn in hoop-like fashion around the aperture left by sev-

(Continued on page 186)

WHERE IS THE BIRD?

A remarkable photograph at close range showing the protective camouflage of a woodcock. The bird is scarcely visible even under the sharp lens of the naturalist's camera.

Photograph taken by
DANIEL L. MACDAVID,
Hartford, Connecticut.

CLOSE TO NATURE: An unusual photograph of an opossum in its natural habitat, taken by P. McCormick Henry.

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The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — ROY CHAPMAN ANDREWS, Sc.D., Director

VOLUME XLVI—No. 3 ★ ★ ★ ★ ★ ★ OCTOBER, 1940

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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.

ASSOCIATE: D. R. Barton.

ART AND PRODUCTION: 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 DEPARTMENT: Sherman P. Voorhees, Manager.

REPRESENTATIVES:
Frank S. Whitman, Chicago, Ill.
Warwick S. Carpenter, Santa Barbara, Calif.
Wells Constantine, New York, N. Y.

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The American Museum of Natural History wishes to express gratitude for the assistance in the promotion of the interests of NATURAL HISTORY that has been rendered by the Work Projects Administration.

NATURAL HISTORY is published monthly (except July and August) at New York, N. Y., by The American Museum of Natural History, Seventy-ninth 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.

Archbold Expedition photo

CAMPED in an almost unknown section of New Guinea. One of the most enterprising expeditions ever to penetrate the wilderness flew 110 men and three months' supplies in to this remote site at 11,000 feet above sea level. The big tent was the hospital. Clothes and bedding were hung out to dry whenever there was sunlight. Various other camps were established round-about, and a trail was cut to a navigable river in case of mishap to the plane

(Below) New Guinea in New York. An artistic and scientifically accurate portrayal of the landscape and bird life of the Snow Mountains resulting from the scientific exploration of the region and now on public display at the American Museum

AMNH photos by Coles

FLYING BIRDMEN

By A. L. Rand

Research Associate,
Department of Ornithology,
The American Museum of Natural History

A brilliant feat of aerial conquest for science brings a tropical alpine panorama of wildlife from the interior of one of the world's least known islands. The story behind the Archbold-New Guinea Snow Mountains Group recently completed at the American Museum of Natural History

(Above) HARDLY DISTINGUISHABLE from a living bird, this bearded honey eater, mounted with all the skill of modern museum taxidermy, is one of 34 species which enliven the foreground of the reconstruction opposite

The flying boat *Guba,* which recently made a speed record when flown from San Diego to New York in 15 hours and 49 minutes, and the presence of Lake Habbema on the top of the Snow Mountains of New Guinea, were two of the most important links in the chain of events which led, among other things, to the newest group in the Bird Hall of the Whitney Wing of the Museum.

This group portrays with scientific accuracy the bird life and vegetation of an exotic mountain region which has been seen by fewer white men than that portrayed by almost any other group in the Museum.

No aircraft had ever taken off from water at such a high altitude as that of Lake Habbema in the interior of New Guinea, the largest island in the Pacific. Our plan called for the transportation by air of about 100 men and three months' supplies to Lake Habbema at 11,000 feet above sea level. The lake has been so remote that we were only the fourth expedition to see it; we were the second party of white persons to camp on its shores, and the first to bring back adequate collections. Previous parties toiled for weary months over mountain trails to reach this place —to reach it at all was an achievement.

It was on the assumption that we could land and take off from Lake Habbema that we laid out our program to study mammals, birds and plants from sea level to snow line on the north slope of the Snow Mountains. But none of us had ever laid eyes on the lake. The plan to bring back complete material so that all could enjoy the bird life of this remarkable setting in the Museum came as an afterthought.

The Dutch expeditions of 1909-1913 were the first

Archbold Expedition photo

(Right) THE FLYING BOAT *GUBA,* which transported the large expedition piecemeal to the interior of New Guinea under the leadership of Richard Archbold of the Museum Staff

to see it. They were also the first people to climb Mt. Wilhelmina. The next time the lake was seen, and first visited, was by another Dutch party in 1921. Their account of the lake led us to believe that it was suitable for aircraft operations. Before going to New Guinea we carried out tests at Lake Tahoe, high in the Sierras of California. These experiments

told us our flying boat could land and take off at such altitudes, if the lake was big enough and deep enough.

We started preparations for this expedition early in 1937, but it was not until June, 1938, that we were in the field. The *Guba* flew halfway around the world from San Diego, from the east, while part of the scientific staff came round the other way, from the west, and part from Australia. A military escort furnished by the Netherlands East Indies Government had come from Java, the Celebes and Amboina; and a man had been sent into the interior in northeast Borneo and had recruited Dyaks for carriers, who came with their carrying baskets, canoe-making tools, blowguns and poison darts.

When all was ready we made preliminary reconnaissance flights to plan our approach to the work. How eagerly we looked forward to seeing Lake Habbema on these flights! How relieved we were to find it long enough and deep enough! Still there was the awful suspense of the first landing and take-off. Only the crew was on board; the rest of the party listened in on the coastal radio set. The landing was a success and proved our plans sound.

Then came the heavy freighting to Lake Habbema of our food and personnel, tents, and palm thatch for building, our military escort, and our Dyak carriers. The latter were to move us about to different camps and were to cut a trail through to a navigable river, so that in case of accident to the plane we could walk and raft back to the coast and civilization. One hundred and ten men and three months' supplies for them were flown in to Habbema during the last two weeks of July.

Our camp was on the lake shore: a village of canvas and palm thatch with the Netherlands flag flying from the flagpole. It was a strange country, and soldiers stood guard day and night. Broad, native tracks crossed the country, and time and again we saw long caravans of nearly naked natives braving the chill of these altitudes on their way across the mountains. Just why they came up into this cold region we never knew. Perhaps to visit kinsmen beyond the ranges. They never disturbed us, and until the time we left here our contacts, though friendly, were few. Mostly they ignored us. At first it seemed as though they refused to believe we were real. Sometimes they passed within a few feet of me, eyes averted, as though they did not believe in the presence of these strangely garbed humans who came down from the skies, bringing their houses with them.

We spent about a month around Habbema, then for six weeks, in wet and cold, we worked in the very shadow of Mt. Wilhelmina. The alpine condition here is one of the extremes in the whole central Pacific area. Here, within six degrees of the equator, we prowled through dark pine forests and rhododendrons; and, climbing higher to timber line, we found alpine grass, studded with little yellow, white and blue alpine flowers, some like buttercups and daisies. We camped at the base of the peak itself, and it was up where grass gave way to rock that we discovered one of our best birds, a gray, red-breasted flycatcher new to science. We even climbed to the very edge of eternal snow, where big chunks of coarse, crystallized snow lay under ledges of rock. To find similar conditions elsewhere in this area, one must go to New Zealand or to the Himalayas. We didn't reach the summit. A variety of circumstances kept us back. But that had been done before, in 1910 and 1921. And we did something much more satisfactory, we had material for a detailed faunal survey, something no one else had even been able to attempt.

When we arrived back at Habbema, ready to leave this country for the warmer, forested slopes below to the north, we wanted to bring away a better souvenir than our notes and specimens; we wanted to be able to show people what this isolated, little-known land held, better than we could with words and photographs. A habitat group was the only way.

New Guinea groups had been talked of for the new bird hall, but we had not expected to collect any.

Archbold cabled:

> HAVE LOCATED IDEAL SITE FOR ARCHBOLD SNOW MOUNTAIN GROUP. SHALL WE PROCEED WITH COLLECTING?

Chapman replied:

> COLLECT GROUP.

We were definitely committed. The background was to be painted, so we took advantage of the first fine day to make a panorama study with our miniature cameras. This we did in both color and black and white.

We first made a model of the group in a five-gallon kerosene tin. On the left was forest, with a conspicuous pine bough on which the birds of paradise could dance; to the right it gave way to alpine grassland with its gay flowers. In the background was Habbema, and beyond it Mt. Wilhelmina.

After we decided what to collect, the actual collecting took only a few days. Everyone helped. The weather had turned bad and was cold and rainy much of the time. The big pine bough was cut and lowered by ropes to keep it from breaking, then cut into sections and each section numbered. The shrubbery was tied into bundles in the rain; the moss for the forest floor was sodden. The turf for the alpine grassland was solid enough so that squares could be marked out and skinned off the earth, like sods for a

lawn. For these the rain did not matter; they were sodden most of the time rain or no. The Dyaks carried them back to camp and spread them out for color photographs to be taken. Samples of flowers and leaves were pressed between papers for guidance in shape and texture in the work of reconstructing the scene.

Drying was a problem. This we finally solved by putting the material on racks in the supply tent and keeping a charcoal brazier going inside.

Later, when all was dry, the whole group material, along with our other specimens, was loaded into the *Guba* and flown to the coast to be packed and shipped by steamer.

Not knowing the size of the group, we had wanted to be sure of having enough material, a point which the Museum's Department of Preparation emphasizes. Later we found we had collected enough wood, branches and shrubbery to fill completely the space finally allotted to us, which is one of the largest in the hall.

The birds, of course, were my special interest. What ornithologist has ever heard of New Guinea without thinking of birds of paradise? The common one was the black, orange-wattled McGregor's Bird of Paradise which gathers for communal "dancing" in certain pine trees. I was fortunate enough to be able to watch their displays and later to find their nest, and to discover that male and female share nest duties. Less common was the beautiful, long-tailed, iridescent Splendid Bird of Paradise, which some call the most beautiful bird in the world.

Though the birds of the lowlands of New Guinea are justly renowned for the brilliance of their plumage, it is surprising to find such brilliant birds so high in the mountains. As you go up in the mountains in the tropics, the birds decrease in brilliance, just as when you go from the equator to the poles. But there were several other beautiful birds here at timber line. The lories as a group are brilliant. And we found two here, the little blue-faced lories, whose beauty was enhanced by the contrast with the red fruit of the umbrella tree on which they frequently fed, and the green and red alpine lories, that flew over in squeaking flocks or climbed about in the pines. We found parrots here, too,—the short-tailed Psittacellas, one with a chestnut collar and the other, larger, with a green and black barred back. We found the crested starling, nesting in the shrubbery; it is one of the most attractive of all New Guinea birds, with its soft blue, olive, gray and black coloration, its confiding ways, its soft notes, and its manner of hopping about through the twigs, now right side up, now upside down, recalling a chickadee's actions. We often saw the tiny, brilliant red and black honey eater, perched on some exposed twig as it paused on its flight from one forest patch to another. It is one of a group of birds which, in this part of the world, help take the place of the hummingbirds.

One of our important finds was a red weaverbird, which turned out to be new to science. But to list all the rare birds we found here would be to list most of them. The birds of the Snow Mountains have been perhaps the rarest in collections. A Dutch party got the first specimen of a Snow Mountains quail, for instance, in 1910, and it was so different from any known species that it was described as a new genus and species. No other specimens had ever been taken until we found it. It was common in the alpine grassland, living on flowers and leaves and seeds and fruit—whatever was available. At night it slept in hollows under tussocks of grass. One day, while traveling in a snowstorm, I flushed three from under a rock ledge where they had taken shelter. In couples or threes they usually lie close and flush quickly, with a roar of wings and often a cackling call. They would make good game birds. We found a nest with three eggs under a shrub, and one day a line of transport carriers started a brood of young. For twenty years previously the genus had been known only from a single specimen.

Hardly better known were a common bearded honey eater of the shrubbery and a big yellow and green honey eater that sat up, giving loud, melodious calls, or hopped about on the ground with tail cocked up. A little brown weaverbird, which fed commonly in the grass near camp, did not have a name until last year. A few skins had lain in the museum in Leiden since 1913, and while we were in New Guinea the ornithologist in Leiden named it. On the lake we found flocks of pochards, familiar looking because of their resemblance to bluebills. The arrival and departure of the airplane always threw them into confusion, and we could catch the silvery glint of their wings as they circled, too far away to see otherwise. The coots, also like our birds, were more phlegmatic, and only spattered out of our way. More interesting were the mountain ducks, named in honor of that renowned New Guinea birdman Salvadori.

In the forest were the black and white Friendly Flycatcher and the Rufous Fantail, members of a large New Guinea group noted for the attractive manner in which they spread their tail as they flutter out after insects in the trees and shrubbery. The Friendly Flycatcher has an additional attractive habit, which prompted us, indeed, to give it the name Friendly. It seemed attracted to us as we moved about in the forest and often came up to investigate,

(Left) A PAUSE in the work of collecting a characteristic tree trunk for the display group in the Museum. Most of the material in a museum habitat group, sometimes even the soil itself, is actually taken from the spot. The men are *(left to right):* A. L. Rand, Richard Archbold, R. Booth, R. R. Rogers. In the background are Dyak carriers, brought by scores from Borneo

Archbold Expedition photos

(Left) A BAND OF DYAKS collecting turf and flowers in upland New Guinea for the replica scene in New York. Thousands will thus have an opportunity to become acquainted with a region they could not otherwise have seen. Among dozens of exhibits in the American Museum, the region shown in this one has been seen by fewer white men than any other

(Below) NATIVES OF NEW GUINEA who visited a secondary camp of the expedition high on the range. Unclothed they traveled these inhospitable highlands and slept around little fires at an altitude where frost collects on the grass at night

sometimes accompanying us a short way. Once I saw one even being "friendly" with a little squirrel opossum. It was mid-morning in the forest; the opossum was running up and down saplings, apparently peering and poking into moss for insects, and for a long time the little flycatcher kept fluttering about, catching insects for itself in the immediate vicinity of the opossum.

Occasionally we found a woodcock hiding in the shrubbery. It is a close relative of the European woodcock, and, like it, has a flight song which it gives at dawn and again in the early evening. Flying low, on level flight over the forest, it gives a *"que queek queek queek"* which I came to think one of the pleasantest of the New Guinea bird songs. It heralded the daylight and closed the day.

To see some of these things, to get an idea of the sweep of this high country and the impressions of clean, cool dampness; to see the beauty of the rhododendrons and orchids, and to see some of the bird life, you have only to stand before this group in the Bird Hall. From our photographs and data the artist has not only produced a beautiful picture but has truly portrayed the darkness of the forest, the gleams of the lake, the paleness of the hills, the light and shadow, as we saw them from the ridge above camp on a fine day.

(Above) AN ALPINE VISTA in tropical New Guinea: Mt. Wilhelmina from the shores of a small lake, showing scattered patches of timber struggling toward the bare rock of the peak. During dry periods the snow melts off this face of the peak

ALMOST continuous wet weather hampered preservation and packing of material. Specimens are shown here laid out on racks to dry in the sun at the main camp at Lake Habbema. W. B. Richardson, the mammalogist, is examining some of the collections

MUSEUM QUIZ

"Information, please" is the request which comes 25,000-strong each year to one of the world's unique clearinghouses of information. An inside view of the amazing curiosity of the American public

By Roy Chapman Andrews

Director, The American Museum of Natural History

George Washington's false teeth appeared in the Museum not long ago. They were awesome looking things set in a steel denture with a spring which kept the upper set in place when he opened his mouth. I have always thought that the Father of Our Country had rather a grim expression and now I know why. The teeth came to our Department of Mammals in the hands of a New York dentist who wanted to have Doctor Anthony tell him from what animal they were made. A wapiti or elk had contributed the teeth.

This was one of approximately 25,000 questions answered by our Museum's Scientific Staff during 1939, of which, as best we can estimate, one half were highly technical and dealing with intricate scientific questions relating to the life of our community, and the other half non-scientific and personal.

George Washington's question was easy and right up our alley, but what is a curator in a natural history museum to answer when he is asked how sour milk is used in the manufacture of billiard balls? Or, "How can I preserve my bridal bouquet perfectly in color and form?" "Where can I get a copy of the $25,000 check given to Colonel Lindbergh for his flight across the Atlantic?" "What shall I do to get rid of the smell from sewerage that backs up under my house?"

A song writer wanted to know if a song could be written about an "orange moon in June," and a great department store asked if wearing wooden shoes was detrimental to health. A doctor at the Medical Center sent us a bone that had been swallowed by a patient, for identification. A radio broadcaster asked for some live ants which would walk on a microphone pickup; a novelist begged for "a list of insects that might be found in the basement of a pawnshop." The editor of a popular magazine devoted to the theater, restaurants and amusements, wanted to know what to advise a reader to do for a turtle that was blind in one eye, and a great motion picture producer asked what were the possible throat noises of dinosaurs.

A list of the questions asked the staff of the American Museum of Natural History shows that when a person is uncertain where else to get information about a subject, whether or not it pertains to natural history, he gives the question to us. We are a center for the most amazing number and kinds of inquiries, more than half of them technical, most of them serious, but some so extraordinary that we can only suspect the mentality of the people who ask them.

At least a third of the staff members' time is devoted to answering questions that come by letter, telephone and personal visit. We don't mind it, for it is a part of our job as a public institution. I must admit that it is more thrilling to describe the new species in a collection of birds from South America, to unwrap a 3000-year-old mummy, or plan the details of an expedition to Tibet than to send a serious answer to questions like these:

"How are the flowers and bushes in your habitat groups kept so fresh? Are they watered every night?"

"What is a doodlebug?"

"Where can I get a photograph of a bee's sting?"

"Are there any women and thunder storms at the south frigid zone or South Pole?

"Please let me know the name of the scientist who wanted a young couple to go to a Deserted Island and stay for five years nud."

"What makes a man turn to stone? My great-grandfather died 200 years ago. We dug him up the other day. His body was turned to stone. How much will you give me for him?"

"At my house there are spirits roaming around. What can you do about it?"

"What are the insects mentioned by Joel in the Bible?"

Nevertheless we do answer these questions and give a serious answer, too, even though it may seem a waste of time.

I must not give the impression that our people are largely occupied with replying to inquiries of that sort. As a matter of fact they are only a very small part of the number that are received every day, but were I to chronicle the variety and multitude of scientific questions I am afraid that no layman would read this article.

What we consider technical questions mostly concern the identification of specimens of every kind

from a dinosaur bone to minute sea animals; these, of course, far outnumber all the rest. Requests for practical assistance in conservation, education and every branch of natural science represent a great number. A sister-institution asks for help in producing biological sound films; a foreign government would like advice on laws for the protection of whales; the Audubon Society wishes to discuss the proposed regulations affecting the control of fish-eating birds at hatcheries and rearing ponds. A neighboring state asks what is the effect of Vitamin B_1 and hormones on aquatic plants or water occupied by fish; a man representing a great refrigerating concern wishes information about the preservation of mammoth remains in the frozen tundra of Siberia.

We are a clearinghouse for newspapers and magazines. Hardly a day passes that the editor of some publication does not check with us on the accuracy of an article submitted or of a story that has come over the wires, or ask for information on some unexpected subject. Every spring when vacations start, we know that the sea-serpent story will crop up. Resorts have learned the value of reports of strange apparitions to draw tourists, and, of course, it makes excellent copy for a feature writer. The Loch Ness Monster put that little village in Scotland on the international map in a big way. Mermaids, too, run a close second; and possible discoveries of ambergris, the valuable substance used in perfumery, go into the thousands. I may say, in passing, that although I have examined hundreds of "finds" myself, no one has ever yet brought me a chunk of real ambergris.

Many thousands of dollars have been saved by the advice which our Department of Entomology has given individuals who have houses infested with termites or valuable trees which are being destroyed by some unknown insect.

The U. S. Customs Service makes frequent use of our staff on all sorts of questions where objects of natural history are concerned or for expert determination of various importations. I once saved a man from a heavy fine or imprisonment when I was a member of the Department of Mammals. A Customs official brought to the Museum what he maintained were the canine teeth of wapiti or elk. These were formerly used as watch charms by the Order of Elks, and as thousands of animals were slaughtered for the two teeth alone, stringent laws were passed against their importation. This man maintained that his specimens were walrus teeth. By sectioning them I proved him right and saved him from serious trouble.

Designers discovered that the plumage of various birds gave unusual and beautiful patterns for new ribbons, and primitive Indian fabrics found in the American Museum produced ideas which are incorporated in many modern dress goods. These are all discussed with people in the Museum.

Hardly a day passes that some member of our staff is not asked for advice by a young man or woman who is planning a career. I suppose that I get more of these questions than any of the others. Letters pour in asking, "How can I be an explorer?" "What courses must I take to fit me for Museum work?" "What do various branches of science offer as life jobs?" Dozens of mothers ask for interviews to discuss these problems of their children.

At certain times we are deluged with requests for travel information, routes to various countries; costs; clothes to wear, etc. By this I do not mean sportsmen or explorers who are looking for expert advice which would naturally be best known by our field men. On the contrary, these are the sorts of questions that any tourist agency could answer much better than a natural history museum. For instance, a gentleman came to tell us that he was bored with the cold weather of last spring; that he wanted to move to a warm climate. Where should he go? Did we have information about business connections in the Netherlands East Indies or Africa?

Motion picture companies find the Museum a mine of information on natives, customs, houses, dress, etc., for films and for all sorts of technical questions involving authentic production. Doctors, of course, often come to us with questions in comparative anatomy and even for advice in treating neurotic disturbances in patients.

"True or false" questions which come to the Museum would be grand for a radio quiz. Some of them are: "Do bears suffer with arthritis?" (Yes.) "Is it true that a herd of Lilliputian horses, the size of police dogs, exist in the Grand Canyon of Arizona?" (No.)

"Is there any truth in the story that skunks sometimes cause fires in barns, the assumption being that a spark of electricity from the fur of the skunk under proper circumstances would ignite gases in the barn." (A superstition for which we cannot justly accuse the poor skunk.)

"Do foxes troubled with fleas hold a piece of wood in the mouth, run to a stream and slowly submerge. The fleas are supposed to leave the animal's body and take refuge in the wood. Then the fox drops the wood and swims away." True or false? (False.)

"Is it true that 65 billion represents the number of people born into this world since its beginning?" (Probably 90 billion would be closer.)

"Is it true that the praying mantis jumps out of trees onto the backs of rats and bites their necks so that they bleed to death?" (No.)

There is in my office what we call the "Believe-It-Or-Not" file. I am ending this article by quoting four which are typical.

Dear Sir:

I have known that, organized by your great Institution, frequently from New York depart hunting expeditions. If one of these expeditions should need a barber and hairdresser (also sharpshooter) I would be very glad to obtain that position.

Gentlemen:

Gentlemen, let me have your attention to this letter. It is very important to me, also it means my happiness and future career.

I have been informed, that the American Museum of Natural History is about ready to send out another exploring expedition soon.

Adventure is calling me. The lure of adventure has taken its final hold on me, now and forever.

Gentlemen, I ask you to send me out with that expedition. Take me, think it over, but don't refuse me. Gentlemen, the thought of not going almost drives me mad.

Gentlemen, I pray for this to come true as I have prayed for this opportunity to write. Enclosed are four cents in stamps, and I'm now waiting eagerly for an answer.

Yours for exploring and adventure.

For the Present: Farewell Gentleman and all.

Dear Sir:

I am a bachelor 65 years of age. I am orphaned, live 57 years in Chicago, have a clear record. I can furnish 1,000 bond and references. I will pay you $100 if you find me a wife but not a negrow. She must have $10,000 cash. I am a temperance man. I will join your Museum, also the wife may be from 16 to 60 years of age. I have $250 in 3 banks—they are closed. I carry $10,000 insurance.

Yours truly,

Gents:

I know you will think this is a crazy letter but when I tell you the facts you will be glad I am writing to you for it means money to you and me.

My husband—a good, fine man—had ao awful sickness and when he came out of it, he had no sense of feeling. You can stick pins, needles or any sharp object in him and he just laughs. He is a lot of help to me around the grocery store and I hate to lose him, but this is my idea.

Put him in a sort of cage in one of your rooms and let the visitors stick pins in him at 25¢ a prick. This will be, I know, a big money-maker for you Museum people and for me, as I would, of course, expect a certain percent of each prick. I know the public will flock to see this human pincushion.

Let me hear from you quick, as I know you will never regret it.

Yours truly,

P. S. He has a fine appetite and will eat anything.

I am somewhat fearful that this story may have left an impression that the Museum Staff wastes a great deal of its valuable time in answering questions such as I have given above. This is far from true. These examples give only the amusing side of the picture and are perhaps one per cent of the 25,000 inquiries which come to us every year. The other 99 per cent are serious questions of real importance, which help carry on the Museum's function as an educational institution.

DO NOT MISS

The Sahara Desert is approximately the size of the United States, and some of the sand dunes in it are higher than the world's tallest buildings. Though it is one of the hottest regions on earth, it contains mountains that are snow-covered part of the year. It is one of the greatest natural barriers on the face of the earth, and its secrets have stirred the imagination of man from early times in a way that is both grim and romantic. Recently **MARTIN BIRNBAUM**, whose travels elsewhere in Africa and in Central America are familiar to readers of NATURAL HISTORY, crossed the Sahara from north to south, not by the age-old method of the camel caravan but by automobile. In the next issue he will tell the story of this trip, culminating in a visit to the ancient city of Kano. There is an old Arab saying that "once you were able to walk from Mecca to Morocco in the shade." But if the heat of the sun is any criterion, you will enjoy Mr. Birnbaum's best narrative on a cold winter's evening. This author's wanderlust, incidentally, continues unabated, for after a brief pause in New York after his latest trip, he departed for Hawaii, and a letter from him informs us that he is again on his way back to America, with other expeditions in the back of his head.

The geographers say that an island is a body of land entirely surrounded by water. William Monypeny Newsom will show in a forthcoming article that the strange island of **ANTICOSTI**, in the Gulf of St. Lawrence, has also been surrounded by shipwreck, disaster, bad luck, and misinformation. On an expedition to it for the American Museum of Natural History, Mr. Newsom collected specimens of its animal life and delved into its unusual history. His narrative becomes a vivid story of a piece of land which through the centuries has been the scene of many adventures. Two and one-half times as large as Rhode Island, it is one of the few large sections in the modern world to come into the possession of a single person. When Henri Menier, the "Chocolate King" of France, built his manor on this lonely island, he installed sixteenth century Flanders tapestries and furniture from the period of Louis XIII.

IT HAPPENED IN 42 DAYS

A Story in Pictures by GUY S. PECKHAM

Seven stages in the growth of the red-tailed hawk are shown in these photographs, taken at intervals of almost exactly one week. The nest was in the top of a large oak tree, 65 feet from the ground, which made the photographer's task an exceedingly difficult one. The coloring of a young red-tailed hawk can be seen on the cover of this issue of NATURAL HISTORY.

NEST AND EGGS

JUST HATCHED

8th DAY

15th DAY

22nd DAY

29th DAY

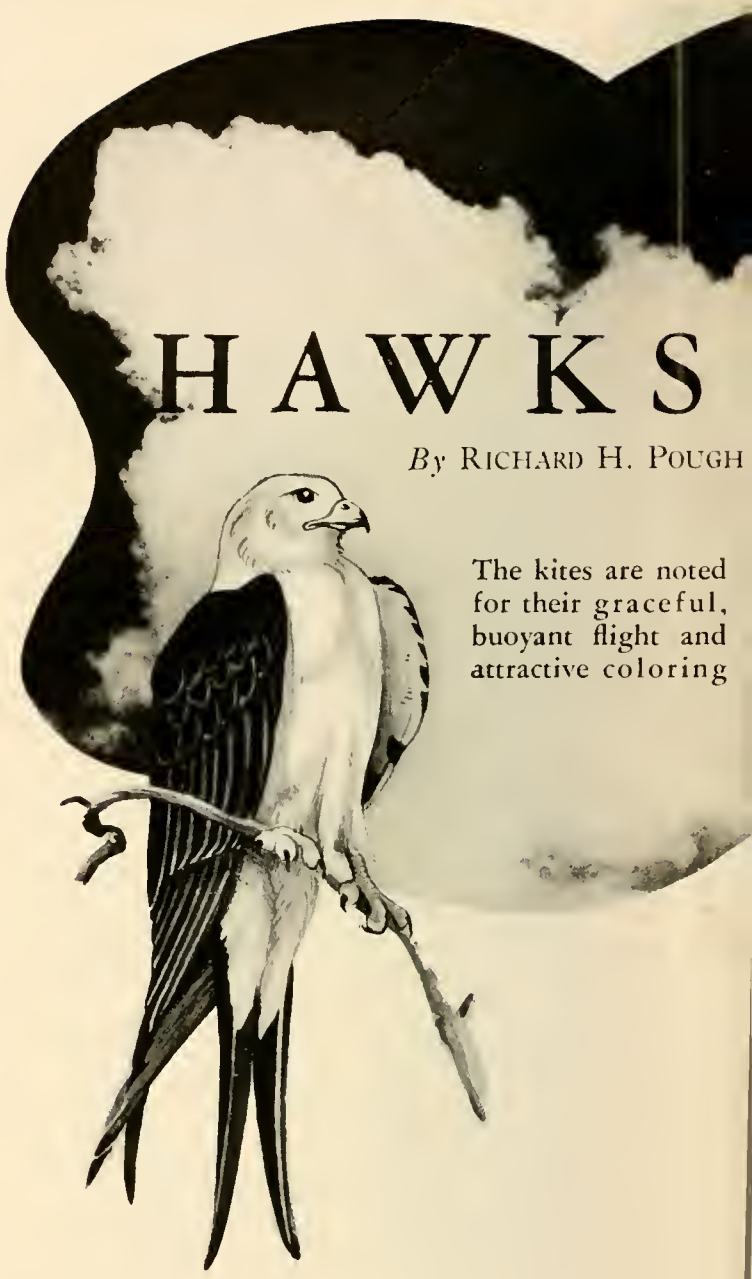
36th DAY

42nd DAY AND FAREWELL

Every spring and fall hawks make a spectacular migration, and if your eyes are sharp you may have the thrill of spotting these masters of the art of flight, conquerors of the realm of the sky, and heroes of the age-old sport of falconry

HAWKS

By RICHARD H. POUGH



The kites are noted for their graceful, buoyant flight and attractive coloring

HAVE you ever awakened on a cool, crisp fall morning feeling it would be a crime not to spend the day out-of-doors, yet not knowing quite what to do? Well, if it ever happens again let me make a suggestion. Try looking for hawk migration routes. If you are successful, you will be treated to some thrilling sights.

The same sudden drop in temperature that fills you with renewed energy, serves as a warning to the hawks that the time has come to start their journey to winter quarters. Leaving the shelter of forest and woodland, where for months they have been just shadowy forms of which one seldom got more than a glimpse, they ascend aloft to ride the winds.

Some hawks are early migrants and are started on their way south by the first cool weather in late August. Moving slowly, these early migrants from the northern limit of the range of the species, pick up others along the way, to join the flight and increase its numbers. Among broad-winged and Swainson's hawks this slow building up of the flight often results in concentration up into the thousands, a truly spectacular sight.

If you have never taken any especial interest in birds, let me recommend the birds of prey as a starter. To many persons who are already "birders" this may sound like strange advice. But in my opinion hawks, because of their size, their active movements, and their superlative mastery of the art of flight, have a universal appeal for the human race.

No sport has a longer history or been more widely engaged in than falconry. For several hundred years it was the favorite sport of all Europeans who had the means to indulge in it. Undoubtedly the basic appeal of falconry is to man's love of perfection in any form of activity, and in this case the appeal of such perfection is all the stronger for being in a field in which man himself has no ability.

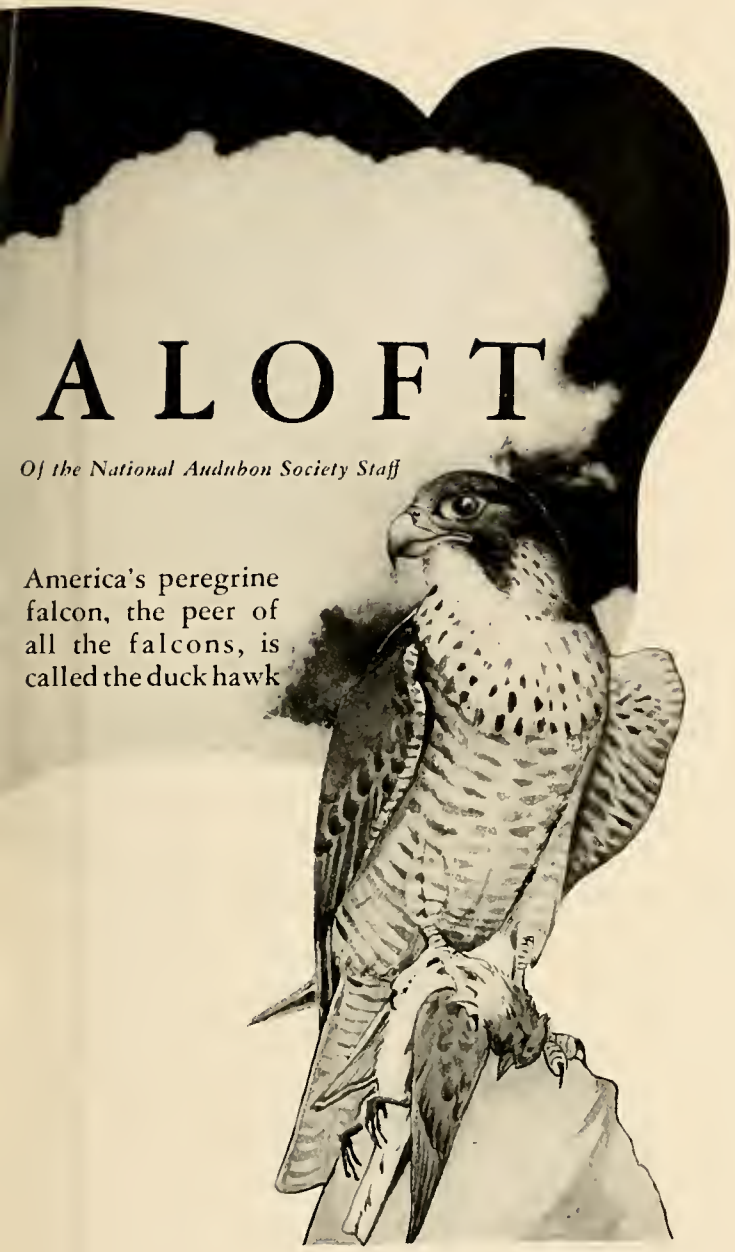
The order Falconiformes—the scientific classification to which all the birds of prey belong—includes the fastest of all birds, the peregrine falcon; the largest bird capable of soaring flight, the California condor; and the finest gliders in the bird world. This group of birds can be said to represent the highest development reached so far by animal life in its efforts to make itself at home in the last of the earth's three layers to be invaded by living organisms.

It is impossible to dislike hawks once one has become intimately acquainted with them. Gracefully built, beautifully patterned and colored, alert, highly intelligent, capable of being readily trained, and often quite affectionate, these birds completely win over anyone who has ever had one as a pet. No horse or dog lover is any more ardent about his hobby than a falconer. However, to see any wild animal at its best, one should go to its native haunts, where it is completely wild and free.

Every fall some nineteen species of birds of prey that breed in Canada migrate down across at least part of the United States. Many do not need to go farther than to the middle or southern part of the

ALOFT

Of the National Audubon Society Staff



America's peregrine falcon, the peer of all the falcons, is called the duck hawk

country to find suitable wintering grounds. Some, like the goshawk, roughleg, and gyrfalcon, seldom go much farther south than our most northern states. A few, though, undertake long migrations down into Central and South America. The Swainson's hawk, a once abundant plains species, still common in migration, which breeds as far north as Fort Yukon, Alaska, on the Arctic Circle, goes in the winter to the Argentine Republic—a veritable Pan-American envoy at large.

Of course, many of these same hawks also nest in the United States, but so terribly decimated are their ranks as a result of the common prejudice against them, that were it not for Canadian birds from breeding grounds still relatively free from human molestation, the flights would be only a small fraction of their present size. Actually there are many parts of the country where hawks (those rated as useful as well as those regarded as harmful) are so completely extirpated that a local ornithologist's only chance of seeing them is during the migrational flights.

Although it takes place twice a year, this great migratory movement is often observable in any given area only once a year, as most hawks use somewhat different routes in spring and fall. To date, these migration routes are only very imperfectly known. Apparently the main reason for this is the general lack of detailed knowledge among naturalists as to where and when to look for the flights. As many as a thousand hawks a day may go through areas fairly well covered by bird students and yet remain unrecorded for years. Even larger areas have yet to be thoroughly investigated by bird students, and although local residents may be quite familiar with a migration, they seldom realize that information about it would be of scientific interest and should be reported to some natural history organization.

Before it is possible to discuss in detail what is now known about hawk migration, one must have at least a general understanding of the characteristics of the different groups of birds which in this country are all lumped under a general term "hawk." Actually "hawk" is a word with many meanings. Originally, as applied to birds, it meant a bird-eating bird. To this day in England, only those birds of prey that feed primarily on other birds are called hawks, the members of the other groups within the order being designated as kites, buzzards, vultures, eagles, falcons, harriers, and osprey.

Unfortunately the early American colonists applied these terms in a most haphazard and incorrect way to the many kinds of birds of prey they encountered in this country. The vultures they called buzzards, while the buzzards, falcons, the harrier and the osprey were all called hawks. Only the kites, eagles, and true hawks received names that in any way corresponded to the names of closely related European species.

It is regrettable that "hawk" happened to be the term most widely applied to the various species of American birds of prey, as it carries the false implication that the birds so designated are principally bird-eaters. Undoubtedly the mistaken impression which is still prevalent, that all hawks steal chickens and destroy game, can be traced to the mistakes that were made in the original naming of our American birds of prey, and to the confusion which these incorrect names have always tended to foster. In this country "hawk" has now become so completely synonymous

with bird of prey that we really have no choice but to use it in this broad sense.

From the standpoint of accuracy "bird of prey" is little better than "hawk" as a descriptive name for the group. Taken literally it would imply that they were the only birds that lived by preying on other forms of life. Actually there are few birds that do not prey on some form of animal life during at least a part of their life.

Hawks vary more in their feeding habits than most groups of birds. Many eat almost anything they can kill or find dead, while others have become highly specialized for the utilization of certain specific types of food. The everglade kite of southern Florida is typical of the extreme case. This bird is dependent on fresh water snails of the genus Ampullaria for its entire food supply. It is so specifically adapted to feeding on these that it is no longer capable of sustaining itself on any other food. When drainage or drought destroys the aquatic habitats of these snails, the kites have no alternative but to leave the area or starve.

Few hawks are quite as highly specialized as the everglade kite, but each species has its own characteristic abilities which enable it to obtain certain types of prey much more readily than others. The difficult task of catching birds, for instance, is a mode of life to which the Accipiters, the sharp-shinned, Cooper's and goshawk—members of the true hawk group—are well adapted. They have a long tail which enables them to follow every twist and turn made by a fleeing bird in its efforts to escape pursuit. In addition they have short, heavy, powerful wings capable of tremendous bursts of speed when they are attempting to overtake their quarry before it reaches cover dense enough to prevent pursuit. And most important of all, these birds have an uncanny ability to keep out of sight in some treetop until they spot a bird far enough from good protective cover to offer a fair chance of capture. Endowed with such abilities, it is not surprising that they are fully capable of catching all but the most alert and rapid fliers.

The big, soaring Buteonine hawks, with their long, broad wings and fanlike tails, present a marked contrast to the Accipiters. The difference is so apparent that their European relatives were given the distinctive group name of buzzard to differentiate them from the hawks. As might be expected from their appearance, our common Buteonine or buzzard hawks—the red-tailed, broad-winged, red-shouldered, and the roughlegs—are too slow to catch healthy birds except by a lucky accident. Their food is chiefly mice, other small mammals, frogs, snakes, and large insects.

From their method of obtaining prey the Buteos can be aptly characterized as "pouncers" in contrast to the Accipiters, which can best be described as "chasers." The typical Buteonine hunting method is to spot the movement of some suitable object of prey from above, and then descend upon it. Sometimes this is done from a high perch at the top of a dead tree; but more frequently these hawks detect the presence of prey while they are soaring high in the air. The broad wing and tail surfaces that characterize all Buteonines give them a buoyancy which enables them to stay aloft for hours without apparent effort. Nothing demonstrates better the remarkably sharp eyesight possessed by hawks—eyesight that apparently far excels our own—than this ability to catch sight of small animals from hundreds of feet in the air.

One can learn a great deal about air currents by watching the Buteos and their relatives, the vultures. There is really nothing mysterious about their ability to float on outstretched but motionless wings for hours at a time. All that is necessary is a current of rising air moving upward at a rate at least equal to the rate at which the gliding bird would normally tend to lose altitude—a rate that for these soaring species, is slow because of their large wing and tail area. Only rarely are there times, such as windless early mornings, when suitable air currents are lacking; and it is chiefly then that one finds the Buteos resorting to high perches to look for prey, instead of soaring.

The rising air currents used by soaring birds are of two types, *thermal* and *deflective*. *Thermals* develop when the air near the ground is heated (as a result of the sun's striking the earth) to a point where it becomes lighter than the air above it. When this happens, columns of warm surface air start rising up here and there, just as hot air and smoke do in a chimney. As these columns are frequently capped by a thunderhead, they are easily spotted, and it is in the invisible warm air column under these clouds that one should look for hawks. Often a field glass is needed, as the birds may be so high as to be beyond the range of the naked eye. If watched they can be seen to circle round and round in order to stay within the column.

Updrafts due to *deflection* occur whenever a wind blows across hilly country. Air striking an obstruction, such as a hill or a cliff, must rise to pass over it. Like thermals, these rising air currents are much used by hawks. As the birds use only the lift, which the force of the wind creates, they do not have to and in fact seldom do travel in the same direction as the wind. In many regions hawks migrate long distances along ridges where the prevailing wind provides a continuous updraft. In a single day hun-

dreds and even thousands of hawks have been recorded gliding south above such ridges.

Although Buteonine hawks are often accused of killing large and active birds, their pouncing technique seldom effects the capture of a really healthy and active adult bird. Naturally there will be times when old age, disease, an accident, or gunshot wounds may prevent a bird from escaping, but as a rule birds elude these slow-flying hawks quite easily. The few birds that Buteonine hawks do catch are probably in most cases better off dead than left to die the slow, lingering death that otherwise faces a sick bird. Furthermore, the prompt removal of a badly diseased or heavily parasitized individual is definitely beneficial to the rest of the species, as it stops the spread of germs and parasites to the healthy birds that would continue to associate with the sick one as long as it stayed alive.

Probably because of their distinctly limited ability to catch active prey, all of the Buteonine hawks eat reasonably fresh carrion whenever it is available. As a result of this scavenging habit, they are often unjustly accused of killing animals that were actually killed in some other manner. It is never safe to assume that a Buteo killed a certain animal just because the bird was flushed from its carcass.

Not realizing these facts, many a farmer bears a wholly unwarranted prejudice against these highly useful hawks. As proof of their guilt, he will tell how he has actually trapped them at their kill when they returned for a second meal. This sounds like a rather convincing case against the Buteos, unless one is familiar with their scavenging habits. Unfortunately the farmer does not know that the bird-eating Accipitrine hawks, which are usually the ones responsible for the actual killing of poultry, seldom return for a second meal. In most cases there probably wouldn't be anything left on which to make a second meal even if they did return. It does not take long for the keen eyes of any Buteo that happens to be in the neighborhood to spot such a tempting repast as the partially consumed carcass of a freshly killed bird. So the next time you have opportunity, put in a good word for the bird which may have been caught only by chance at the scene of the crime. Explain that the common practice of putting out a dead chicken with traps set around it to catch a "chicken hawk" is far more likely to get a harmless scavenger than a real chicken killer.

Some species of hawks have found carrion such a satisfactory source of food that they seldom kill for themselves, and the group of hawks known as vultures (but often incorrectly called buzzards) has evolved to the point where its members no longer have talons capable of killing or carrying off prey. The turkey vulture, a common American member of this group, is completely dependent on dead animals for food, and it is often seen along highways feeding on the various victims of modern high speed transportation.

The bald eagle, our national emblem, seldom seeks other food if carrion is available. Dead fish are practically the staple food of this bird, which explains why one rarely finds the bald eagle away from water. In regions where the fish hawk or osprey occurs, the bald eagle is not above turning robber, obtaining much of its living during the summer by diving at homeward-bound ospreys, forcing them to drop their catch. The eagle then retrieves the fish, often before it hits the water, and carries it off to its own nest or feeding perch.

Even the golden eagle, a more powerful bird than the bald, is perfectly satisfied to live on carrion if it is available. In the West this habit of scavenging has earned for the golden eagle a largely undeserved reputation as a lamb killer. Many lambs born on the open range die at birth or shortly after, and a recent investigation disclosed that most of the lambs that eagles were accused of having killed, showed unmistakable signs of having been dead when the eagles first found them.

The most flagrant errors in the naming of our American hawks occurred in connection with the genus Falco. Our largest falcon is practically identical with the famous peregrine falcon used so extensively by the medieval falconers, yet it was called duck hawk, despite the fact that it is not a hawk and seldom catches ducks. Equally confusing is the name that was given to our next smaller falcon, the pigeon hawk. One's first assumption is that it probably eats pigeons, while actually it received the name because of its resemblance to a pigeon. Our smallest falcon, a beautifully colored little bird, which feeds largely on insects during the summer, was the most grossly misnamed of all. It had applied to it the name sparrow hawk—the name by which the common European Accipiter, a much disliked bird, is known.

Long wings narrowing gradually to a point at the ends, and a streamlined body, blunt forward and tapered to the rear, give the falcons an appearance of speediness. Although they lack the ability to maneuver which a long tail gives the Accipiters, the falcons are undoubtedly the fastest fliers among the hawks and probably among all birds.

The falcons utilize their great speed to capture flying prey. The duck hawk feeds on such birds as the blue jay, flicker, and shore birds; while the pigeon hawk takes smaller birds and flying insects, such as beetles and dragonflies. Depending for success on sheer speed, the falcons must do their hunt-

ing in the open, as they are unable to follow a zigzag course through trees—in the manner of an Accipiter. In fact, if a bird is an expert twister and dodger, it is almost impossible for a falcon to catch it. A falcon attempts to strike at the end of a rapid dash or dive. If it misses, its momentum carries it far past its quarry, often causing the falcon to lose so much time maneuvering into position for another strike, that the quarry has ample opportunity to escape by dashing into a patch of cover.

In many ways our sparrow hawk is not a typical falcon. It is more likely to get its prey by pouncing on it than by chasing it. During the summer large insects are the sparrow hawk's favorite food; in the winter it feeds heavily on mice, although it also takes an occasional sparrow or other small bird. It has its own special hunting method. From a lookout perch it spots a suspicious movement in the grass, then flying to a position over it, it hovers in one place like a kingfisher until its prey again reveals itself by a further movement.

Of harriers we have only one, the bird we call the marsh hawk. It hunts close to the ground in open country, using a technique that might be termed "hedge hopping." This habit of flying a few feet above the vegetation apparently enables it to catch its quarry off guard and thus seize it before it has had a chance to try to escape. Although its talons are weak and its flight slow, involving much loose flapping of wings, the marsh hawk appears to have no trouble capturing rats, mice, and a certain number of birds. Probably its success can be attributed to its fairly long tail, which enables it to turn, twist or drop suddenly when prey is sighted. Like Buteonine hawks, the marsh hawk is also a consistent eater of carrion when it can be found.

In the matter of routes and methods of migration, special preferences are to be observed among the soaring Buteos, the fast-flying falcons, and the shelter-loving Accipiters. These preferences are common to each group as a whole, so we can ignore species distinctions. It is about as uncommon, for instance, to see a migrant pigeon hawk on a mountain ridge flyway, like Hawk Mountain, Pennsylvania, as it is to see a broadwing at a coastal point like Cape May, New Jersey.

The place to look for the Buteo flight in hilly or mountainous country is over any long ridge with a north and south trend. On fall days when fairly strong winds are blowing more or less at right angles to such a ridge, cliff, or other obstruction, hawks can be seen coasting southward in a glide as steep and fast as the lifting power of the resultant updraft will permit. Actual timing between two points on the same ridge has indicated that with strong winds the birds may progress southward in a continuous glide on motionless wings at speeds up to 60 miles an hour.

In more or less flat country like the Great Plains, the Buteos progress by alternately climbing on thermals and gliding, thus proceeding from one updraft to another along their course of flight. Often however, even in what seems like very flat country, a river valley or a low rise will produce deflection currents of sufficient strength for straight gliding. Human gliders have adopted these same two methods of flight. Soaring effortlessly on man-made wings, the sailplane enthusiasts at the celebrated field at Elmira, New York, depend upon prevailing updrafts at the rim of a high escarpment at one end of the field. In Texas, on the other hand, gliding is successfully practiced by the use of thermals.

The timetable of the various species along the flyways will vary. The earliest Buteos to go south are the broad-winged and Swainson's hawks that have to go all the way to South America. It is interesting that besides making the longest migrations these are the only two that travel in definite flocks.

August 20th will usually see the first flocks of these two species coming across the Canadian border; and by September 20th the bulk of the species will be in the United States. Within another month, by October 20th, both species will have largely passed across the Mexican border, well on their way to their winter home.

The southern flight of the other Buteos is less definite as to date, as there is often considerable overlapping of the breeding and wintering range. However, the peak of the flight of red-shouldered hawks follows that of the broadwings, with the redtail flight coming still later from mid-October on into early November. Other soaring species, such as eagles and vultures, are usually found scattered in among the Buteos all during the flight period. Far less is known about the Buteos' spring flight, although we do know that April is in most places the best month to look for it.

The falcon flight, on the basis of present knowledge, appears to be confined to a definite flyway only along the coast. Here it follows the shore line and the outer beach strips, the birds cutting freely across the water from one point of land to another. The falcons—strong fast fliers—do not seem to be at all afraid to cross large bodies of water, even though it may involve going completely out of sight of land. They are the only hawks that will do this, but they do it so habitually that both duck and pigeon hawks are a familiar sight to sailors on coastal steamers. Quite often they alight on such vessels to rest, or to feed on a catch while perched on the crossarms of the rigging.

The Accipiters present a real puzzle. One sees them along the mountain ridges in October just skimming the treetops, yet they are also frequently met in the low intervening country, and in some winds they are abundant at certain points along the shore. The fact that most of the Accipiters seen along the coast are young birds, and that along the Atlantic coast they are seen chiefly after periods of strong, northwesterly winds, gives rise to the theory that such areas are not in the species' normal migration route and that the Accipiters seen along the coast are inexperienced birds that have been blown off their course. The fear of crossing water, which all Accipiters display, tends to add further weight to this theory. This fear is so strong that when they get out on a point they will often backtrack for many miles to pass around the head of the bay or inlet rather than cross even a fairly narrow stretch of open water.

The osprey, being dependent on fish for food, is chiefly confined to sea coasts and river courses during its migration to its winter home, along the shores of the Gulf of Mexico and the Caribbean Sea. It does, however, seem to have some inland flyways, especially in the spring, although they have not yet been located except at a few isolated points.

The marsh hawk, like the Accipiters, moves south over a broad front. At times it is very common along the coast, but it is also frequently seen in the mountains; in fact, there are few areas that are not visited by a few migrant marsh hawks. Its migration is chiefly remarkable in that some of the birds go to Cuba for the winter, not hesitating to brave the hundred miles of open water which separates that island from the Florida Keys—a surprising feat, in view of the apparent weakness of the bird's flight.

Should you be successful in locating some of the hawk flyways in your region, keep as detailed notes as you can, and don't worry if at first you aren't always able to determine the exact species. Even meager records can often be quite valuable to a person working on the birds of the area. If you are so fortunate as to be in a region where hawks breed in any numbers and you would like to band a few of the young before they leave the nest, to find out what becomes of them, the author will be glad to furnish numbered government bands and keep you posted regarding any returns.

If you encounter cases of hawk persecution, send to the National Audubon Society (1006 Fifth Avenue, New York, N. Y.) for some of its educational material on hawks. In most cases this should enable you to improve the situation. If by any chance you would prefer to have the Association attempt to handle the matter directly, just send the details, and appropriate action will be taken.

DO NOT MISS

When Theodore Roosevelt was crossing the campos of inner Brazil, facing the perils of the unknown, he was made suddenly homesick by the song of the South American sparrow which poignantly reminded him of its northern cousin he had so often heard at Oyster Bay. It was partly because of this incident that **DR. FRANK M. CHAPMAN**, dean of American ornithologists, set out to track down the relationship of the two birds, a long and tortuous quest that leads into the mystery of bird migrations and to the complex effect of environment. In a forthcoming issue he sums up his fascinating investigations based on the acquisition of more than a thousand specimens collected over a span of 50 years in all quarters of the sparrow's vast range, from Guatemala to Cape Horn.

Henry B. Kane, nationally known nature photographer whose full-color picture of a hawk appears on the cover of this issue, was the author of a magnificent alubum of photographs published serially in NATURAL HISTORY under the title *Seeing Nature Through the Camera's Eye*. In the next issue he will present an unprecedented photographic story entitled **AMERICAN SILKWORM.** We think of the silkworm as being essentially a Chinese insect, yet here in the United States the woods are literally full of giant, wild silkworms. Despite their abundance, the sight of a Promethea spinning its cocoon is rarely observed, owing to its leaf-green camouflage. Mr. Kane's record of it has beauty and scientific interest which make it a remarkable photographic achievement.

If you hear the dreaded warning of a rattlesnake—do not run, don't even walk to the nearest exit. Stand still! Nature gave snakes the instinct to strike rapidly moving objects. Don't move and you are not apt to be bitten. So says Ross Allen who milks rattlesnakes for a living. In his forthcoming article he shows how **A SNAKE IN THE HAND** is worth two in the grass from the point of view of medical research because of the valuable humanitarian purposes the venom can serve. His job of capturing and keeping these unjustly hated creatures sheds much light on their habits and peculiarities.

(Above) STAR GOD OF LONGEVITY. A white jade representation of this Star God, who may be recognized by his abnormally high forehead, his happy expression, and the symbols of long life which accompany him—the stag with its horns turned back and the fungus of immortality *(Author's collection)*

(Above) THE SYMBOL for Good Fortune, carved in a jade girdle pendant. On the other side *(below)*, the artist has skillfully fitted the Star God of Longevity into the same pattern *(Author's collection)*

GODS and

Stories full of mystical charm give new meaning to familiar decorative figures and reveal the philosophy which has influenced the ancient carving art of China

STUDENTS of the jade objects that have come down to us from the centuries preceding the Christian era are often impressed by the almost total lack of figures of deities in the forms of men. To such an extent is this true that it was not until the seventeenth century of our era that we find the followers of Taoism carving jade images of Lao-Tzu, the Chinese philosopher who flourished about the sixth century B.C. In works of this period Lao-Tzu is sometimes depicted as accompanying and dominating the Eight Immortals, his characteristic attribute in these instances being a joo-i scepter denoting supremacy.

Like Lao-Tzu, certain of the stellar deities worshiped in ancient China as ritualistic abstractions were later carved in jade in human forms. In this way a star called the Old Man of the South Pole, which was the object of sacrifices as early as 246 B.C. became embodied in the late Ming time in the many jade figurines and carvings of the Star God of Longevity. Images of this stellar god, known as Shou Hsing, depict him as an old man, whose expression is smiling and happy and whose venerable head has an abnormally high forehead. He is generally represented as riding on or accompanied by a stag, the beast of long life. Also, he frequently holds a peach, symbol of immortality, and a long staff to which are attached other symbols of long life and happiness.

The Star God of Affluence is naturally much worshiped in China. Jade images usually represent him as standing on a tortoise or sometimes accompanied by a dragon. Connected with this deity as a talisman is the famous "money tree," from the branches of which are suspended strings of cash, and whose fruit are ingots of gold—wealth to be had by merely shaking the tree.

In China literary attainment is ranked among the highest honors. Students aspiring to advancement in literature invoke Wen Ch'ang, the Star God of Literature to aid them in passing creditable examinations. Like other stellar deities, Wen Ch'ang is very closely connected with the constellations. He is reputed to have his residence in a portion of the star group that we know as the Great Bear or Great Dipper. As a man he was said to have lived on earth in the T'ang dynasty (A.D. 618-907), but was also reputed to have been reincarnated no less than sixteen times. His images, which date from the Ming dynasty, sometimes show him as a fine looking man holding a writing brush and a book and standing on a carp, signifying literary eminence. At times he is represented as a disembodied spirit of unprepossessing appearance with deformed head and with one foot

*The author's career and personality are recounted on page 177 of this issue.

IMMORTALS in JADE

By Herbert P. Whitlock*

Curator of Gems, The American Museum of Natural History

(Below) THE STAR GOD OF PROSPERITY carved in smoky quartz. Over his head and at left appear the two "lucky boys" *(Morgan collection)*

All AMNH photos

raised in rough imitation of the Chinese character designating the star group that is his home.

The reader may be acquainted with the rabbit that decorates the disk of the moon according to Chinese legend, an artistic example of which is seen on the opposite page. From early Ch'ang time workers in white jade have produced many examples of the legendary moon disk, some of which are both elaborate and beautiful. The legend illustrated in this design concerns the adventures of Heng O, the wife of Shen I, the Divine Archer. Shen I besides being a skillful bowman was an accomplished architect. He built a magnificent palace upon the White Jade Tortoise Mountain for Chin Mu, the daughter of Hsi Wang Mu, the Golden Mother of the Tortoise. For this immortal labor Shen I received as a reward one of the wonderful pills which would render him immortal. The Divine Archer hid the pill of immortality under a rafter of his house and departed upon another of his thrilling adventures. While he was away Heng O, guided by the radiant light and blissful odor emanating from it, found and ate the precious pill. Thereupon she suddenly found that she could drift through the air like fibers of the finest silk; and, just upon the return of her husband, she flew through the open window.

Heng O continued her flight and presently reached a silvery luminous sphere, solitary and cold, in reality the surface of the moon. Here seated beneath a cinnamon tree she was seized with a violent fit of coughing, and presently from her lips there emerged the coating of the pill of immortality that she had so foolishly eaten. Before her eyes this changed into a rabbit as white as purest jade, and thus came into being the ancestor of the spirituality of the *Yin*. From that time the rabbit took up its abode in the moon and busied itself with compounding the pills of immortality in a mortar under the branches of a cinnamon tree, which is what you see it doing in the illustration opposite.

The concept of immortality, has played an important role in Chinese thought from the very earliest times. The philosophers and sages of Taoism sought eternal youth no less avidly than did the mystics of Europe in the Middle Ages. From the Taoist concept of immortality have emanated a group of legends that have contributed at least one goddess who has been immortalized in jade.

In the legendary continent of Shen Chou, far into the Western Sea, Hsi Wang Mu, the Golden Mother of the Tortoise, was formed of the pure quintessence of the Western Air. Her palace is built high among the inaccessible K'un-lun Mountains and is constructed of gold and precious stones. There upon the borders of the Lake of Gems grows the celestial Tree of Immortal Peaches, which puts forth leaves only once in 3000 years. Three thousand years more are required for the immortal fruit to ripen, making the cycle 6000 years. So once every 60 centuries, upon Hsi Wang Mu's birthday, there occurs "the Feast of the Peaches," when all the Immortals are summoned to renew their immortality through partaking of the divine fruit. The guests at this long-delayed birthday party are regaled with "music on invisible instruments and songs not from mortal tongue." The Golden Mother of the Tortoise is represented as a beautiful woman dressed as a Chinese princess and attended by very young girls, who bear her fan and a basket of the Immortal Peaches. These Attendants, either two or five in number, are the Gemmeous Lasses or Fairy Maids. She is also often attended by a peacock upon which she rides through the clouds on her frequent celestial travels.

A charming stellar myth that is sometimes portrayed in jade carvings of late period is the fable concerning Aquila and Vega, the stars known to the Chinese as the Herdsman and the Weaver-girl. The daughter of the Sun God, the heroine of this story, was so constantly engaged at her loom that her father, concerned because of her unvarying industry, decided that she should be married. Thinking that marriage would brighten her life and divert her mind from the exclusive consideration of household things, he selected for her husband a neighboring herdsman who tended cattle on the banks of the Silver Stream of Heaven, which we call the Milky Way. So well did this domestic arrangement succeed, however, that no sooner was the Weaver-girl married than she became gay and lively. Her only concern was to make herself attractive and agreeable in the eyes of her husband, and her loom was discarded in favor of beautiful clothes and charming graces.

In great anger at seeing so deep a change come over his daughter, the Sun God ordered his son-in-law, the Herdsman, to betake himself to the other side of the Silver Stream of Heaven, that deep and rushing river of stars, and decreed that only once a year upon the seventh night of the seventh month should they meet and embrace. In order to enable the herdsman lover to cross the heavenly river to the side of his wife, the Sun God caused a great flight of magpies to join wing to wing and so to form a living bridge upon which the eager feet of the lover crossed the Silver Stream of Heaven.

The two figures carved in relief in jade show the Herdsman accompanied by an ox and his celestial consort holding a distaff in her hand. Between them the cloudy outlines of the "river of stars" rolls eternally.

The introduction of Buddhism into China in the first century of our era served to graft upon the existing Taoistic habits of thought many ideas and concepts strongly tinged with Hindu myth. One of the most far-reaching of these Hindu influences was the habit of ascribing to sages and philosophers the quality of self-sequestration. As is well known, this trend toward the imitation of the mode of life of the Bodhisat has produced in India a veritable army of zealots devoted to a life of self-denial, celibacy and mendicancy.

In China there grew up, following the introduction of Buddhism, a group of semi-historic, semi-legendary human spirits dwelling apart in mountains and hills remote from human contacts. Thus we have the *Pa Hsien*, or Eight Immortals, who have at various times during a period of some 2000 years attained immortality in the Western Paradise through devotion to Taoism and abstraction from the world.

Two of the eight are represented as females. Each of the eight has come to be characterized, in the little jade carvings which depict them either singly or in a group, by some conventional object associated with his legend, and also by a characteristic headdress. As

(Below) MOON DISK in white jade showing the rabbit under a cinnamon tree. The rabbit, embodiment of the *Yin* spirituality, is compounding the pills of immortality, from one of which it emanated. The entire design dramatizes the story of Heng O, who as a three-legged toad, took up her abode in the cold and serene moon *(Drummond collection)*

(Right) A jade carved figure of Wang Mu, the Golden Mother of the Tortoise, holding in her hands one of the Immortal Peaches of the orchard over which she presides *(Author's collection)*

TWO VIEWS of a coral snuff bottle representing two stellar deities, the Weaver-girl *(above)* and the Herdsman *(below)*, whom she married *(Drummond Collection)*

a group, their legend seems to have taken form at about the time of the Yuan dynasty (1280-1368), although some if not all of the *Pa Hsien* were separately celebrated as Immortals from a much earlier time.

The Chief of the Eight Immortals, Chung-li Ch'uan, undoubtedly has the most ancient history. Some accounts of him state that he lived 1000 years before our era, which would make his legend antedate the life of Lao-Tzu. Another account gives the period of his life as in the Han dynasty, which extended from 206 B.C. to 220 A.D.

In his old age Chung-li Ch'uan became a hermit and by meditation and abstraction obtained the secrets of the elixir of life and of the transmutation of metals. One legend tells how on one occasion while he was deep in meditation, the wall of his little hut was rent asunder, exposing to view a marvelous jade casket in which he found the secret of how to obtain immortality. His images may always be recognized by the feather fan that he holds, with which he fans the souls of the dead back into their bodies.

Chang Kuo-lao, another of the Immortal Eight, was supposed to have lived as a hermit in the T'ang dynasty (A.D. 618-907) and to have inhabited a mountain in Shansi province. He was a very famous magician, even being credited with the amazing feat of appearing alive and well after his body had died and begun to decay. He is often represented riding a white mule which was capable of carrying him thousands of miles a day and of being folded up like a piece of paper when not in use. When Chang Kuo again required means of locomotion, he had only to fill its mouth with water and spurt the fluid over what had previously seemed to be only a sheet of paper in order to reincarnate this miraculous beast of burden.

Jade images of Chang Kuo, when representing him as mounted on his white mule, sometimes show him facing its tail. His emblem is a kind of musical instrument formed from a bamboo tube with two rods with which it is beaten.

In one of the stories related about him, it is said that a celebrated Taoist necromancer was asked by the Emperor reigning at that time (A.D. 735), to tell who Chang Kuo really was. After exacting a promise from his sovereign to make a penitential journey to the home of the sage, Ta-shan, the necromancer replied, "Chang Kuo is a white spiritual bat which came out of primeval chaos."

Lan Ts'ai-ho may well be called the Immortal Street Singer. Although all the carved figures of this Immortal are represented as a woman, an ancient Chinese authority states that Lan Ts'ai-ho was a youth, "who could not understand how to be a man." Obscure legends credit her with having lived in the T'ang dynasty, from the seventh to the tenth centuries of our era.

She wandered through the streets of ancient Chinese cities clad in a tattered blue gown, with one foot shod and the other shoeless, singing a doggerel verse that denounced the transient pleasures of mor-

(Below) **THE CHIEF OF THE EIGHT IMMORTALS (Chung-li Ch'uan), who fans the souls of the dead back into their bodies with a feather fan** ***(Drummond Collection)***

(Below) **TWO OTHER IMMORTALS: Lan Ts'ai-ho, the Immortal Street Singer, whose emblem is a basket of flowers, and the magician Chang Kuo-lao, with his hollow bamboo and rods** ***(Drummond Collection)***

THE IMMORTAL STREET SINGER, carrying her customary basket of flowers, is again represented on the white jade girdle pendant at upper left. On the back of it *(above)* is a one-line Chinese ode in seal characters: "Flowering trees return again" *(Author's collection)*

tal life and extolled the lasting joys of immortality.

Single figures of Lan Ts'ai-ho are much commoner among jade carvings than those of any other of the Immortals. She is invariably shown as bearing in her hands her emblem, a basket filled with flowers.

If we accept as doubtful the feminity of Lan Ts'ai-ho, the only woman among the Eight Immortals is Ho Hsien-ku, who is said to have lived in the seventh century, in the T'ang dynasty.

Legend also credits her as being the daughter of a shopkeeper in the province of Hunan. She early took to the life of a recluse on a mountain in her native province and became so steeped in Taoist mysticism that she was enabled to float from place to place through the air. She ultimately disappeared from mortal view; some say that she ate one of the peaches of immortality and so attained eternal bliss.

Although not so popular with the jade carvers of the Ch'in period (255-206 B.C.) as Lan Ts'ai-ho, single figurines of Ho Hsien-ku are frequently encountered. These represent her as poised on a floating lotus leaf, with her emblem, a lotus blossom, held in one hand. Often a fly-whisk takes the place of the lotus bloom.

Lu Tung-pin was, in all probability, an historic personage; at least a very definite date, A.D. 798, has been assigned to his birth. Also his father and his grandfather were officials under the reigning dynasty. There is nothing abnormal or fabulous in the record of his life up to the time when he attained manhood. Then on a journey which he was making to the province of Kiangsi, he met the Fire-dragon and was presented with a magic sword that rendered him invisible amid the clouds. Later he met the spirit of Chung-li, who instructed him in the magical lore of Taoism. While still young he was exposed to ten supernatural temptations, and having successfully withstood these trials, he attained immortality, was invested with various magical weapons, and traversed the world for upward of 400 years, killing evil dragons and generally rendering occult service to mankind. His images may be distinguished by the emblem of a great sword, which in every case is slung over his back.

Han Hsiang-tzu probably lived during the ninth century. He was a nephew of Han Yu, a famous

(Below) THE ONLY OTHER WOMAN among the Eight Immortals, Ho Hsien-ku, is identified by the lotus blossom held in her hand. Poised on a lotus leaf, she had the power to float through the air *(Drummond Collection)*

scholar, and himself attained a considerable eminence in literature. He was also a wonderful musician, his favorite instrument being the flute, and his playing on this was of such a supernatural quality that he was said to have caused flowers to grow and blossom. He was instructed in Taoism by the Immortal Lu Tung-pin who conducted him to the Tree of Immortal Peaches in Wang Mu's orchard. In striving to reach the fruit, Han Hsiang-tzu fell, and in so falling attained immortality. His emblem is the magic flute, which accompanies him in all of his carved representations.

Ts'ao Kuo-chiu, the most recent of the Eight Immortals, seems to have been actually connected with the ruling family of the Sung dynasty. He was a brother of the Empress Ts'ao Hou and ranked as a military commander during his lifetime, which has been given as A.D. 930 to 999.

In order to explain how such a highborn and well-known personage joined the ranks of the Immortals, legend says that the occupants of seven of the eight grottoes in the Upper Sphere wished to see the eighth inhabited by a worthy person. They chose Ts'ao Kuo-chiu because "his disposition resembled that of a genie." Subsequently Ts'ao Kuo-chiu became a hermit. One day he was visited by the Immortals Chung-li and Lu Tung-pin, who asked him what he was doing.

"I am engaged in studying the Way," replied the hermit.

"What way and where is it?" they asked.

When Ts'ao Kuo-chiu pointed to the sky, the ritual continued: "Where is the sky?" When he pointed to his heart, the immortal visitors were satisfied and said, "Truly you have answered well. The heart is the sky, and the sky is the Way; you understand the origin of things."

Thus was Ts'ao Kuo-chiu added to the Immortals. His emblem is a pair of castanets, and his images wear a court headdress and official robes.

Chung-li Ch'uan

Chang Kuo-lao

Lan Ts'ai-ho

Ho Hsien-ku

Quite in contrast to Ts'ao Kuo-chiu, the Immortal Li T'ieh-kuai seems to be a purely legendary personage with whom no period or dynasty may be connected, although one tradition speaks of him as living in the Yuan dynasty (A.D. 1280-1368). He lived the life of a mystic, devoting himself entirely to the lore of Taoism, and became versed in all the practices of magic and necromancy. Among other supernatural feats, he sometimes projected his soul from his body, the disembodied *anima* mounting to the skies and there communing with celestial beings. On one such occasion he instructed his disciple Yang to cremate his body after a lapse of seven days, as he intended to return before that time if at all. But Yang was called away to console his dying mother after only six days had elapsed, and supposing Li T'ieh-kuai to have departed forever, burned his body. So, when the soul of the sage returned after seven days, he found nothing of his mortal habitation but a heap of ashes. Whereupon the dispossessed *anima* entered the remains of a lame beggar who had died, and he maintained this ignoble semblance throughout the rest of his earthly career.

It is relatively easy to identify the jade figurines of Li T'ieh-kuai because he is universally represented as leaning on an iron crutch or staff. He holds in one hand his emblem, the magic gourd, from which ascend clouds and emanations.

In addition to the various emblems which serve as a means of recognizing the Eight Immortals, each of them has been assigned a conventional head covring or (in the case of the two women) a fashion of dressing the hair.

Thus jade, whose beautiful hues and soft texture make it a substance most pleasing to handle and admire, has frequently been chosen by the Chinese as the medium in which to carve the likenesses of their gods and immortals—beings partly of this world and partly of the mythical sphere in which the colorful and imaginative philosophy of the Orient revolves.

Lu Tung-pin

Han Hsiang-tzu

Ts'ao Kuo-chiu

Li T'ieh-kuai

A SERIES OF HEADS drawn by the author, to show conventional headdresses (in the case of the men) and hair arrangement (in the case of the women) by which the Eight Immortals may be recognized

AN ACTUAL PERSON OF HISTORY apparently lies back of the legendary Lu Tung-pin, shown at extreme left *(upper figure)*. He is said to have withstood ten supernatural temptations and then traversed the world for over four centuries, killing dragons and rendering occult service. A great sword generally hangs over his shoulders to identify him.

The musician Han Hsiang-tzu *(lower figure, extreme left)* also probably lived in the ninth century. His supernatural musical ability is said to have caused flowers to grow and blossom; hence he is traditionally represented carrying his favorite instrument, a flute *(Drummond Collection)*

(Left) THE MOST RECENT of the Immortals, Ts'ao Kuo-chiu, was seemingly connected with the ruling family of the Sung dynasty. Note his emblem, a pair of castanets *(Drummond Collection)*

THE LAST OF OUR EIGHT IMMORTALS, Li T'ieh-kuai *(right)*, once kept his soul out of his body so long that he had to take the body of a lame beggar. Hence the iron crutch or staff with which he is universally represented *(Drummond Collection)*

FASHION DESIGNS IN

Full appreciation of form and color among clams and conchs is gained through an understanding of how Nature unfolds their complex patterns from simple beginnings

THE kingdom of beauty is free to all who can enter it, but only those who have eyes to see can find their own way to its inner temple. Many will be content merely to glance at a sea shell and say that it is pretty before placing it to their ears to "listen for the sound of the waves." Even the Walrus appreciated the Oysters and paid his highest tribute to their flavor, but it remained for the discerning naturalists of an earlier day to reserve for clams and conchs such lustrous names as Venus, Astarte, Juno, Semele, Melo.

Some prefer to keep their mysteries unsolved and take for granted whatever beauty they may find in Nature's patterns, but experience shows that the more we can learn about the origin and unfolding of a natural design, the more deeply do we feel its beauty. Such must be the apology of an evolutionist for having sought to penetrate one of the main secrets of the molluscan world.

In natural designs a profusion of details often tends to conceal a few simple and easily grasped principles. But while the principles have a wide application, any particular case always represents the end result of an age-long history. This must be deciphered at least in its main outlines before the facts of the present can be properly interpreted against the background of the past. And since a part of the remote past does live on in the present, it is necessary both to keep open before us the fossil records of ancient life and to compare the living with the dead in order to learn which traits come from the older heritages and which are of later date.

Now there are many thousands of species of fossil and living shell-bearing mollusks, so it might seem at first to be a hopeless task to learn much about them even in a long lifetime. Fortunately, however, the molluscan world is one which permits itself to be surveyed and mapped in great detail. Through the coöperative and mutually corrective labors of many students, it is now divided into classes, subclasses, orders, families, genera, species, subspecies, and individuals, in descending order. If we constantly keep these "maps" (or classifications) before us, we may in even a few years

(Below) ONE STYLE, from infancy to aldermanic girth.
The swelling contours of this worthy clam
Are here engraved upon his ample shell.
Each growth ring spells one feast, each line one fast.
One feast, one fast, and thus his life ran on
Through many a varied year until the storm
Stopped short the life, but left the shell unharmed

All AMNH photos by Coles

Answers

(Each percentage is an average based on all the stomachs of the species examined to date by the Fish and Wildlife Service)

Sparrow hawk eats 70% grasshoppers.

Osprey eats 100% fish.

Cooper's hawk eats 19½% poultry.

Broad-winged hawk eats 21% snakes.

Red-shouldered hawk eats 15% frogs.

Red-tailed hawk eats 51% mice.

Swainson's hawk eats 56% ground squirrels.

Golden eagle eats 54% jack rabbits.

Sharp-shinned hawk eats 96½% small birds.

Additional information on hawk diet is contained in Food Habits of Common Hawks, *Circular 370, U. S. Department of Agriculture; 5¢ (Superintendent of Documents)*

AMERICAN BIRDS OF PREY

A Chart Compiled by RICHARD H. POUGH for NATURAL HISTORY Magazine, October, 1940 ·

Drawings by RUDOLF FREUND and ROGER T. PETERSON (*in circle*)

Our birds of prey can be divided into six groups as shown below. Typical illustrations are given as well as the breeding ranges of various species in each group. Learn to know your hawks and enjoy the thrill that comes from observing their incomparable mastery of flight

VULTURES

Ugliness

CALIFORNIA CONDOR. Possesses world's largest wing area

BLACK VULTURE. Good scavenger. All vultures walk; most hawks hop

TURKEY VULTURE, master of effortless flight; kills nothing

KITES

Gracefulness

EVERGLADE KITE. Threatened with extinction. Eats only snails

MISSISSIPPI KITE. A rare but potentially beneficial bird

SWALLOW-TAILED KITE. Our most graceful and beautiful bird

HAWKS

A long tail

GOSHAWK. Power and speed make it one of Nature's boldest

SHARP-SHINNED HAWK. Almost exclusively a bird-eater

COOPER'S HAWK makes a sudden onslaught from wooded shelter

BUZZARDS

A heavy body

RED-TAILED HAWKS. Fr[illegible] of the farmer, despite ill-te[illegible]

RED-SHOULDERED HAW[illegible] feed largely on injurious rode[illegible]

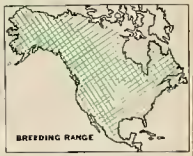
FERRUGINOUS ROUGHLE[illegible] A superb bird, needlessly slaug[illegible]tered

EAGLES

A massive neck

BALD EAGLE. Emblem of the United States; now a rare bird

GOLDEN EAGLE. A large, agile hunter of the mountain wilderness



FALCONS

Streamlined

SPARROW HAWKS. Our smallest and most brightly colored hawks

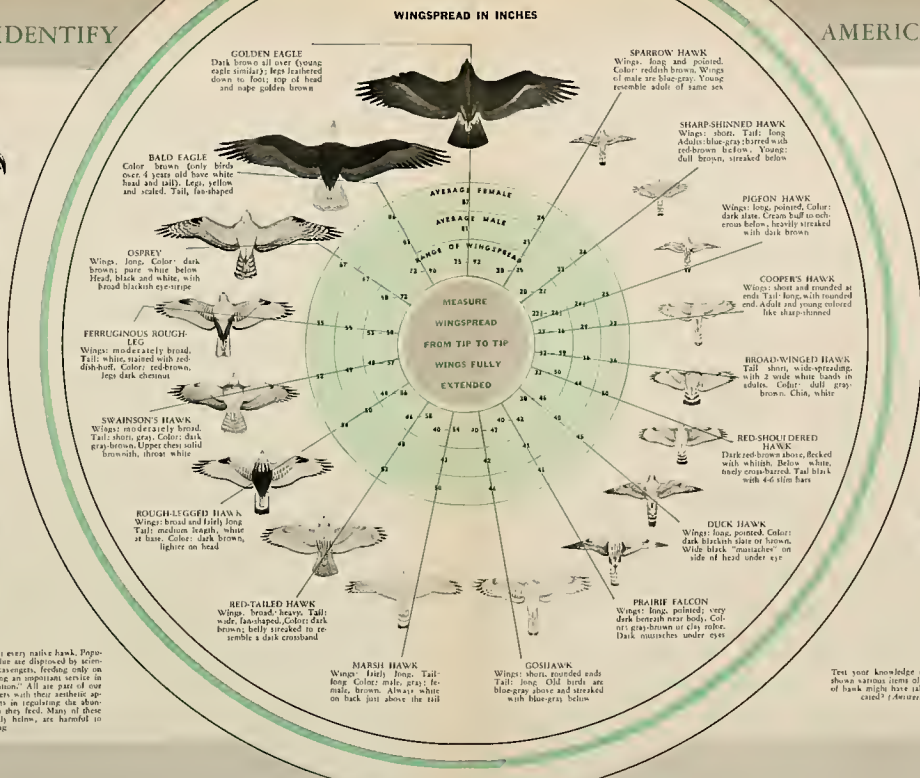
DUCK HAWK. Rated the fastest flier in the bird world

PRAIRIE FALCON. Haunts dry canyons and ridges of arid West

HOW TO IDENTIFY AMERICAN HAWKS

A UNIQUE PICK-POINTED BEAK. The Everglade Kite's "snail pick" enables the bird to extract a live snail from its shell without breaking it. This kite lives entirely on one kind of fresh-water snail. No snails, no kites

THE OSPREY'S "FISH TONGS." They work with two toes forward and two behind—an arrangement possessed by no other bird of prey. This and a sole as rough as a file, make the foot of an osprey a perfect mechanism for catching fish. Flying away with its prey held in both feet, the osprey turns the fish head on to reduce air resistance

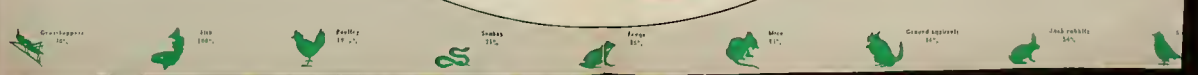


THE FALCON'S "MEAT-CUTTER." A sharp tooth and notch in its beak enables the falcon to cut meat in a running stroke, instead of tearing it

VULTURE'S FEET ARE ONLY GOOD FOR WALKING. A taste for flesh but no way of killing prey makes the vultures dependent on carrion. They are therefore entirely harmless and beneficial as scavengers

Nature has a place and need for every native hawk. Popular misbeliefs denying their value are disproved by scientific study. Many hawks are scavengers, feeding only on dead animals and thus rendering an important service in Nature's "department of sanitation." All are part of our wildlife, rewarding Nature lovers with their aesthetic appeal and playing essential parts in regulating the abundance of the animals on which they feed. Many of these animals, illustrated symbolically below, are harmful to farming

Test your knowledge of hawk food habits. Below are shown various items of prey. Can you tell which species of hawk might have taken each with the frequency indicated? *(Answers on reverse of this sheet)*



THE WORLD OF SHELLS

By William K. Gregory

Curator, Departments of Fishes and Comparative Anatomy
The American Museum of Natural History

gradually build up some knowledge of the territory as a whole, especially if we study our individual specimens as representatives of the larger groups.

As in the human world, fashion designs for clams and conchs involve both form and color. Although the clam tribe is by no means ancestral to the snail-like mollusks, the history of its shells is in some respects easier to interpret and yields many striking examples of our present theme. If we look closely at an ordinary clam *(illustrated at lower left)*, we shall see that the outside of each of its two shells bears a concentric series of evenly curved lines. Each one of these lines records a former stage in the growth of the shell, so that the most recent zone is on the outer edge, while the tiny baby shell is usually preserved at the top. This habit of carrying on its back a nearly complete set of growth stages from infancy to old age is useful to the clam because its armor is thus automatically enlarged to suit the size of the animal within.

(Above) THE WORLD'S FASTEST CLAM? With its long, thin, streamlined shell and sharp-edged foot, the razor clam would seem like a sure winner in the Clam's Day sweepstakes. Its cousin the Tellina clam *(upper row, right)*, although far less successful in reducing "waistline" and adding to "length," yet seems to represent the rangy type from which the "razor" has been bred

(Above) MEDIEVAL ART or natural design? In this Florida "turkey-wing," as viewed from above, the growth forces have wrought a brilliantly balanced symmetry. The "wings" on either side start from the umbo or growth center. The straightness of the median hinge line records the even balance of the opposing growth forces

The shells of most other mollusks, both bivalves and snail shells, grow in much the same general way, that is, by building out the shell along its outer edge, next to the gape, or opening.

The material of which the shell is made consists mostly of calcium carbonate, which oozes out from many small glands that lie along the outer edge of the growing mantle or apron. We can readily understand that if all the little shell glands secrete their material at equal or nearly equal rates, the shell will grow larger evenly in all dimensions so that an old clam will be very like a young one. If you ask me what makes all the little shell glands work together so evenly, I can only say that a racial or hereditary tendency in certain kinds of clams causes all the little shell glands to be as much alike as peas in a pod and to behave far more alike than do the famous quintuplets.

There is a convenient technical name for any such series of similar units. Some years ago I invented for them the term *polyisomeres*, from the Greek stems meaning "many equal parts." I may say now that polyisomeres of one kind or another form at least the background of all natural as well as human designs. And if clams could sing, even their vocal patterns would involve polyisomeres of several kinds.

The most primitive of the clam tribe have their right and left shells, or valves, nearly alike, and the hinge line along the back is long and straight. Thus if we look at the "turkey-wing" shell at left, we see a symmetrical design with its rights and lefts disposed toward each other as the so-called "mirror image" is to the original. This particular design looks as if it might perhaps have come from some sort of primitive or medieval source. I am not saying that medieval artists copied Nature or that Nature copied them. Merely that in this and many similar instances both parties have hit upon a principle of design that for some reason has a wide appeal to the human eye, namely, the balancing of symmetrically arranged polyisomeres on either side of a midline.

Every student who has seen models of the development of the frog's egg will recall that after the spherical stage is reached, the cells begin to heap up along either side of a notch which eventually lengthens out in a fore-and-aft direction. In this way a spherical body is transformed into an elongate animal, with "mirror image" (or bilateral) symmetry. Something of the same sort has happened in the remote ancestors of the razor clams *(modern examples above)*, in which

the fore-and-aft length of the shell has come to be many times greater than its height. This change took place so long ago that even the oldest known fossil representatives of the razor clam family already resembled their modern descendants in general plan; but certain members of the family are much less elongate than others, and in the not distantly related family of the Tellina clams we find shells of intermediate proportions that seem to lead back to a more normal clam type.

The razor clam, as we have seen, owes its peculiar form to an extreme emphasis of its length. And so does the giant pen shell.

The opposite case, in which the vertical diameter has become excessively great, is seen in the hammer oyster *(lower right)*. Both extremes may have been derived in remote geological times from a more primitive and central form, illustrated by the horse mussel, in which both length and height are moderate.

Thus when certain parts of an evenly growing series become accelerated or retarded, equality, or monotony, gives way to emphasis or accentuation. In technical terms, polyisomeres give rise to *anisomeres,* or unequal parts.

When certain equally spaced units are selected for emphasis, the surface of the shell may be covered with nodules, ribs, flounces or spikes. In the spiny oyster below such more or less regularly spaced outgrowths have a double aspect: they are polyisomeres in so far as they resemble each other, but they are anisomeres in comparison with the less emphasized units which they have outdistanced in growth.

In this case the spines may be useful to the owner because they would make it difficult for a devouring starfish to wrap its arms around the shell in order to pull the two valves apart. So a natural design which happens to have a certain aesthetic value to the human eye may have a purely utilitarian value to its owner.

That branch of science which measures the rates of growth from infancy to old age would find excellent mate-

(Right) WHERE flounces are required. The stony folds built up by the mantle of the spiny oyster may have a protective value against starfishes

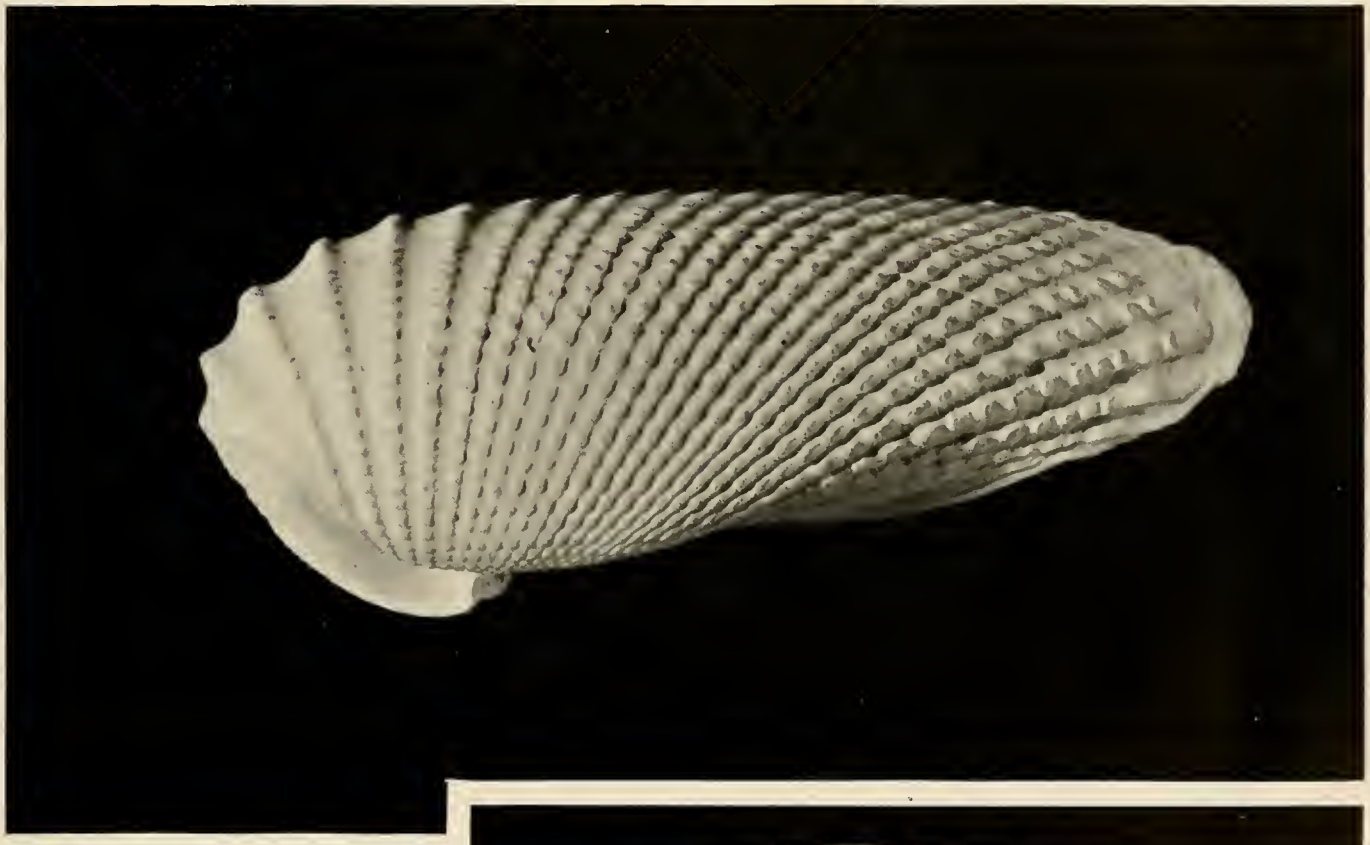
(Below) THE CONTOURS SHIFT, the plan alone remains: diverging proportions among mussel and oyster shells. In the most primitive stage *(lower row, left)* of the horse mussel both length and height are but moderately developed. Increasing height in the wing shell and pearl oyster culminates in the excessively high and narrow hammer oyster *(far right)*. Increase in length alone produces the pen shell *(top, left)*

rial for study in the valves of the Florida angel shell *(below)*. Inspection of its beautiful system of fanlike and zonal lines shows that any given point moves under the influence of two sets of forces which are tending to increase the height and the length respectively. At the front end of the shell the outwardly growing force is predominant and the first radial rows are nearly at right angles to the long axis; toward the rear end the backwardly growing force increases, so that the radial rows are directed more backward than outward.

In the scallop shell, on the other hand, growth is more evenly radial and fanlike. A scalloped or plaited edge is produced whenever the edge of the mantle is divided into an alternating series of faster and slower growth nodes along radial paths. This tendency is carried to an extreme in the widely serrate edges of the so-called giant clam or Tridacna. On the other hand, zonal ridges are produced when forward growth is temporarily checked and the entire outer edge of the mantle humps itself up into a fold.

The color patterns of bivalves are doubtless just as much a result of spatial arrangements of growth forces as are the forms of the shells. Pigment-producing cells are located in the edge of the mantle just beneath the under surface of the horny outer covering. The widening color rays of the sunrise shell at bottom must have been produced in much the same manner as that described for the radiating rows of points in the angel wing, while the wedges in the many-zoned Chione clam follow the folds of the mantle.

When a man is called a "pinhead" he is supposed to be deeply insulted, but to a clam such an epithet would be not only a compliment but the equivalent of an honorary title, for a clam has literally no head at all. Whether a clam has even a tiny brain



(Above) AN ANGELIC ABACUS. The angel wing's amazing system of radiating ridges and nodes record the intersections and resultants of two sets of growth forces, one radial the other zonal

(Right) COLOR DESIGNS in the clam tribe. The widening rays of the sunrise shell have been laid down along the edge of a steadily widening mantle; the dark wedges of Chione follow the strong folds which the mantle secretes at regular intervals. In the turkey-wing *(lower row, right)* the wavy bands are due to unequal growth rates

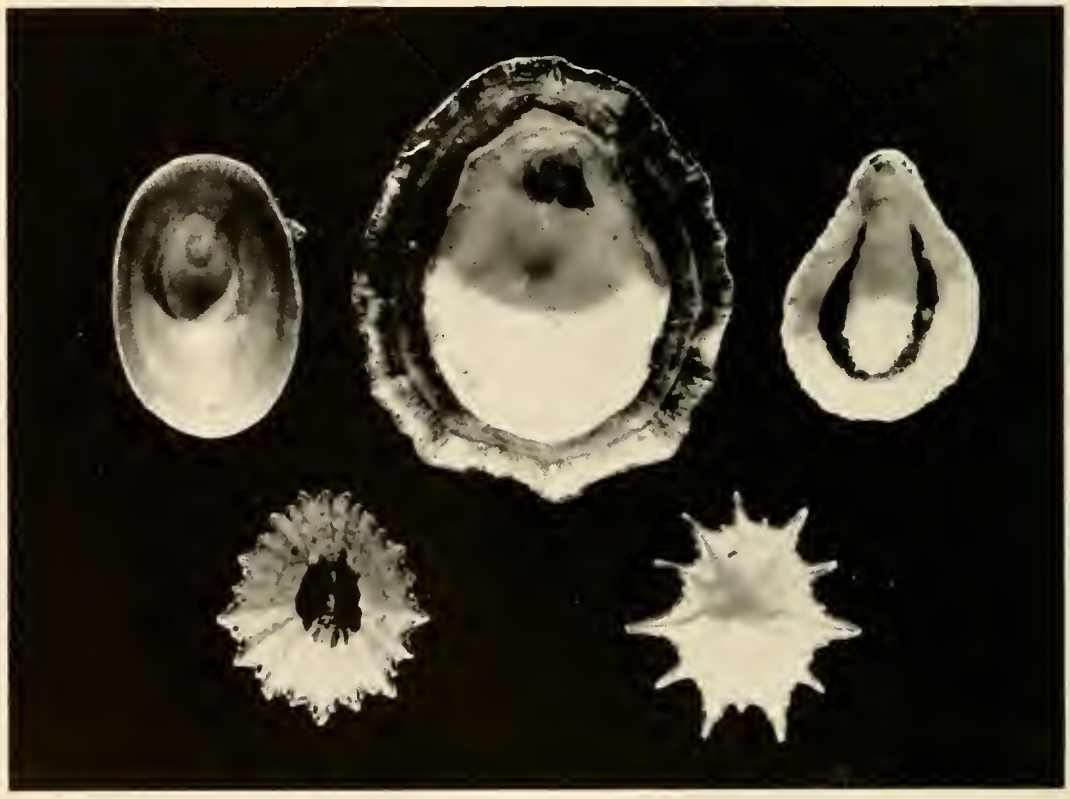
is partly a matter of definition. He has at least a network of sensory and motor nerves which are connected with several small receiving stations called ganglia, which serve to coördinate his simple activities. Thus he does pretty well in the game of life. He lives snugly in a streamlined movable house, and if danger threatens, his plow-like foot can pull his shell quickly into the yielding sand. The countless clams and other bivalves might be compared to the flocks and herds of peaceful herbivorous animals on land. The typical sea snails, on the contrary, play the part of the carnivorous animals and live by killing and eating the weaker citizens of the molluscan world.

which rides like an elephant's howdah on the animal's back. This shell is like a fool's cap which has been twisted into a spiral horn. On top of the foot, behind the shell, is a stout oval or circular shield. When stimulated the snail squeezes as much water out of himself as is necessary and pulls himself into the lower whorl of the shell. The last part that rolls into place is the oval shield or operculum, which serves as a trap door and completely closes the aperture, forming a stout front door to the snail's castle.

A real knowledge of the evolution of form and color in the world of clams and conchs can hardly be gained without reference to questions of their respective origins on the Tree of Life.

of the outer skin known as the mantle. When in the course of time this cap became twisted it tended to become one-sided and assumed the peculiar spiral form typical of snails as we know them. At some remote period before the twist of the shell became developed, certain groups of snails were evolved with a split mantle which produced two nearly equal shells, and thus the bivalves or clam-like mollusks arose.

On the other hand, among the fossil relatives of the clams the ram's-horns (Chamidae) actually succeeded in developing secondarily a coiled snail-like shell out of their left valve, while their right valve gave rise to an operculum-like structure. But these snail-like clams are only pseudo-snails, for the



(Above) **FASHIONS in hat shells. Seen from the underside these diversified limpet shells seem made for heads of varied shapes**

A typical sea snail is a much more complicated animal than a clam. It has a real head and a very complex feeding machine, including a long bandsaw or flexible, strap-like rasp set with countless teeth. With this it can make neat circular holes in the shells of its victims, who may belong either to the clam tribe or even to its own species, for in the sea snails' age-long code of morals only might makes right. The sea snail can hunt for its prey, creeping about on its muscular base or foot. The snail's viscera are coiled up like a Chinaman's queue and they are tucked away inside of the shell

Clams and snails are exceedingly different creatures, and their lives have been distinct almost since the beginning of the fossil record; yet both are shell-secreting mollusks with many fundamental characters in common, so it is probable that at some exceedingly remote period they had a common ancestral source. What was this source?

The best scientific opinion considers that the snail type is the older. Its original ancestor was a slug-like animal with a shell shaped like a pointed cap on its back as described above. This was manufactured by a glandular fold

true operculum of real snails is not developed by the mantle.

The embryology of the clam and snail tribes shows only that they both belong to the primary grand division of the animal kingdom that includes the annelids and crustaceans.

Thus even without knowing the exact origin and derivation of the clams and snails, we can realize that in comparison with their remote bilateral ancestors they may be almost as much transformed and specialized as whales and snakes are in comparison with their respective four-footed ancestors. Consequently we can know

definitely only the later chapters in the evolution of the diverse forms and color patterns, but without the long perspective we may easily misinterpret this history.

As noted in a previous article on shells,* the apparent bilaterality of the limpet shell is probably not a primary but a secondary or derived condition; there is indeed some reason to believe that the remote ancestors of the limpet once possessed a well-coiled shell, traces of which are seen in the Hungarian hat shell. A variety of limpets are illustrated at left. If we increase the rate of growth along the long axis of the aperture, we naturally get a long, oval limpet, like a Chinese coolie's hat but made for a very narrow head. In one peculiar form of limpets the front half elongates while the rear widens, producing a gourd-like shape; the blue mark in the center gives it a curious but accidental suggestion of an oyster. In other limpets there are nodes of more rapid growth around the lower edge of the mantle which produce projecting points and even a starlike contour.

In some of the very primitive fossil shells from the Upper Silurian age of New York State (roughly 350 million years old), the shell forms a symmetrical "horn of plenty" with no lateral twist. As in the clam, the tiny baby shell is at the top and as the animal grows, the aperture of the shell increases in a nearly circular way.

In the article referred to earlier we saw how the twist of an even coil into a helicoid or spiral was brought about simply by accelerating the growth of the outer and lower part of the shell-secreting mantle. This caused any point on the outer surface of the mantle to move faster along the arc of a larger circle, but since the shell was also growing downward, the circle was constantly being pulled downward into a spiral ramp. Thus was derived the long or high corkscrew spiral of the turret shell.

In the top shells the growth rate increases slowly and evenly, so that the changes from one whorl to another are gradual.

At the other extreme, the abalone shell-form has resulted from a very rapid geometric increase in the outward and downward growth accompanied by a reduction in the building of the spire.

In most shells after the baby stage is passed, the growth tendencies, whatever they may be, continue to become more and more pronounced but do not change their general character and direction, so that the young shell is much like the old shell except for its smaller size. In some shells, however, there is a marked change in the direction of the growth after the shell has attained a certain stage. In the worm shells, for example *(above)*, the baby and early child stages form normal and respectable little turrets, but afterward the shell-secreting mantle seems literally to get out of touch with the inner coil of the shell. It pauses, loses its sense of direction, and then wanders wildly first on one side, then on the other, until a tangled mass of stony tubes results. This illustrates the important principle that degeneration, or loss of a primitive but relatively high stage of development, may bring about a deceptive appearance of simplicity and primitiveness. That is why we should keep our comparisons on the widest possible basis, always investigating the history of a design and not assuming that it is primitive just because it is simple.

In an even spiral ramp in which the growth has proceeded very gradually the aperture is often small, but in shells in which the coil widens very rapidly the aperture may become enormous. In the series shown at left, the lateral and downward growth has

(Above) A WARNING TO PINOCCHIO: shells that start out as respectable little turrets but lose control of themselves and soon turn into a tangled mass of "worm" tubes

*See "An Evolutionist Goes Shell Hunting," by William K. Gregory, NATURAL HISTORY, November, 1939, pp. 203-212.

(Above) THE ABALONE'S "MOUTH" is big, because his foot's so large! Scientifically speaking the aperture of the shell widens to keep pace with the growth of the foot which fills it. The curlicue in the left-hand shell is all that remains of the primitive spire

(Above) THE TOP SHELLS go in for stripes or zigzags. The pigment-secreting cells all follow the "stop-and-go" system but by varying the times and rates produce a wide variety of patterns

been so very rapid indeed that the shell becomes secondarily flattened, the aperture is enormous and the spire is lost, as in the abalone. This means that the animal has become much too big to retreat into its shell. Sometimes this tendency results in the thinning and reduction of the shell, until in the sea hares the shell becomes vestigial or disappears.

Although the color patterns of the sea snails attain greater complexity than those of the clam tribe, the basic principles are the same, especially that color patterns are first of all dependent upon the growth pattern of the shell itself. Thus it seems reasonable to suppose that the more primitive types of shell-forms would also bear the more primitive color patterns. Among the more primitive top shells (trochids), for example, as shown above, we find vertical zigzags or broad stripes set obliquely to the spiral axis; eventually, as in the New Zealand tiger shell, they may break down into vermiculated streaks on a dark background.

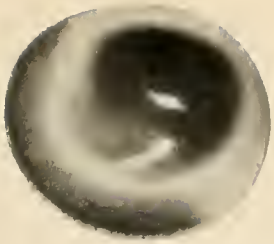
That the structural spirality of the shell itself plays an important part in the arrangement of its surface pattern is well illustrated in the center photograph of the reversed whelk shell, viewed from above, in which the radial bars are tangent to the spiral.

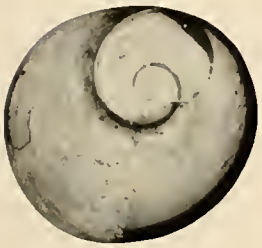
In the cat's-eye turban of the tropical Pacific the excessive pigmentation which is common in tropical shells has produced a rich brown background relieved by **U**-like marks and bands *(right)*. Since the edge of the mantle is like a slowly moving recording cylinder, we may conceive that a horizontally-placed **U** results from a vertical bar which has been bent forward by growing faster at either end than in the middle.

The remarkable "cat's-eye" which is seen on the lid of certain turban shells has been developed on the outer side of a structure which on the inner side plainly shows its spiral mode of growth, as shown on opposite page, top left. A trace of this underlying

(Above) THIS SPIRAL goes the "wrong" way. And the pattern goes with it

(Below) TURBANS are always in style. These swirling coils suggest the glittering court of an Indian prince

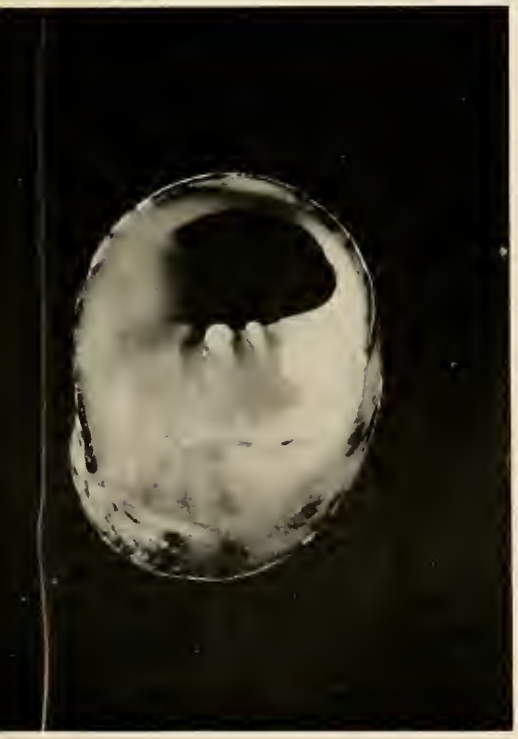




(Above) THE GLEAMING "cat's eye" *(at top)* guards the sea snail's castle. The spiral growth of this unique form of trap door is shown on its inner side *(below)*

(Right) MOST MOON SHELLS *(Natica)* and neritids *(upper row)* like to be inconspicuous. Some moon shells, however, wear pretty bands *(lower row, right)*

(Below) IN THE "BLEEDING TOOTH" shell the "teeth" serve as part of the hinge for the trap door



spirality may be seen in the cat's-eye itself. The circular or zonal appearance of the cat's-eye pattern may be due perhaps to the slow spread of an oily spot of pigment outward from the center in a spirally-growing, thick lens of pearly substance.

Comparison with the large eye-like spots in the wings of certain butterflies, or with the eyes in the tail feathers of the Argus pheasant is likely to be misleading, for each of these has arisen in its own peculiar way. Nevertheless in every such case which I have as yet examined, it is possible to trace a progressive series leading from a simple alternation of dark and light to an eye-like end result; and all such cases exhibit a contrast of light and dark which we may provisionally think of as an expression of polarity or repulsion between chemical substances of opposite characters.

The question whether the cat's-eye pattern of the turban shell may be of any particular value to its owner in the struggle for existence, is not easy to answer. The cat's-eye is really more like the eye of a large fish. It may be visible from above when the snail is crawling along under water. It might conceivably scare off small fishes which otherwise might be bold enough to nibble at the snail itself. But it is doubtful whether it could be seen by the giant conchs, which may be supposed to be the principal enemies of the turban shell and which rasp a circular opening in the shell itself.

In the black-crow family (Neritidae) the shell may be a shiny jet-black; at the other extreme, it may be almost albino; often it may have little dark bars on a lighter field *(above)*. On the underside of one of our most common neritids we find the famous "bleeding tooth" *(at left)*. The "teeth" are really projections

Many of the moon-shell family (Naticidae) have assumed a modest brown habit which seems but little in accord with their piratical habits. Some of them are even adorned with a delicate, narrow riband bearing prettily-colored spots and horizontal **U**'s (see page 167). An even more brilliant shoulder riband is developed among certain forms in the columbellid family (left).

Such sharply differentiated patterns, in which a single, narrow spiral band is seen against a very different background, have probably had a long antecedent history leading back eventually to the oblique crossbars of more ancient shells.

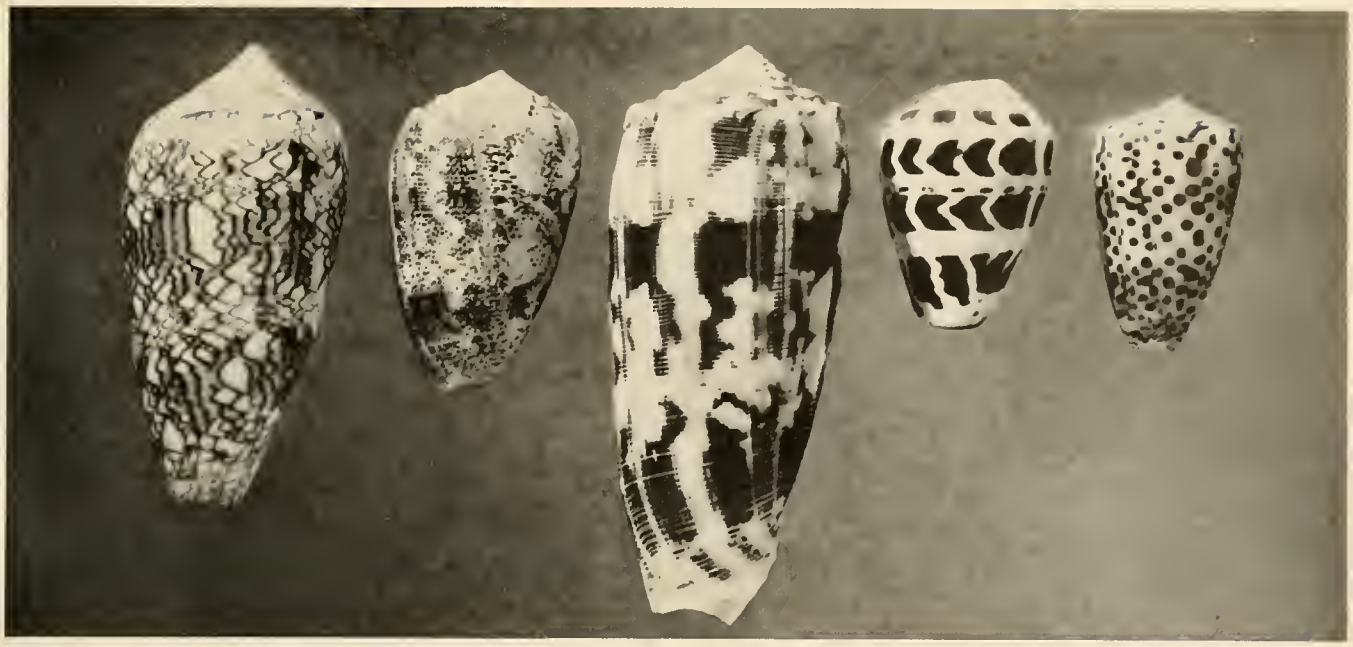
Many of the volutes and olives *(above)* delight the eye of collectors by combining lovely forms with striking patterns. The majestic Juno of Florida contents herself with a simple pattern of well spaced, fairly large spots, as also does her nearest relative in Queensland. Contrary to what we might at first suppose, this elegant simplicity is probably by no means a primitive stage but has been attained only after a long and peculiar history. The most primitive decorative units in the olives, volutes, mitres and cones, so far as I have been able to decipher the evidence, are not rounded spots but horizontally-placed **V**'s, or interrupted wavy lines along the edge of the mantle, which were at first very small and numerous. Possibly there are in such cases two sets of growth forces, which seize upon the pigment coming from a single gland and carry it along diverging paths. It is also probable that in some way this sharp oscillation of pigment lines is controlled by the zigzag way in which the minute "bricks" of the outer and

(Left) THE SEA SNAIL with the "magic girdle." In a sea snail's beauty contest this pert little columbellid might win first prize away from more stately rivals

(Below) A SIMPLE THEME with endless variations. The immortal Bach might well have been an ardent admirer of the volutes and olives, because they too learned the secret of extensive repetition with varying emphasis. Their patterns are all built up on the wavy or **V** plan

from the central column on which the trap door rests. The red smear is of unknown origin and significance. Assuredly the resemblance to a human baby's tooth and gums is as completely accidental as the manlike form of the mandrake root.*

* See "The Dr. Jekyll and Mr. Hyde of the Plant World," by Henricks Hodge, NATURAL HISTORY, October, 1939, pp. 160-167.



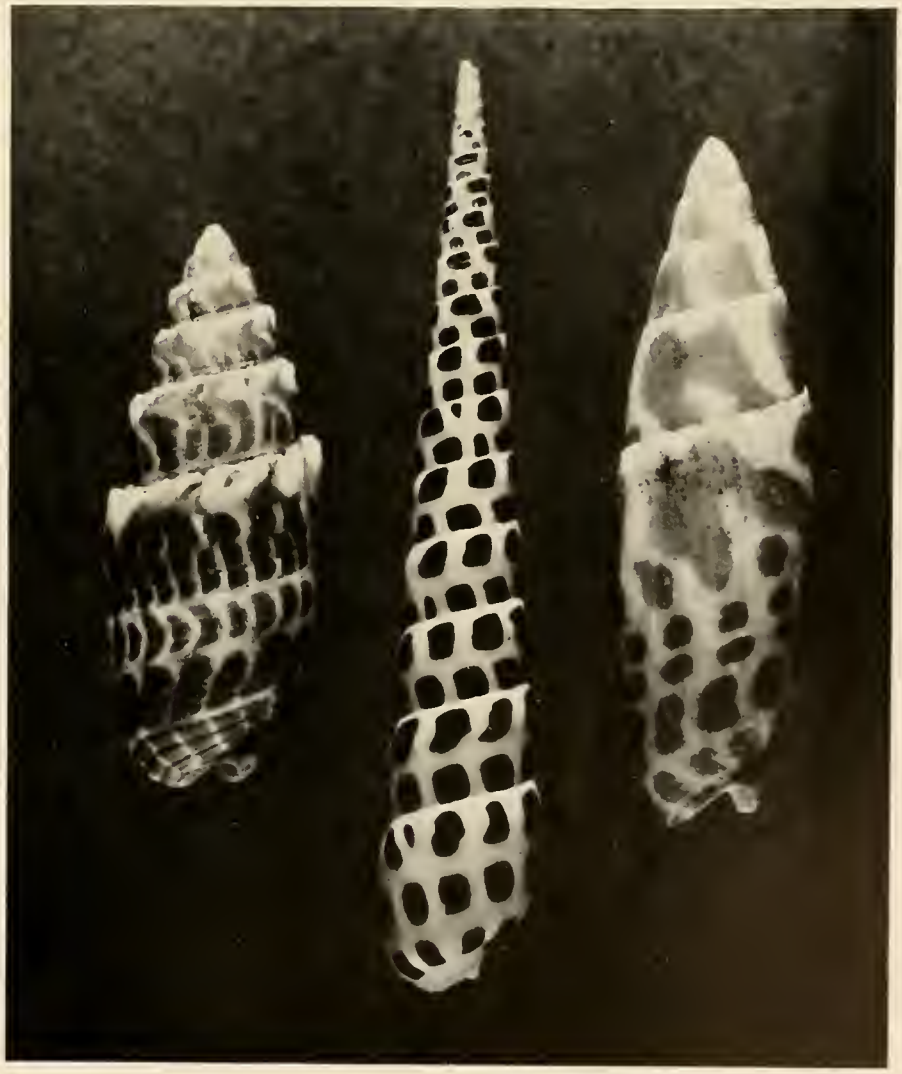
inner layers of the shell are laid down. At least we know that the apex of the **V** in these families is always directed away from the forwardly-growing mantle. When there are many **V**'s, they produce a pattern which suggests an army of little tents. When the **V**'s become greatly crowded together, they tend to give rise to bands of color. In some species the mantle "goes on strike" and stops printing **V**'s for a while; this leaves a clear uncolored area, often with ill-defined boundaries. Sometimes one of the limbs of the **V** becomes greatly elongated, while the other remains short. In the ample Melo, or bailer, which is only an overgrown and specialized volute, a spiral crown of spikes, springing from the "shoulder" of the lower whorl, surmounts an irregular scattering of rich brown markings. Intermediate stages connecting this with the **V**-shaped volute type are known.

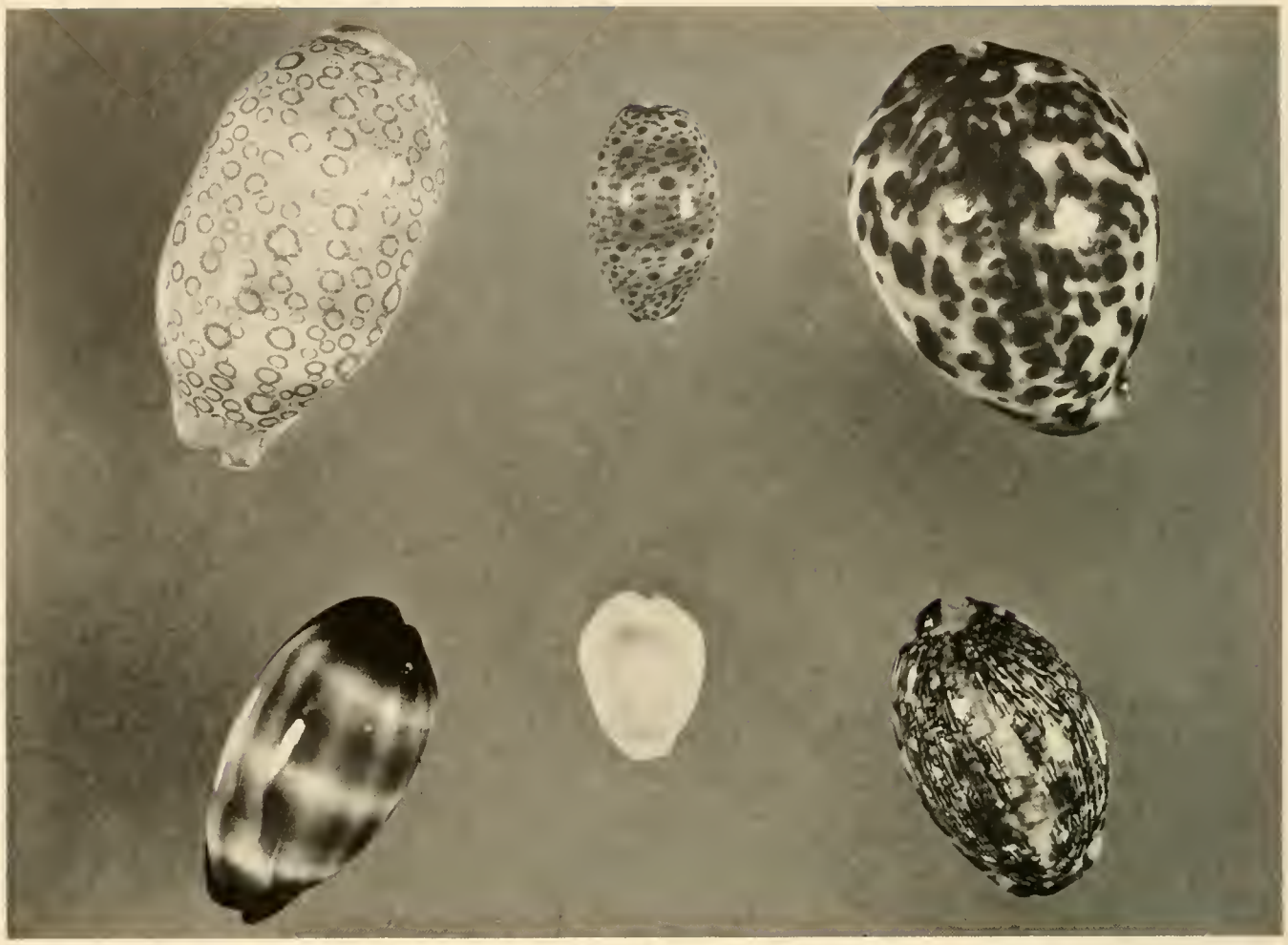
The cone shells *(above)* show a wide variety of color patterns which are eagerly sought by collectors. The Countess von Linden has suggested that the most primitive color pattern in this family is the one consisting of very fine longitudinal lines on a pale background. By analogy with the olives and volutes, however, I am inclined to think that the more primitive conditions are shown in *Conus porphyrio,* which has a combination of vertical zigzags and **V**'s crowded at certain levels into longitudinal zones. The **V**-shape, or tent-like pattern, culminates in the rare and much admired cone named *Conus gloriamaris,* the Glory of the Sea.

In these few samples of cones we

(Above) ONE-FAMILY FASHION SHOW of the cones. Only a few entries are shown here out of several hundred that may be seen in the Museum's exhibit. Starting with vertical wavy lines, some of the cones run to crowded tents, others to brilliant zones, and some to bold checker patterns

(Below) TWO MITRES and an auger. Solomon and all his pomp are gone, but these more splendid gifts remain



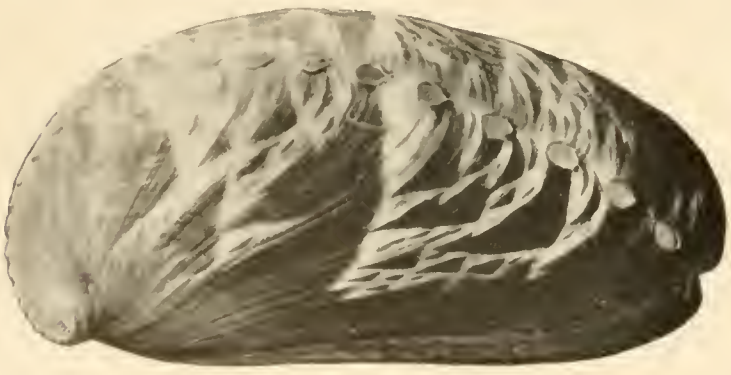


(Above) THE COWRIES guard their secret well. Nobody seems to know exactly how these cunning artisans manage to print the circles, blotches, broken lines, and "Arabic writings" that adorn the shells of the various species

see zones breaking up into blocks and blotches. In certain cones not shown here there are even rows of triangular dark patches on a white field, producing a striking checker pattern. In the Virgin cone all markings are lost and an immaculate field is left. The bishop's mitre shell makes an imposing display of its stately procession of cardinal red bars and lakes on an ivory field, as shown on the preceding page. These bars may be the remnants of more continuous zones.

Hitherto the patterns of **V**'s, bars, zones, and the like have had what seems to be a broadly decipherable history within the limits of particular families. But there are other kinds of markings, including the open circles and leopard-like spots of certain cowries *(above)*, which require further study. Doubtless these circular forms are somehow determined by the fact that in this family an extension of the mantle is reflected completely over the outside of the shell, upon which the mantle lays down new spots above the old ones. We might imagine that if the mantle should swell up into bubbles, the circles might be deposited wherever the bubbles intersected the surface of the shell. Analogies with stenciling and printing are interesting, but the great need is for observation and experiment on living cowries to find out exactly how the shell-artist produces his effects.

The unpoetic name of "muttonfish" is given by Australians to the abalone illustrated below, whose shell-pattern might rather suggest a background for a sea nymph, with dark fronds bowing gently in the slowly moving tide. Our wonder at this loveliness becomes even greater when we realize that it springs from the union of the same forces which built up the shell upon which the design is spread and that every individual piece in this pattern is bounded by segments of the mathematician's favorite curve, the logarithmic spiral.



(Left) THE MUTTONFISH deserves a better name. On its back this shell bears one of the most beautiful of all the designs in the world of sea snails

Photo by the author

A pair of wood duck courting on the author's pond

Wild Ducks for the Asking

By S. Dillon Ripley

Anyone with a suitable plot of land and a few living decoys can aid and befriend our wildfowl. From out of the sky will fly wild ducks to seek shelter in your private sanctuary, giving you a vastly rewarding hobby and perchance adding new chapters to our knowledge of social behavior in birds

It is feeding time, and as I walk over to the pond I wonder how many ducks will fly in as is their custom at this hour. The birds on the water are impatient, twisting and turning, pirouetting and displaying to each other. One or two, bolder than the others, come out onto the bank and stand there surveying me speculatively, the while they ruffle and preen their feathers. At last from far down the valley of the brook there comes the faint "oh-eek" of a pair of flying wood ducks. Gradually the whistling sound of their wings is apparent, and then suddenly they come into view. With a rushing noise they bank, sideslip, and then, with a last frantic waving of the wings they splash down into the water. The other wood ducks swim to the new arrivals with many whistles and little duck cries. The males especially give a great show of mock anger at this intrusion and stretch their necks and throw out their crests. When the first handful of food is thrown out, however, all pretense is gone in the ensuing scramble.

It is in moments such as these that the full pleasure of a duck pond is realized. Keeping wild ducks was formerly a rather rare hobby in America. Now, however, it is becoming better known, and at present there is a goodly company of enthusiasts: bird-lovers, sportsmen and conservationists alike.

Europe is the place today where the greatest enthusiasm for keeping waterfowl has been developed. England particularly, where nearly every other person is an amateur naturalist, has a great number of ponds, often of the backyard variety.

A few years ago, I happened on some delightful essays written by the great English statesman, Lord Grey of Fallodon. His hobby had been raising wild ducks on two small ponds in Northumberland. Fired by the idea, I decided to build a pond on a few acres of land in Connecticut. At the end of a month I had it built, a mere puddle of a pond in fact, made by diverting the course of a small brook. Around the water a smallish area of land was planted with trees and shrubs. The whole is surrounded with a low fence to keep out stray animals. Small paths are cut between the plantings, and there is a stretch of lawn where the birds may sit and sun themselves. Inside the fence it is fast becoming a sort of wild garden, with hemlock and laurel for cover, bush cranberries and black alder for food, and for ornament, banks of wild flowers, asters, field lilies, and bottle gentian.

Lord Grey's book had described how, from a nucleus of a few pairs of wing-clipped, non-flying birds, it would eventually be possible to have a sizable flock. There are several breeders and trappers that sell live ducks for about $6 for a pair of teal and $10

for a pair of wood ducks, though one may have to pay over $100 for something very rare. Having once "cast your bread upon the waters," the young birds from these pairs are allowed to fly free to circulate about the neighboring countryside, adding thus to the local duck population and also attracting other wild ducks back into the pond with them.

At last everything was ready. From a dealer in game birds of various sorts, I bought my first pairs of ducks—mallards, teal, wood ducks and redheads. All the birds immediately rushed to one corner of the enclosure when they were turned out of their shipping box. There they tried frantically to escape, going up and down and back and forth against the fence. This went on for some time, and it seemed as if the duck pond was to become a rather dismal failure. Gone was any thought of being able to sit by the pond and watch the contented birds feeding at my feet while little groups of wild ones hurtled in from the skies.

And then one day it happened. As I sat on the bench rather disconsolately throwing grain onto the water, the ducks began to draw closer and, timidly at first, to snatch a few morsels even as they fell. It wasn't many weeks before the birds were untying my shoe laces and tugging at my trousers for more, so quickly did they realize that here they were perfectly safe and at home. The next spring some of my birds bred, and young birds were raised who soon became as tame as their parents. Four years after the pond had been built there were as many as 75 wild ducks flying into it at one time.

But why, it may be asked, is this duck pond worthy of more than passing interest, more than a casual hobby of a type little known in America? The reason is not far to seek. Such a pond with the food, protection, and quiet offered by it, is more than just the home of a little flock of captive ducks. It is a refuge, however small its area. A refuge yes, and more than that. Such ponds as these not only practice conservation in their small way but teach it as well. Leaders of educational study groups, nature photographers, field students, all may learn and benefit by the lessons to be derived from seeing and studying wild birds at their ease.

There are, of course, really notable places for this, such as the park at Oakland, California, where the ducks have become amazingly tame. There are few people who will not agree, however, that although such a sight is impressive, the birds appear simply as a mass. It is almost impossible to pick out any individuals. Only in a small place with a limited number of ducks do the differences in habit and behavior stand out.

But perhaps this is not the most important function of the pond. Primarily it is a refuge of a type that should be more widely developed by individuals in this country. The possibilities of conservation along these lines are impressive. Efforts are being made by the Federal and State Governments to buy up large areas of land along the principal routes taken by ducks on their migrations in order to provide them with safe stop over and resting places. Other areas in northern United States and in Canada where nesting takes place are being supervised so that floods or droughts will not interfere with the survival of the nests and the young ducklings. Naturally these are the big important moves in wildlife conservation. But there are other places where the Government has not gone, less well-known places where few ducks fly, where the hordes of years ago have been long forgotten. It is possible that in places like these a few small private ponds will do much toward restoring and increasing the local duck population.

Take the case of the wood duck, for instance. Twenty years ago this most beautiful of all our waterfowl was doomed to practical extinction. It was too trusting a bird, living on ponds and small streams where it was often within easy gunshot. Fortunately about 20 years ago a law was passed prohibiting the shooting of these birds. This in itself was good, but it was not enough. A small stock of wood duck existed in captivity at the time, and valiant efforts were made by several individuals to increase this stock. One of the most impressive achievements in conservation ever made by a private individual was that of a man in Connecticut who succeeded in raising more than 4000 ducks in fourteen years. Few people had ever raised any young wood duck at all, let alone raising them in numbers. Most of these ducks were allowed to fly free and to populate the surrounding ponds and streams. Birds from his flock have been identified by means of the bands on their legs in a majority of the 48 states.

Largely through this great effort alone, wood duck are again fairly common in New England and along the Eastern Seaboard. The State Game Department of Connecticut finally became interested and after some years took over a good deal of the control of the project. But wood duck are a non-sporting breed, protected by law from being shot because of their scarcity. It remains to be seen, therefore, how the Department, financed largely by hunters' license fees, will keep up its interest in a vanishing species whose extinction is, sad to relate, a matter of indifference to the ordinary hunter.

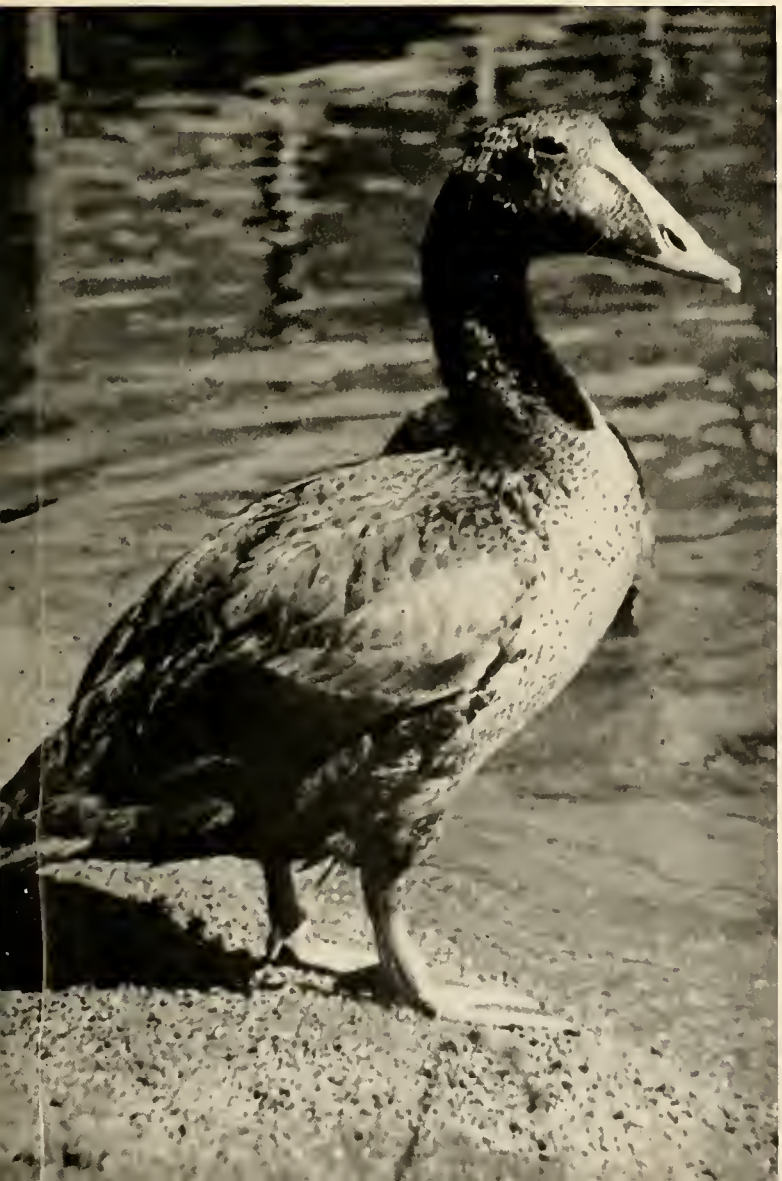
Some of these same hand-reared wood ducks fly into my pond, especially in the spring and fall when the migrating instinct is on them. Here they are

CONSERVATIONISTS look with favor on one of the latest American hobbies, the raising of wild ducks in small, private ponds. Requiring no more care than chickens and vastly more interesting, ducks reward their keepers with engaging antics and genuine friendliness. Above, a drake widgeon angrily shoos a pair of intruders from a part of the pond adopted as his own

A PAIR of Canada geese are also ardent home defenders. Note protruding tongue *(above, right)* as a loud hiss warns of too close an approach to the nest. However, this goose is a good citizen in any duck pond; for, despite superior bulk, he never molests smaller members of the community. Even in the much publicized "peck order" governing the social scale of fowl, size counts for little. Everything appears to hinge on bluff. By banding their birds, duck pond owners may investigate this phenomenon and study many surprising individual personality traits as well

BELOW ARE SHOWN one adult and four young eider ducks. The plumage of this species provides the superlatively soft "eider down" used in our quilts and pillows. Actually an oceanic bird, the eider seems almost out of place on a private, inland pond, but it quickly becomes ridiculously tame

Photos by the author



tame, although outside, along the brook, they may be quite wild. For the people who come to see the pond, many of whom have known wild ducks only in front of the business end of a shotgun or a carving knife, it is quite an experience to join me in a walk down the brook. A few hundred yards along and a pair of wood ducks goes up like a shot, the female crying out, "oh-eek, oh-eek." We turn and retrace our steps to the pond, for the birds have circled and dropped in there among the trees. Sitting down on the bench to watch, we count the wood ducks as they come swimming up. There are twelve now where there were ten before. The new wild birds are among them, but what a contrast in behavior there is. Of course they have metal bands on their legs, identification tags which we glimpse as they paddle out onto the bank. They are birds from my friend's flock. And yet there is no one who could doubt that they are not perfectly at home in the wild state. Temporary captivity may have made them tolerant of the presence of people, but only in a selected place.

The practical side of keeping these wild birds is remarkably simple. Nesting among ducks takes place once a year, in the spring. For this there must be plenty of cover in the enclosure. Wood duck and their relatives from China, the mandarin duck, nest in trees. If these birds' wings are clipped they must be provided with nesting boxes placed a few feet up in the low trees with runways leading up to them. Food for wild ducks is the same as for chickens. Ducklings are raised under hens or in electric brooders, unless conditions on the pond are exceptionally good for the mothers to raise their own broods.

Wild ducks in general are divided into two classes, the surface-feeders like the mallard and wood duck that do not like to dive, and the diving ducks like the redhead and canvasback that are accustomed to going under water for their food. If some of the food is thrown into deep water, the mallards will try desperately to get it, literally standing on their heads in the process. Meanwhile the redheads go merrily about underwater, their large webbed feet churning behind them like propellers as they gather up the food. After a while the mallards will give up the struggle and instead vent their spleen at the passing hind ends of the redheads who are much too busy to care.

Of the kinds of ducks that do well in temporary captivity the best are wood duck, widgeon (the so-called baldpate), pintail, teal of various kinds, and mandarin. Mallards are not good to keep with other ducks, as when they become tame they get very pushy and obstreperous with the smaller birds. Among the divers, the best are the redhead, canvasback, ring-neck, and one or two of the foreign kinds. The scaup, often called broadbill or bluebill, which is so well known by gunners from New England all the way down the coast, is said not to do well in captivity. I am not so sure about this, as I have had a female broadbill for some time. She was picked up on Long Island Sound after she had been shot in one wing. The wing was cleaned and disinfected and she has been on the pond ever since. In this connection I often wonder why it has taken so long for people in the United States to learn what fun and what a sporting proposition it is to have a place for wild ducks. In many ways it is quite as exciting as duck shooting and a lot more soul-satisfying into the bargain. Someday perhaps, if our wildfowl become as scarce as they are in England today, our retired duck hunters will take up duck keeping. I can guarantee them a good time.

The most exciting moments on the pond come just after a new duck has arrived. There is a tenseness in the air as the old residents survey the new arrival. Last week a friend sent me a drake broadbill, which we hoped might pair with my wing-shot female. The bird finally arrived in a shipping box at the station, looking rather dry and dusty after a two-day train trip.

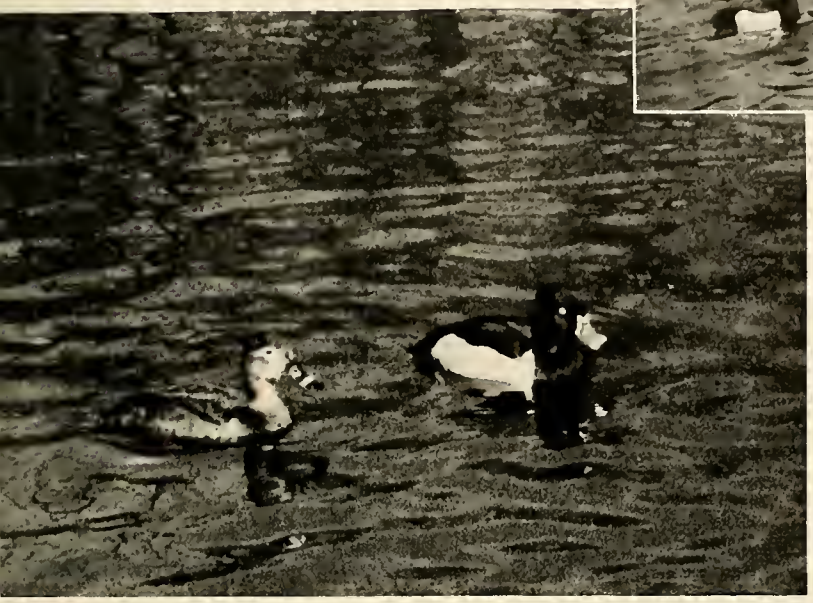
I hurried back to the pond with the box and opened it on the edge of the bank. The water was mostly covered with ice, but there was a big open lead where the current ran. The drake scrambled out on the ice, where he skidded a little before regaining his balance and dignity by a vigorous flapping of the wings. Then he went off to bathe with great splashings and the most obvious enjoyment. If ducks ever show happiness it is at this moment when they bathe, now dipping to let the water run over their backs, now rising up by treading water to flap their wings, now down again, as with a final ruffling of feathers they settle on the water, sleek and shining.

The other ducks had been up on the ice, but now several came hurrying down to investigate the new arrival. It always surprises me how readily ducks recognize each other. The first one to swim out was the female broadbill, who had not seen one of her own kind for a long time. They both contemplated each other for a moment, and then she made a "quack" noise that I never heard before. At that they swam off together apparently perfectly good friends. I felt rather relieved. There were to be no squabbles this time. The new bird was apparently going to fit in quite easily to his place in the social scale of things.

Strangely enough, female ducks are never received as quietly as all this. It has been my observation after ten years of watching ducks that the female of the species is a good deal more aggressive than the male.

(Right) THE FAMOUS British statesman and lifelong bird fancier, the late Lord Grey of Fallodon, is here shown feeding ducks on his private pond. It was in England that the hobby of wild duck raising got its start, and Lord Grey was one of the prime movers

Photo by Frank M. Chapman



(Left) THESE ARE ringneck ducks. Energetic and attractive birds they lend beauty to the pond and dive entertainingly for their food

(Left, below) WOOD DUCKS. Not long ago this species was nearing the brink of extinction under the guns of "sportsmen." In the future hunters might well turn to raising their former prey as a hobby. It is quite as exciting in many ways as shooting

(Bottom, left) A MALE DUCK of the species known as Old Squaw. Like the eider, this is a sea-going duck and one of the rarest birds in captivity. The one shown here was found covered with fuel oil on a beach and kept for some time in Mr. Ripley's pond

(Below) MANDARIN DUCK. Closely related to the American wood duck, these Chinese imports are among the most gorgeously colored of all ducks. In ancient China, a pair was always carried in wedding procession as a symbol of marital fidelity. The outlay for attracting wild ducks to your pond is small, the pleasure and benefit, endless

Photos by the author

It is the females who establish what the scientists call the "peck order." According to this scheme of society each bird of a flock is fitted into a place of dominance or subservience with reference to all the other members. Duck *A* can peck any or all of the other ducks, whereas Duck *B* can peck all but Duck *A*, Duck *C*, all but *A* and *B*, and so on down the line. Duck *X*, for there always is a Duck *X*, thus gets pecked by all the others and can't peck back in return. Usually Duck *X* is the latest arrival on the pond, or perhaps one of the youngest birds. In spite of the cruel-sounding title "peck order," things are not as bad as they seem, for the birds are so ruled by habit that ordinarily a peck simply means a threatening gesture on the part of one bird who never expects or receives any retaliation. Strength seems to play little part in these ceremonies. Often the biggest ducks are not the most important. I suspect, though so far I have not been able to prove it, that the "peck order" is probably largely psychological, depending more on the personality of the bird than on size, age, or experience.

Among my ducks, the males play only a small part in the workings of this society. Sometimes my Duck *A* is assisted in her attempts to keep order by her mate. At these times he ranks definitely as Duck *B*. At other times, however, when not led on by his aggressive mate, he has been shifted well down the scale by some hitherto unnoticed female who can quickly send him about his business by her greater aggressiveness.

All of these speculations and theories are part of the fascination of a duck pond, but just studying individual birds is one of the most interesting parts of duck keeping. Some of the birds have come by now to be quite old residents and full of personality. There is a drake mandarin, for instance, that I have had for five years. During this time he has had three wives, on all of whom he has lavished the greatest care and affection. The first duck was killed by a weasel, one of those tragedies that will happen. The second wife was one whose wing had only been clipped temporarily. In the spring she nested inside the pond, but she soon took to flying outside the brook and calling her brood to her. The ducklings which had been milling about disconsolately would hear her call from 50 yards away and would suddenly be galvanized into action. Through the water they would streak; then over the bank in a body until they came to the fence. A great scurrying up and down would ensue until a place was found in the one-inch mesh big enough to let them through. The struggling was terrific, sometimes two trying to get through the same hole at once. Finally they would all squeeze through and burst down breathlessly to rejoin their impatient mother in the water. A little while later the process would be repeated back into the pond again.

One day they got through for the last time, for when the ducklings tried to get back again they had fed so well that they were just too big to manage the hole in the wire. This apparently very much perturbed the mother, for she led her brood away and never appeared again. Now the drake has a new wife, a rather coy little creature only recently arrived. At first he paid small attention to her, thinking doubtless of his former happiness. But the mandarin is nothing if not an opportunist, and the last week or two he has begun to show off mightily before her. Dipping his bill into the water impatiently, he proceeds to jerk his head back while dilating his magnificent crest and vibrating the beautiful butterfly-like feathers above his wings. At the same time he makes his strange low booming call. Surely the new duck will not long be able to resist him.

There is another duck that has newly paired this fall. I have had a female American widgeon for four years but only recently got a male. Last year nothing came of this importation. He was a bird of that year, and, as I decided afterwards, perhaps a little young to assume the responsibilities of his position. At any rate he sulked most of the time, would not come to me when the other birds were fed, and betrayed a great shyness before the female, who pecked at him whenever he came near. This spring, however, all is changed. My drake is a man at last. He and the duck present a perfect picture of harmony as they swim about together, both of them at intervals displaying one to the other with raised wings and high-pitched whistling voices.

Another event that I am anxiously awaiting this year is the pairing of my eiders. The eider duck, famed for ages as the source of the warmest, lightest down for quilts in the world, is a true diving duck, a bird of the open sea. Very seldom does this duck venture on shore and then only on the most inaccessible reefs or islets off our northern coast. Eiders are strangers on a pond like mine, but I have been attempting for a few years now what many call the impossible, namely, breeding eiders in captivity. Lord Grey kept a drake eider on his ponds for eleven years. My oldest bird so far has lived to be three and a half. Gradually I am building up my little flock of these ungainly yet appealing birds. Some day I hope to announce with pride the birth of my first home-grown eider ducklings. Perhaps then I shall even be able to make my own quilt out of the down left by the mother ducks in their nests.

There is something wonderfully appealing about these funny birds with their greyhound profiles and

Continued on page 186

KEEPER OF THE GEMS

A life spent cherishing the world's most precious jewels has given Herbert P. Whitlock rare insight into the lore of minerals and the mysteries of human psychology.

By D. R. Barton

In public fancy, the ideal modern Museum man is a sworn enemy of confinement. Always poised for the take-off, he seems happy only when scrambling up the gang plank of a ship or plane bound for Tanganyika, Patagonia, or some land of ancient dynasties and modern revolutions. His spirit is admirably intrepid, his goal the capture on behalf of science of some mysterious creature or the fascinating investigation of a little-known native tribe. To those who hold fast to this ideal—and it is not altogether unwarranted—the term "curator" always seems puzzling. A few emphasize the prefix and idly wonder what dread ailment such a man is prepared to cure. But as a rule, the term merely connotes the ultimate in voluntary confinement, mustiness, old books, and dingy glass cases. This is, of course, unfair, and fit company for the adage that all university professors are congenitally absent-minded. Nevertheless, a curator is by definition a caretaker, and hence a stay-at-home. And when this literal image is placed alongside that of the roving globe-trotter, the public understandably becomes confused. It is a situation which prompts resurrection of that shrewd query as to who takes care of the caretaker's daughter while that gentleman is preoccupied with his chosen vocation.

But the explanation is simple. The Museum needs both run-arounds and stay-at-homes to fulfill its multifarious responsibilities. Most department heads are of an intergrade species dividing their time between collecting and taking care of what they collect. But if we are to accept Roy Chapman Andrews as a paragon of the explorers—and I think we should—then certainly Herbert Percy Whitlock, sage of minerals and gems, is our model curator.

Mr. Whitlock, whose article appears on page 152 of this issue, had the good fortune to inherit the greater part of his treasure trove of diamonds, emeralds, rubies, sapphires, and legion lesser lights of the General Collections like calcite, pyrite, quartz, fluorite, and natrolite. These formed so rich an assemblage of mother earth's component parts that he has never felt obliged to slash his way through South American jungles or straddle an Algerian camel in search of others. Perhaps this is just as well, for Curator Whitlock emphatically prefers a swivel chair, a microscope and a desk-load of minerals deposited there by some hopeful free-lance. Sparingly, and then only after rigorous scrutiny, a handful of these offerings may be added from time to time to the greatest single collection of minerals and gems on this side of the Atlantic. Mr. Whitlock admits that the day may come when his department will have to undertake collecting expeditions on the scale of the faunal departments. But so far as he is concerned that time is, happily, not yet.

AMNH photo by Kirschner

Herbert P. Whitlock

Though he sees the calendar gradually approaching the middle of the 20th century, Mr. Whitlock would not think of boarding an airplane, to say nothing of a camel, and so cogent is his stark fear of automobiles that he heartily endorses Roy Andrews' assertion that civilization holds more terrors by far than the darkest jungle. His wanderlust is abundantly sated by a few mineralogy conventions in distant cities. His favorite water conveyance is a lake-going rowboat and he thrills as deeply to a three pound bass as Andrews ever did to a ten-ton whale.

And why should he wander afield when his priceless gems have traveled so far and seen so much? What does the space of a century matter when you are dealing largely with well-nigh indestructible beauty that has already weathered many centuries and will weather at least as many more? Time may march on, but a rare diamond remains constant and aloof from the men and nations who squabbled for its possession. Then, too, beneath its polished shimmer, molecules of a single element (carbon) have been wrought into remarkable crystal shapes worthy of prolonged and contemplative study.

No, Herbert P. Whitlock is an outstanding museum man but the perfect antithesis of an explorer. And there is another paradox. In a strictly academic sense he is not a scientist. That the scarlet hood denoting a Doctor of Philosophy has never besmirched the formal black of his commencement gown is one of his proudest boasts. Mr. Whitlock is the only un-doctored American Museum curator, and his degree, of all things, is that of civil engineer. He has, however, a still greater distinction. His early papers on the highly mathematical science of crystallography attracted international attention and won him speedy election to the American Academy of Sciences —a profoundly austere institution whose portals are closed to many a mere Ph.D.

Logarithms, mines and blow-pipes

The J. P. Morgan collection of precious gems together with the Museum's vast store of minerals came under Mr. Whitlock's capable wing in 1918. Prior to this date he had served nearly two decades as Curator of Minerals in Albany's State Museum, to which office he had advanced from a junior professorship in Columbia Uni-

versity's School of Mines—his Alma Mater.

A New Yorker throughout life, Whitlock was no stranger to the American Museum. Indeed, he had witnessed much of its growth up to 1918 and delights in recalling boyhood visits to the institution when its collections were housed in the old arsenal building on 65th Street, now a police station.

Around that time he was a student in the Chevalier Institute where he wrestled with log-books and absorbed the precepts of trigonometry, the higher geometries and calculus, ultimately claiming his engineering degree. Certain phases of the laboratory work interested him in a device known as blow-pipe analysis. Later, at Columbia, he made exhaustive analyses of mineral colors by this method and, what with one thing and another, found himself launched on a mineralogical career.

At the American Museum it was a case of the institution shaping the man. The Albany post had, of course, limited him to the minerals of New York State, but now the whole world of mineralogy was opened to him and, in particular, here were some of the most renowned jewels in the world—a fact that immediately brought him into fascinated contact with the esthetic and, therefore, the human aspect of his profession.

For however little geographical exploration has come of this profession it has certainly led him to considerable exploration of human nature—or, as the anthropologists would put it, human nature as it appears in our own culture.

In the course of the day's work he has an unusual opportunity to observe the actions and attitudes of people who have come to him with specimens for identification. Frequently they also seek an evaluation. For "How much is it worth?" is the question most frequently asked inside his offices and in the Gem Hall outside. All attendants are instructed to reply, "We don't know. We set no money value on our collections." And while Mr. Whitlock regards it as a public duty to identify any stone free of charge, that, in substance, is his own response to all who seek market prices.

There are several good reasons for this. In the first place, Whitlock doesn't know market values at a given moment since they are no more constant than the stock market to whose fluctuations they are, incidentally, remarkably sympathetic. Then, outside, among the exhibits there is the matter of safeguarding the collections. To make a practice of telling visitors what was payed for the gems (always far above their "sacrifice" value as stolen goods) might invite burglaries. The Museum has a clean record in this respect and wants to keep it. No one has ever tried to rob Mr. Whitlock's vigilantly policed bailiwick, undoubtedly the Museum's most tempting possession.

But, expediency apart, the gem curator's reticence is motivated by a strong desire to condition the public away from the How-much-is-it-worth frame of mind. For people who measure all things by the dollar he has only pity. If this is their only standard, then there is no point in their visiting the Gem Hall, for they will learn nothing. This Hall, at its simplest, shows what happens when man and Nature collaborate to produce beauty in its most imperishable form. And if that strikes no spark in an onlooker, the loss is his.

One day Whitlock guided a wealthy young man and his fiancee through the Hall. Stopping before the gleaming 563-carat sapphire, Star of India, the young man ecstatically praised its gorgeous radiance. The fiancee turned to Whitlock and asked the ubiquitous, "How much is it worth?"

On the basis of this single phrase, he gave their marriage one year. He was wrong. It lasted six months.

Another time, he had the honor of conducting the exiled Infanta of royal Spain on a tour of the collection. The former Princess wished to see the Russian Easter Eggs—those intricate gem "confections" which Russian aristocrats exchanged at Eastertide up to the year when Church and nobility alike were swept out of existence by the revolution. Whitlock wondered if these "eggs" might not have a certain sinister significance for a princess expelled by her people. But no. It appeared she had a collection of her own. "However, nothing so choice as that." She pointed to the Museum's celebrated deep-rose Rhodonite. This egg happened to have been carved in Ekaterinburg. And it was in an Ekaterinburg cellar that the entire Romanov family was stood against a wall and shot. "I wish I had that one," the Princess said. There was something peremptory in her tone. Whitlock was rather embarrassed. After all, this was the United States. "It is magnificent. I wish I had it," she repeated. But Whitlock led her to the next case, musing the while that royalty never learns.

Because of acquisitiveness and monetary emphasis people miss the pure delight of jewelry. Surely Keats was thinking of gems when he wrote, "A thing of beauty is a joy forever. Its loveliness increases; it will never pass into nothingness." For the emeralds that graced Cleopatra are probably still in existence somewhere in the world today.

But gems are not reserved for queens and princesses and millionaires. This notion is in large part responsible for the How-much-is-it-worth complex, and the surest antidote, Mr. Whitlock avers, is not to place fine jewelry within the reach of women of modest incomes—for that has already been done—but to call their attention to this accomplished fact. To this end he says, "I believe that every woman should have at least one beautiful gem. Its value is unimportant. It may be a semiprecious stone that cost only $10, but if she selects it with care—learns something about its composition, source, and cutting, and loves it for its color, radiance, and character—it will give her a constant spiritual stimulus. It will give her vastly more pleasure than masses of precious stones worn by women who merely want to show off.

"Jewels should be bought and worn because they are beautiful, not to excite envy in the hearts of other women. The exhibitionists do not know that in over-decorating themselves they are like a theater bearing an immense electric sign that tells what kind of show is inside. They are the sort who value a dog for its pedigree rather than because it is intelligent and loving.

"The ancients said that precious stones lived and breathed and had souls. I am not sure they were wrong, for at times, when I have held a magnificent gem in my hands, I have felt myself to be in the presence of a spiritual Something that we mortals cannot understand.

"The general impression is that beauty is to be found only in the rare and, therefore, expensive gems—the diamond, emerald, sapphire, and ruby. Many persons feel they must have costly gems or none at all, that wearing a semiprecious stone is a sign that the head of the household isn't making much money. With those persons I have no patience.

"Carat for carat, I believe there is more beauty in chrysoberyl cat's-eye—than in any other gem. Alexandrites are leaf green in daylight and raspberry red in artificial light. Perfect stones can be bought for about $100 a carat.

Continued on page 180

When are two warblers better than one?

If you have ever watched a nest of young yellow warblers carefully, you have observed that both parents co-operate in the job of feeding them.

Sometimes the mother sits on the nest while the father forages for worms, seeds, and other delicacies. Sometimes both the mother and father hunt for food.

But the mother is never left alone to shoulder the complete care of her young if there are more than two young birds in the nest; for the mother warbler, by herself, cannot take care of her children properly. The job is too much for her.

The task of a human mother is even more difficult. It is very hard for her to bring up even one child by her own efforts. For trying to be a real mother while providing food and clothes and a home for her child and herself is a desperate, even heart-breaking struggle for a woman.

No man, who loves his wife, ever consciously exposes her to such a burden. But you probably have known too many cases where devoted husbands have left their wives with small children to bring up, and no money to bring them up with, simply through oversight or delay or too optimistic an attitude toward the future.

Unless you are certain that your loved ones are amply protected, no matter what should happen to you, why don't you call your local Travelers agent or insurance broker? He can give you sound, homely advice on what kinds of insurance are most necessary for you to have, and how much you should have.

Moral: Insure in The Travelers. All forms of life, casualty, and fire insurance; all forms of fidelity and surety bonds. The Travelers Insurance Company, The Travelers Indemnity Company, The Travelers Fire Insurance Company, Hartford, Connecticut.

"There are three charming stones that are 'sleepers.' The public knows little about them, and few jewelers carry them in stock. They are the tourmaline, the zircon, and the peridot. Fine specimens of all three can be bought for from $8 to $15 a carat.

"The tourmaline is found in almost every tint. It is rich in coloring and ideal for brooches, pendants, and earrings. The zircon is sometimes called by jewelers 'jargon,' 'hyacinth,' or 'jacinth.' In its pure white form it is often difficult to distinguish a zircon from a diamond. In golden-yellow and leaf-green it is gorgeous. Peridots run from dark green to bottle green. Sometimes they are called 'evening emeralds.'

"Any woman who will forget about diamonds and will choose stones best suited to her coloring and settings that enhance the gems, can acquire lovely ensembles of peridot, zircon, tourmaline at less cost."

Nor is there the slightest reason to be ashamed of synthetic stones. "In buying gems the average person must rely upon the integrity of the dealer. Even many jewelers are unable to tell accurately the value of a stone. They often judge it entirely by the price they paid.

"Why, then, place so much emphasis upon the value of gems? Synthetic rubies and sapphires are undetectable except by an expert. Why not wear them? If your purpose is to fool your friends, such gems only add to your inferiority complex. But if you have the proper attitude, and if you use some artistic discrimination in selecting stones and settings, and are quite willing to state that the jewels are synthetic, they will give you real pleasure."

It must not be inferred, however, that Curator Whitlock is a crotchety disciplinarian who wishes to set himself up as *fuhrer* of our national jewelry habits. He is alert to the almost universal appeal of a good story and has one for each of the "glamour" stones in this collection, as well as many of those outside it.

To gain popular appreciation of gems, he has been known to thrill an audience with tales of deceit, bloodshed and supreme sacrifice surrounding some of the world-famous diamonds: how one thief sold his loot to a ship's captain in return for "a safe passage to a distant land" and how the skipper placed a sinister interpretation on the terms by promptly tossing the luckless thief to the sharks. The sale of diamonds was formerly a recognized means of raising European armies and may remain so to this day. In France during the reign of Henry IV the celebrated Sancy diamond was being dispatched for precisely this purpose in the keeping of a trusted messenger, when that worthy was fallen upon by highwaymen, killed and robbed. . . . "But not of the Sancy diamond" Mr. Whitlock relates. "The faithful servant swallowed the gem before he fell under the knives of the bandits, and his master, knowing something of his devotion, recovered it from his stomach."

But underneath the surface glitter of diamonds and the picaresque episodes to which they have given rise, there appears a reflection of mankind's prevailing stupidity, which has perhaps nowhere been more penetratingly verbalized than in a New York *Herald Tribune* editorial occasioned by the much publicized though temporary display of the Jonker diamond at the Museum. The writer of this brief jeremiad says in part: "The diamond . . . has been regarded through the ages with admiration, fear and awe—very much as hard, durable, brilliant and useless individuals have commonly been regarded by their fellow men. Again rather like such persons, the diamond has caused humanity vastly more trouble than it has been worth on any rational scale of values, and is, therefore, an object of intense fascination. But when to these attributes of all diamonds a stone adds that of supreme bigness, it becomes active news; half a hundred reporters and photographers flock to its unveiling, and it is 'worth' somewhat more than $750,000 simply and merely for being itself.

"It is already so valuable as to approach the valueless. It is so costly that it must be rather hard finding anyone to buy it; it is so precious that no one except a lunatic would think of stealing it. It is wealth compacted into a form in which it can exist only as wealth. It is like certain non-callable bonds, which may be sold by one owner to another, but which will never be repaid. It is in a sense ultimately uncashable; and if the last man in the world should find it in his possession he would be obliged to cast it, and whatever he might have paid to acquire it, into the sea as of no worth to him. Since humanity would have gone, all the human values locked in its cold and brilliant depths would be lost with it, and its last owner would be its ultimate dupe. Diamonds are like that. It is what gives them their enduring hold over the human imagination."

Added to this is the fact that diamonds are a poor investment owing to rapid changes in cutting styles alone. And if you have a legacy of jewels in your family, it is almost certain to be worth only a fraction of what you think. This is especially true if you base your notion on the word of the original owner who is prone to seek greater self-esteem through an overvaluation of his jewels.

The Supernatural

Tall tales of precious gems that bring a flood of misfortune to each of a long succession of owners are well-known to all. For the most part, these supernatural "curses" are probably an emotional rationalization of the ironies so succinctly outlined in the *Tribune* editorial above. Yet even the Museum has been affected by superstition.

Back in the '80's and '90's, President Morris Ketchum Jesup so dreaded snakes that a Herpetology Department was forbidden. Similarly, J. P. Morgan I, principal benefactor of the Gem Hall, hated and feared that notoriously "unlucky" stone, the opal. Accordingly, this gem was scarcely represented at all until after the great financier's death.

Mr. Whitlock has a charmingly simple explanation of why the opal came to be thought unlucky. Opals are really a solidified jelly made of silica and water. Their beauty is frequently also their doom since tiny natural cracks at once provide their radiance and their liability to complete fracture. Even if opals are handled with utmost care, a sudden change in temperature may shatter them to bits. Might not such a mysterious disintegration of so beautiful a gem encourage belief that it was coveted by or in league with supernatural powers? "However," says Mr. Whitlock, "with reasonable care an opal should have a long and vivid life, reflecting in its many colors all the moods of its wearer. It is, to my mind, beauty at its lowest cost."

But pearls—real pearls that is—are just the reverse. True pearls are the product of a small "itch" in the flesh of an oyster, which stimulates a sort of protective calcification of smooth shell material, so that, just because an oyster can't scratch his back, he may contribute to a necklace costing as high as half a million dollars. The Japanese, however, are raising small cultured pearls by introducing an artificial irritant. This variety is much less expen-

sive and distinguishable from the natural pearl only under X-ray and microscope.

Like opals, pearls are unstable and easily damaged. They are inclined to dry out if left in a safety deposit vault and actually do require skin moisture to show up at their best. However, the story of Cleopatra dissolving a pearl in wine and quaffing a toast to Mark Antony is pure fiction. Had she swallowed an acid strong enough for the job, the results might not have been fatal, but it would probably have brutally disillusioned Antony and thus changed the course of history.

Arm chair exploring

Although he is now writing a definite work on Chinese jade, a chapter of which appears in this issue, Mr. Whitlock has never been within 3000 miles of that ancient country. Moreover, his interest in the subject dates back less than a decade. He studied under the late Dr. I. Wyman Drummond, who had never been to China either, but who had amassed one of the finest jade collections in the world. This collection subsequently came under Whitlock's curatorship and since that time he has been gathering symbolic jade on his own—his personal collection at present containing 350 pieces.

The fact that he sticks close to home has placed Whitlock in an excellent position to study and improve upon Museum methods of display. He has left his mark on the Albany Museum where he designed a complete set of 384 exhibition cases all of which are still in use. They display not only minerals but mammals, fossils, insects, archaeological material and other natural history objects as well.

This achievement, together with the renovations in his own Hall of Minerals and Gems, has earned him considerable reputation as a specialist in Museum installation. The technical study of crystallography has also contributed to his feeling for design and a few years ago caused him to dabble in architectural prognosis. While making educational cardboard models of the natural shapes assumed by crystals, Mr. Whitlock was struck by their applicability to the construction of buildings. In these solids he saw indications of an era of fresh inspiration in our national architecture. "An old man," he wrote, "has dreamed a dream. Is it not possible that our young men may see a vision?"

But above all, Mr. Whitlock is a

(Continued on page 186)

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 188.

1. True pearls should be worn only infrequently as any skin moisture mars their beauty.

   True..... False.....

2. The American turkey vulture does not capture turkeys or any other living birds.

   True..... False.....

3. In what measure can it be said that the Father of Our Country was part elk.

4. What bird is the fastest flier?

5. If oysters could "scratch their backs" there would be no pearls.

   True..... False.....

6. The black widow spider is the only truly venomous spider in temperate North America.

   True..... False.....

7. Do bears suffer with arthritis?

   Yes..... No.....

8. The———(amethyst, opal, or pearl?) may shatter to bits under sudden changes of temperature.

9. The pigeon hawk receives its name because it

   (a) Preys on pigeons

   (b) Coos like a pigeon

   (c) Looks like a pigeon.

10. What is ambergris?

11. How heavy is Gargantua, the famous gorilla?

12. Cultured pearls can be distinguished from the natural variety only under X-ray or microscope.

    True..... False.....

13. Is it true that a herd of Lilliputian horses, the size of police dogs, lives in the Grand Canyon?

    Yes..... No.....

14. A peridot is

    (a) An underwater periscope

    (b) A medieval clown

    (c) A gem.

15. How many people have been born into the world since its beginning?

16. Yellowstone National Park was opened as a result of

    (a) Its marvelous mineral baths

    (b) Photographs by William Henry Jackson

    (c) Its suitability as an Indian reservation.

17. A widgeon is

    (a) A kind of duck

    (b) A young pigeon

    (c) The young of any bird.

18. Did Cleopatra dissolve a pearl in wine?

    Yes..... No.....

19. Hawks do not migrate.

    True..... False.....

20. Diamonds are entirely composed of a single element. It is———(carbon, calcium, or silicon?).

YOUR NEW BOOKS

PENNSYLVANIA BIRDS: A DEFINITIVE STUDY
BUILDERS OF AMERICA • RIESENBERG'S PACIFIC
ABOUT SPIDERS • TREES • FERNS • MEXICAN EARTH

WE WHO BUILT AMERICA
- - - - - - - - - - - - by Carl Wittke

Prentice-Hall, $5.00

NOW that the great days of American immigration have apparently passed into history, the extraordinary phenomenon which it represented has begun to attract the notice of serious students. To my mind the characteristics of the 19th century immigration into the United States have been as potent in shaping the temper of our people as such commonly recognized features in our national life as the frontier or the mechanization of everyday life. The ramifications of the subject are worthy of examination, and, if space permitted, they would be fascinating to follow. During this period of the "great migration," in Hansen's phrase, more than 30 million people entered the United States almost entirely from Europe. Although it would be difficult to estimate exactly how many present day Americans are the offspring of this later migration, it is safe to say that at least half and probably more are immigrants or the children and grandchildren of immigrants. Thus the immigration from 1820 to 1929 accounts for at least half our people. Nevertheless the pre-Revolutionary and early colonial migrations have always loomed much larger in our histories. Furthermore during this later migration the European sources were the following countries in the order of their numerical importance: Germany, Italy, Ireland, Austro-Hungary and Russia with England, Scotland, Wales, Holland and France formerly heading the list, now concluding it.

Although a considerable number of accounts are extant dealing with the migration of specific national groups, they are frequently marred by an all too-human but deplorable effort to give a special build-up to a particular group. We are likely to read that the virtues of American society spring from the Germans, the Scotch, the Irish, the Dutch or the French, according to the allegiance of the author. It is, therefore, all the greater service that Dr. Wittke renders in this account of American immigration that his viewpoint is not narrowed by a second-hand attachment to European nationality but embraces the subject with a considerable degree of impartiality. The scope of *We Who Built America* includes the immigration history of each of the principal stocks with the exception of the English, who having received adequate attention from other hands apparently need none from Dr. Wittke's. The causes of migration, the patterns of settlement, and the conflicts and adjustments created by successive streams are discussed for each national group both in colonial and post-colonial times. The factual details constitute a rather rich and sometimes tedious fare, but to anyone interested in the way this country was settled, and that includes most Americans, this should be a history of special interest.

H. L. SHAPIRO.

TREE NEIGHBORS
- - - - - - - by Russell Doubleday

Doubleday, Doran, $1.75

HERE is an attractive little book whose character is suggested by its title. It is not often that an outdoor book is more appropriately named. Thirty-two trees that grow east of the Mississippi and north of Charleston, South Carolina—about three-fourths native to this part of America and the rest introduced—are included. Each tree is illustrated by a close-up photograph showing the character of the bark, and by an excellent picture of the entire tree—all these photographs having been made by the author.

The text is brief, informal, and readable. As the author states, the facts were verified and the conclusions checked by Mr. Edward J. Alexander, Assistant Curator of the New York Botanical Garden.

In the introduction the author says, "This book is about the companionable trees. Not the forest giants that are awesome in their magnificence, but the gracious trees that can be grown to shade our houses or may be planted to help to compose the picture of our grounds and to harbor birds and squirrels." And it is just such a book.

The interesting characteristics of various trees, and their suitability for certain effects in the home landscape are discussed, with some suggestions in a broad, nontechnical way for their culture and care.

CLYDE FISHER.

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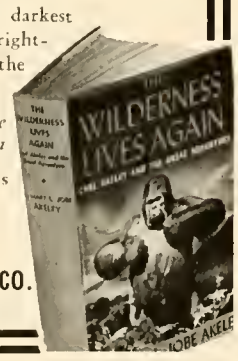

BIRDS OF WESTERN PENNSYLVANIA
by W. E. Clyde Todd, Curator of Ornithology, Carnegie Museum, Pittsburgh. Illustrated in color by George Miksch Sutton

University of Pittsburgh Press, $5.00

NEARLY 50 years have passed since Mr. Todd began work on this impressive volume. While the ensuing half century was not devoted exclusively to its preparation, we may be sure that it has always had first place in his mind. It is, therefore, truly a life work.

Every one familiar with Mr. Todd's previously published contributions to bird lore knows that his standards are the highest and that he spares no effort to reach them. Thoroughness and accuracy of statement are his watchwords. One might well say, "If you see it in Todd it's true." Instead of taking the entire state of Pennsylvania for his field he has, therefore, selected a part large enough to be representative of the whole and small enough to be under his personal supervision. In this region, largely through his efforts, a corps of co-operators has arisen whose contributed observations have permitted him to treat of distribution with the intimacy of a local list and to make the somewhat surprising claim that western Pennsylvania "ornithologically speaking . . . is now better known than any area of similar size in the eastern United States, and the distribution of bird

life within its borders is better understood than is that of any like area." The biographies are informing, readable and sufficiently topical to make them of special value and interest to bird-lovers living in the region of the title. We advise them to secure a copy of the book promptly for Mr. Todd's generosity of spirit in refusing to accept a royalty, and the assistance of the Buhl Foundation in meeting the cost of producing permits its sale at cost.

Mr. Sutton's illustrations are charming. We have today numbers of artists who paint our larger birds in a manner to "stump the critics," but we know of no living painter who is so successful in securing for the smaller ones the intangible touch between "very good" and "perfect" that turns a painting into a portrait. Fortunately, the originals are reproduced in full tone doing credit not only to their color but to their *feeling*—they are real birds. How they would have delighted Sutton's teacher, Louis Fuertes!

FRANK M. CHAPMAN.

THE PACIFIC OCEAN

- - - - - - - - by Felix Riesenberg

Whittlesey House, $3.00

IT is appropriate that the largest, the most romantic and possibly the most significant ocean in the affairs of the world be chosen to initiate this maritime series which will, according to announcement, also include the Mediterranean, the Coral Seas, the Antarctic Ocean and the Caribbean. A little over four hundred years ago the Pacific first entered the ken of Europeans when Balboa by crossing the narrow Isthmus of Panama confronted this vast sea. In the characteristic manner of Europeans, they date its history from this discovery, although it was already known to the Chinese, the Japanese and the many native people inhabiting its vast shores and its countless islands.

The vast extent alone of the Pacific might well have captured the imagination of European explorers and have endowed it with an honorable place in the history of exploration. But the Pacific possessed other and more significant attributes to warrant its primacy. As a route to the rich resources of the East it had incalculable economic importance. For many years the Spanish galleons following routes laid down by early Spanish explorers poured the treasures of the Orient into the avid coffers of Madrid. In the 19th century American clippers, whalers and sealers reaped hazardous fortunes from the Pacific, and in our day the fundamental role of Pacific economy needs no mention.

Of less tangible but equally potent attraction for the European mind were the strange new worlds which the exploration of the Pacific brought to light. Hidden within its horizons detached fragments of mankind rewarded the intrepid exploits of a long line of Spanish, Dutch, English and American sailors. Along its shores rich and ancient civilizations not only offered incomparable sources of economic exploitation but also set up a complex and subtle reaction in the civilization of Europe.

Mr. Riesenberg in his history of the Pacific has elected to retell in a simple, forthright and dramatic fashion the story of the most significant men in the grad al discovery of the Pacific during the 400-odd years since Balboa first met it. His account is mainly anecdotal and designed to entertain. Even within his self-imposed limits his story of the exploration of the Pacific leans heavily on personalities, physical achievements and heroics. The vast economic and intellectual significance of the Pacific upon the European world is largely neglected.

H. L. SHAPIRO.

MY LIFE IN A MAN-MADE JUNGLE

- - - - - - - - - by Belle J. Benchley

Little, Brown & Company, $3.00

THE San Diego Zoological Gardens have grown and grown. Their collections are now extensive and of high interest, and varied habitat groups have been skilfully created from standpoints of practicability and attractiveness. Coming to this vigorously developing institution as a bookkeeper and rising to the position of Director, this author presents a new slant on animal story-telling. Possibly this is because she is the only woman Zoo director in the world.

Each chapter is an animal story by itself or descriptive of phases of zoo activity, such as collecting expeditions, the purchase and distribution of varied rations, and work of the Zoo hospital. The latter forms one of the longer and most interesting chapters, for San Diego can be justly proud of this hospital, with its department of research, corrective measures and dietary studies.

Two huge gorillas, Mbongo and Ngagi, which were purchased from the Martin Johnsons, dominate the book.

There follows an interesting account of how they were weighed.

> "Then one day we released the wire on the bottom of a tall door leading from the exhibition cage into the safety cage in the rear. Through this opening we inserted the platform of warehouse scales with the arm and balance extending up outside the gorilla cage. We had no idea what they would do with it or if we could get them on it successfully. But when the two came out in the morning they immediately walked over and looked at the new apparatus. I stood inside the safety cage with a pan of assorted fruit. I held out a tempting peach and Ngagi reached for it. Then I held another, high above the scales. Without hesitation he stepped upon the platform and when he had taken both hands off the wire of the upper door I gave him the fruit. I touched his fingers so he would let loose again and when he did I gave him more fruit. He stood patiently and very still while we got our first accurate weight."

Thus zoologists may be assured that the astonishing weights of these gorillas obtained in May, 1940—Mbongo 602 pounds and Ngagi 539 pounds as compared with 147 and 122 pounds in 1931

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The subject matter covers a wide range—from wild ducks to gorillas, from *Afropavo congensis,* the biggest bird discovery of the century, to the dinosaur. We learn about termites, the social system of the barnyard, and extraordinary tales of prehistoric times. All in all, this is an absorbing book, in which Dr. Andrews lets his readers share the riches of his well-stored mind.

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—were carefully recorded. It is explained that the famed Gargantua, of the Ringling Circus weighed 500 pounds at his last weighing in.

But all of this is but a part of Belle Benchley's book. Her subjects range in size from elephants to rodents.

RAYMOND L. DITMARS.

THE MEXICAN EARTH

- - - - - - - - by Todd Downing

Doubleday, Doran, $3.00

TODD DOWNING is the author of some of the most absorbing detective stories ever written. One great reason for their fascination is the Mexican setting, which the author re-creates with a profound sense of the visual, atmospheric, and emotional values. To bring the background of his detective stories into the foreground of a travel book was an easy task for Mr. Downing, who did his work with discrimination and skill.

Mr. Downing blends history, tradition, customs, description, and personal experience into a setting against which the visitor to Mexico may adjust and evaluate the incidents of his visit. Without some such preparation, the American traveler may find his trip a sterile one. The foreigner in Mexico who seeks to widen the horizons of his experience will find abundant vistas in the variety and depth of the Mexican scene. The conventional tripper who crosses the border for souvenirs, for dosage with Culture capsules, or for elegant dissipation will have an empty time, for Mexico is a working country, not the background for resorts.

The Mexican Earth should be part of the reading of everyone who crosses the Rio Grande. Its sympathy and understanding will add meaning and significance to even the most humdrum sights. *Mexican Earth* is an appreciation rather than a guide book or a history. Should a cynic say, "The road to Mexico is paved with the good appreciations," one can justifiably answer that without a general understanding there is no field for the histories and guides that give the third dimension of perspective to the Mexican scene.

GEORGE C. VAILLANT.

SOUTH AMERICAN MAMMALS

- - - - by Doctors Angel Cabrera and Jose Yepes

Compañia Argentina de Editores, Buenos Aires (Publishers), $14.00

THE mammals of South America have not been given the attention they deserve by virtue of their many interesting characteristics, and anyone wishing to read something of their classification or life histories has had to search through an extensive and often diffuse literature. At least that has been the case until now when Cabrera and Yepes have come forward with their *Mamiferos Sud-Americanos* as a single volume written in Spanish and designed to give a well-rounded presentation of this important fauna.

The authors are prominent naturalists on the staff of the University of Buenos Aires, with other important zoological connections in Argentina, and have studied the recent mammals of South America over a period of many years. Their book is an excellent addition to the literature of natural history and they are to be congratulated as ambitious pioneers in a new field. The book is written in Spanish, it is well printed and handsomely illustrated, and will be a useful source of reference to naturalists, sportsmen and travelers in South America.

South America has a rich mammal fauna, the number of distinct species and subspecies is a large one, and it would not be possible to list every variety of mammal, with an adequate description and the type of treatment given by Cabrera and Yepes, in a single volume. The authors have had to select the most important forms. With some orders the selection has omitted little, but with other groups, the Rodentia for example, the described forms are legion and there has had to be drastic elimination. Fortunately for the average reader, the mammals with the most outstanding characters from the popular point of view have been given the emphasis in the book, and he will not miss the obscure creatures, some of which are known only from small series in museums.

Lack of space prevents any detailed review of this substantial volume, but the welcome which can be extended to it in the above generalized remarks is intended as a recommendation to any reader with an interest in the mammals of South America.

H. E. ANTHONY.

DOWN TO EARTH

- - - - - - - - - - by Alan Devoe

Coward-McCann, $2.50

THIS is a book of unrelated essays which ought to be better than it is. Mr. Devoe combines natural history with a philosophy which leads away from today's agonizing events into paths of peace. There are many fine passages, a good deal of interesting fact, and the intent is high, yet trivialities of phrase and thought make the result mediocre. Natural historians have set a nobler standard for books on their subject.

The book contains facts which seem to exhaust the supply, and the philosophy is not sufficiently developed, and is negative in its continuous condemnations. Regarding the style, positive faults of unwieldy alliteration and repetition, with frequent resort to bad taste, make nervous, and not peaceful, readers.

There are four general divisions: Creatures, Weathers and Seasons, Animals and Adventures, and The Nature of Things. The world of nature is beautifully described in an early sentence, ". . . a rustling of a million branches, a whistling of a million wings, a movement of a million furred and finned and scaled and feathered things," yet the rhyming makes this sentence clumsy. Another is better: ". . . our earth is a very strange and very lovely and very lively place, and that we would do well, all of us, to draw closer to her."

Descriptions and life histories of earthworms, butterflies, snakes, skunks, oysters, Protozoa, and the ABC of bird structure, are part of the content. The chapter on bird nests is excellent. The conservation appreciation in "Men against Trees" and elsewhere, is needed propaganda. The eternal values of nature are stressed, as they always should be. The stories of the tiger and the rat seem extraneous.

The Misses Bradley's illustrations in black and white are very nicely done.

GRACE E. BARSTOW MURPHY.

EUROPE AND WEST AFRICA. Some Problems and Adjustments

by C. K. Meek, W. M. Macmillan, and E. R. J. Hussey

Oxford University Press, $3.00

TROPICAL colonies have been in the limelight recently, since they supply the civilized world with many indispensable materials. Within the British Commonwealth the various West African countries are important for metals, diamonds, palm oil, and cocoa. The Gold Coast Colony is the world's greatest producer of cocoa, 300,000 tons being exported annually. In recent years mining activity has expanded, tin coming from Nigeria, and gold and diamonds from Sierra Leone and the Gold Coast.

For most of these enterprises the workers are drawn in great numbers away from the village or tribe into centers of mixed population. The method of Indirect Rule, with authority exercised largely through native chiefs and the existing social system, becomes difficult of application. The laborers must be protected directly by the European Administration. Their ways of living are sure to be dislocated by the "impact of civilization," and wise education is needed if they are to be adjusted to the new order. As the old restraints of tribal custom and animistic belief die out, only new religious ideas can provide a healthy philosophy of living.

In 1938, the Heath Clark Lectures at the London School of Tropical Medicine dealt not only with the questions outlined above, but also with those of ownership in cocoa-lands, of labor relations in mining areas, authority of native chiefs, public health measures, and many related subjects. These lectures by three recognized experts, have now been published in a small book of 143 pages, which provides a clear, fair-minded introduction to some of the most urgent problems of British West Africa.

JAMES P. CHAPIN.

TIME EXPOSURE, The Autobiography of William Henry Jackson

G. P. Putnam's Sons, $3.00

"TIME EXPOSURE"—What a peculiarly fitting title is this for the autobiography of a pioneer photographer who began his work more than four score years ago! When members of the Explorers Club introduce their friends to him, frequently they are laughingly told that Mr. Jackson's photographic work was interrupted by the Civil War. Mr. Jackson has been heard to protest, "That's no joke, it's the truth."

Born in 1843, near the famous Ausable Chasm, he very early learned to draw,

having inherited the talent from his mother. He tells the story of his boyhood in upstate New York, of his adventures as a Union soldier along the Potomac and at Gettysburg, of his experience as "staff artist" in the 12th Vermont Regiment, of bullwhacking across the Great Plains while the Sioux and Cheyennes were still busy trying to protect their country from the white man, of making the first photographs of the ancient cliff-dwellings of Mesa Verde, of his photographing much of the Great West on the Hayden geological surveys, of his crossing half of Siberia in an open sledge with the average temperature of 20 degrees below zero.

His magnificent photographs of the unexplored Yellowstone—all made by the old wet-plate process—caused Congress to set aside that region as our first national park.

He has kept up both his photographic work and his drawing and painting to the present day. He now uses a miniature camera with color film, and one of his recent commissions in painting was a series of historical murals for the new Department of the Interior building in Washington finished in 1937 at the age of 94, and he is still painting.

The material for this fascinating story has been drawn from careful diaries which the author has kept for nearly 80 years. Mr. Jackson's host of friends nd admirers will be grateful that he has put it in book form.

CLYDE FISHER.

ABOUT SPIDERS. Introducing Arachne

- - - - - - - - by Elaine V. Emans

E. P. Dutton and Company, $2.50

THIS book is not intended for those who know spiders but is meant "for all who do not know about, and so do not care about Spiders." No more groundless fears of a particular group of creatures exist than those concerning spiders. Miss Emans' attempt to placate many of these unreasonable phobias and to encourage a more friendly feeling toward these animals is to be applauded. A fuller understanding of spiders by the layman is seen as the means to dissipate the haze of mystery and distrust that envelops spiders in the popular mind. The many thousands of species of spiders which are quite harmless, quite beneficial in fact, are contrasted with a single small group of wrongdoers. The hour-glass spider, or black widow, is introduced somewhat apologetically as the only truly venomous spider of temperate North America, and a fair estimate of its dangerousness is given. Suffice to say that this handsome arachnid is not quite as bad as her press reputation would seem to indicate.

The author paints in a most effective manner the various striking peculiarities and interesting characteristics of spiders. Injecting her personal experiences and reactions into the text makes lively reading of even the dullest material. Almost complete reliance is placed on the writings of other people for most of the factual data in the text. This is only natural and quite necessary in view of Miss Emans' recent introduction to the study of these creatures. It is not surprising that there are numerous inaccuracies in her book. Some of them may be charged to erroneous conclusions by previous writers and others are due to wrong interpretation or an unfamiliarity with the recent literature. One has the feeling, probably to some extent unjustified, that Miss Emans makes many of the things that spiders do somewhat too wonderful and too mysterious. Her enthusiasm, however, is quite genuine.

W. J. G.

THE QUIET WORLD OF NATURE

- - - - - - - by Bernard Gooch

John Lane, London

(William Salloch, New York, Agent in U. S .A., $2.50)

FOR those of us who love England, it is good to be reminded that there are still friendly chaffinches, heather on the moors, kestrels on the wing, and an Englishman to write of these ageless wonders. These are the eternal realities outweighing headlined horrors. In the study of nature, there is no redundance. Each flycatcher and lizard holds new interest, as does such a worth-while book as this, which is simple enough for any reader yet inquiring enough for any scientist.

Wearing Gilbert White's mantle, Mr. Gooch presents his wild neighbors in a coverage of three or four acres which he calls his "Dartmoor Garden." His preferences are for the tiniest of creatures—the voles, the salamanders, littlest birds, minnows in the pond.

There are only 70 species of birds available for study. Their small number explains, perhaps, the warm affection permeating the book. Mr. Gooch is a lover of nature with emphasis on the meaning of the word "lover." He has tenderness, gentleness, humor, accuracy, patience and eagerness. "Getting up early to watch the flycatchers, staying up late with the soft-winged owl, one felt not that the day was long, but that time was short indeed if one hoped to watch even a fraction of England's birds."

Dippers and fieldfares, goldcrests and tits are part of the cast of the first chapter, written with the avid ornithologist's combination of fact and glamor. Elsewhere, "Herbert" answers to his name and sheds light on other gulls. The hovering of the kestrel, osprey, and bullfinch is compared to that of the hummingbird. We watch chaffinches and flycatchers build their nests from the first twig to the finished product.

About half the book tells thrilling stories of the love-making of newts, the life of minnows, the dancing of stoats, the taming of adders, the play of ferrets, the thumping of rabbits, the way a toad pushes food down his throat with his eyeballs, a lizard basking on Mrs. Gooch's hand and, most interesting of all, the biography of a salamander. For three long weeks, the Gooches fed two of "Sally's" babies microscopic bits of food on a needle point.

The eight photographs are fair. The typographical errors toward the end are out of keeping. The value of the book lies in the constant challenge of interesting fact, the humor and vitality of the style, and the whimsical emphasis on the human side of his subjects.

GRACE E. BARSTOW MURPHY.

HARDY FERNS AND THEIR CULTURE

- - Edited by Carol H. Woodward

New York Botanical Garden, 25 cents

A BOOKLET of authentic articles and illustrations which tells not only how to grow ferns but how to understand and enjoy their interesting physiology and evolutionary background; a publication recommended for anyone whose gardening interest includes the utilization of these plants to best advantage.

SOUTH OF YESTERDAY

- - - - - - - - by Gregory Mason

Holt, $3.00

GREGORY MASON has combined in *South of Yesterday* the fruits of his archaeological and ethnological research with the adventures incident to their collection. The result is very entertaining and corroborates the opinion of a friend of mine, that "archaeology is fun." Certainly the study of Indian history is no dry poring over musty archives. The student must dig for his data, which exist in inaccessible places, productive of a highly anti-social insect life. Where the documentary historian wears out his eyes, the American archaeologist erodes his seat in the saddle, while the insects consume his flesh from without and the fevers sear it from within. Gregory Mason makes a strong case for the virility of himself and his colleagues.

His work led him into two fields, the Maya country of Central America, and the Tairona area of northeastern Colombia. He balances judiciously the nature of his finds against the travel background of their discovery. His approach is direct, and he does research because it interests him intensely. There is no hint of the somewhat drab didacticism of his professional colleagues nor of their meek idea of contributing their mite to a larger whole. Doctor Mason describes the archaeologist's life as one of adventure and romance and he will undoubtedly attract many aspirants. He draws a charitable veil over the life of archaeologists when they are not in the field. That longer period requires something more than an interest in travel, as we museum men daily have to explain to potential adventurers.

South of Yesterday brings out, however, the intrinsic importance of our continental history. It bridges the gulf between the technical literature and the interest of an ordinary reader. It humanizes those quaint figures that flit purblindly through the jungle in search of obscure knowledge. Finally Doctor Mason evoked in this reviewer a whole chain of amusing memories, which his demure post had led him to forget. *South of Yesterday* is a good job on a difficult task.

G. C. VALLANT.

WILD DUCKS FOR THE ASKING

(Continued from page 176)

waddling gait. They are by far the tamest ducks on the pond. Each afternoon as the food is brought in, there is a concerted rush up the path toward the gate on the part of the eiders. Long necks outstretched, feet flying, they tumble over each other in their effort to get at me and my shoelaces and trouser legs. Not until their special food has been placed for them in their own pan will they desist from their playful attack. Then, however, they rush over to eat with gusto, wolfing down enormous quantities of soaked dog-biscuit, rock salt, and liver or fish. After this they return, still unsatisfied, to the fascinating subject of shoelaces, or perhaps flying up onto the bench, they will look into the still more interesting subject of coat pockets.

And so it goes. Every day there is some change among the inhabitants of the pond. Always there is activity, always amusement and entertainment. As I sit here on the shore of the pond on a bright afternoon, the water is beginning to absorb the first orange-tinted light of the coming sunset. Suddenly over my head I hear a noise and dodge instinctively to avoid being hit. Right out of the purpling sky has come a pair of black duck to land with a clean swish in the water. They passed so close that I could have touched them. The light is dying and it is cold, but I sit there entranced at the animation and the life before me. It is a rare sight and one of much beauty, this little duck world. I now know the pleasure that it brings over the years of watching and I hope that there are many others who may persuade themselves to sample the entertainment of a duck pond.

LETTERS

(Continued from page 133)

ering the neck and removing some of the skull, is shown on page 172 of Major-General Robley's *Moko; or Maori Tattooing*. All accounts quoted by him agree on the removal of the brain as the first step in the process of preserving the head.

I offer these pictures in the hope that they may be interesting enough to reproduce.

ROGER DUFF,
Ethnologist.

Canterbury Museum,
Christ Church, New Zealand.

NOTICE: Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

KEEPER OF THE GEMS

(Continued from page 181)

Museum man—a curator in the fullest sense of the word. The sincerity, educational insight and modesty which have characterized his long career are best conveyed by his personal credo:

"I believe that a modern well equipped museum ranks among the greatest influences for culture, enlightenment and spiritual uplift in any community; because here, as with great music, writing and painting, men of vision may pass on their vision to their fellow men and to posterity.

"I believe that the language that a museum worker should be able to speak is the language of little children."

* * *

POPULAR TALKS ON THE APPRECIATION OF GEMS

Members of the American Museum of Natural History are invited to attend a series of free, informal lectures given by the authority who was the subject of the preceding article. These lectures by Mr. Herbert P. Whitlock are all illustrated and will be given at 4:00 Saturday afternoons in Room 319, Roosevelt Memorial of the American Museum.

October 19: "The Precious Stones"
(Patricians of the gem family: diamonds, rubies, sapphires, emeralds, and opals)

October 26: "The Semiprecious Stones"
(Topaz, garnet, tourmaline, and many less familiar gem stones)

November 2: "Quartz and other Decorative Stones"
(Materials that are used for carved objects: jasper, turquoise, and lapis lazuli)

November 9: "The Antique Use of Gems"
(The evolution of the necklace from prehistoric times through the cultures of the ancient world, and the use of gems as amulets and talismans from earliest times)

PHOTOGRAPHIC PRIZES

The Second Annual Exhibition
of
PHOTOGRAPHS OF WILD LIFE
under the auspices of
THE NEW YORK STATE NATURE ASSOCIATION
will be held at the
ALBANY INSTITUTE OF HISTORY AND ART
125 Washington Avenue,
Albany, N. Y.
October 30—November 10, 1940

A first prize of $20, a second prize of $10 and a third prize of $5 will be awarded to the pictures which best represent the spirit and beauty of living wild birds and animals photographed in their natural surroundings; the prize-winning photographs to become the property of the New York State Nature Association.

REGULATIONS

1. Prints must be mounted on standard 16" x 20" mounts in such a way that the long dimension of the mount is vertical.
2. All entries must be received not later than October 25 by Miss Alice Morgan Wright, 393 State Street, Albany, N. Y.
3. The name and address of the exhibitor must be typed or printed on the back of each mount.
4. There is no entrance fee but postage must be sent for the return of photographs, or they may be called for at 125 Washington Avenue not later than November 20.

Every possible care will be taken in the handling of exhibits but no responsibility will be assumed for loss or damage.

Unless stated to the contrary it is assumed that permission is granted to reproduce any of the pictures exhibited.

FALL FOLIAGE IN FULL COLOR

By CHARLES H. COLES
Chief Photographer, American Museum of Natural History

NO season of the year calls for color photography so insistently as the fall. The brilliant coloring of the oaks in their reds and browns, the maples in shades of scarlet and orange, the dazzling yellows of the hickory and birches, make strikingly beautiful contrasts with the greens of the conifers and the deep blue of autumn skies.

The ease with which Kodachrome will reproduce these highly colored scenes is making color photography more popular each year. No longer does the camera fan pull out a sheaf of black and white prints to show his friends. Now he pulls the chairs into a semicircle about a screen, turns out the lights and projects in vivid colors, to a size far beyond the capabilities of an enlargement, pictures with a realism and brilliance unknown a few years ago.

Judging exposure

A curious observation that is often made among users of Kodachrome is that before they owned a photoelectric exposure meter they obtained a larger number of correctly exposed pictures than after they purchased this highly recommended piece of equipment.

The logic that pointed out the desirability of owning an exposure meter usually ran as follows: the smaller latitude of color film makes exact exposure in the camera essential; a photoelectric exposure meter measures the light coming from a scene accurately; therefore, a photoelectric exposure meter will provide the necessary data to obtain exact exposure.

It is in the second statement that the logic breaks down. While the meter does measure the light accurately, this is not the factor which really controls the accuracy of the exposure. What really counts is the light *falling* on the subject, not the light *reflected* from the subject. If you inspect the instructions that come with each roll of Kodachrome, you will notice that most of the exposure data is given in terms of the brilliancy of the sun; that is to say, the light that is *falling* on the subject. Only a minor correction is made for the color or brilliance of the subject itself, that is, for the light that is *reflected* from the subject.

It would seem, then, that the brightness of the sunlight falling on the subject is really the quantity to measure rather than that coming from the subject. This can easily be done by substituting for the subject something that remains constant in color and reflectivity, and measuring the light falling on it. A test object may be made of a piece of white blotter, a white shirt, or any really diffusely reflecting white object at least ten inches square. Place this object at the subject position, or any place where it will receive the same illumination as the subject to be photographed, and point the meter at it ten inches away from it. Take care that the shadow of the meter does not fall on the test surface. Measure the light and give the scene ten times the exposure indicated for the white surface.

A gray card that reflects one-tenth as much light as the white surface may be used instead. In this case give the color film the exact exposure indicated.

If you want to simplify the reading of the meter still more, go out on a cloudy day, hold the meter over your head, and measure the light from the sky. Now slip a disk of white bond paper over the photoelectric cell and note the reading. Add more disks until the meter reads only one-tenth of what it did on the gray sky. This is equivalent to a little over three f. stops. Touch the edges of the paper disks with cement and fasten them to the cell window.

Now when you want the exposure for a scene in color, stand in the position of the subject and point the exposure meter toward the camera (the reverse of your normal direction). Read the exposure directly and set your camera accordingly. The only time that you will find difficulty in getting a good reading is when the light falls across the subject from either side. In this

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case measure directly into the sun (with the paper still over the window) and double the indicated exposure. (Either open the lens one stop wider than indicated or slow the shutter down to half its speed.) Dark subjects will require about a half stop wider lens opening than the meter shows; and, conversely, light-colored subjects require a half stop smaller. Outside of these minor corrections, the meter will read directly.

Minimum exposure

Sometimes, because of peculiar conditions, any meter may indicate exposures less than 1/25th second at f:11. If it does, ignore the meter. A minimum exposure of 1/25th second at f:11 has been determined by a number of people as a matter of experience.

A very useful filter for Kodachrome photographers is the Pola-Screen, Type 1-A. By using this filter a wide variety of effects can be obtained. In picturing autumn foliage it is useful in several ways. It will darken the blue of the sky, thereby enhancing its contrast to the brightly colored leaves. It will remove surface reflections from the colored leaves, allowing their own color to be recorded in full value. It will remove haze in distant scenes.

Try some color pictures this fall. See what you've been missing all this time. You'll get pictures you'll prize through many seasons.

Answers to Questions on page 181

1. False. Pearls are inclined to dry out if left in a vault and require skin moisture to show up at their best. See page 181
2. True. The turkey vulture is completely dependent on dead animals for food. The group of birds known as vultures no longer have talons capable of killing or carrying off prey. See page 149
3. An elk or wapiti contributed his false teeth. See page 142
4. The peregrine falcon or duck hawk, both races of the same bird. See page 146 and Chart
5. True. Pearls are the result of a small "itch" in the flesh of an oyster which stimulates a sort of protective calcification. See page 180
6. True. See page 185
7. Yes. See page 143
8. Opal. See page 180
9. (c) Because it looks like a pigeon. See page 149
10. Ambergris is a valuable substance from the sperm whale used in perfumery. See page 143
11. Gargantua weighs approximately 500 pounds, but two gorillas at the San Diego Zoological Gardens have tipped the scales at 602 and 539 pounds respectively. See pages 183 and 184
12. True. See page 181
13. No. See page 143
14. (c) A gem. A peridot is a green gem, rarely carried by jewelers and sometimes called an "evening emerald." See page 180
15. About 90 billion. See page 143
16. (b) Photographs by William Henry Jackson. See page 185
17. (a) A kind of duck. See page 176
18. No. The beverage could not have contained enough acid to dissolve a pearl without having had more serious effects when drunk as a toast. See page 181
19. False. Every fall some nineteen species of birds of prey migrate down across at least part of the United States, some clear to Central and South America. See pages 146 and 147, and Chart
20. Carbon. See page 177

RADIO

The American Museum's New Horizons

THE American Museum of Natural History again holds the mid-week spot on Columbia's 1940-41 series of the "school of the Air of the Americas" with Wednesday's New Horizons, featuring Dr. Roy Chapman Andrews, Director of the Museum. Hans Christian Adamson, Assistant to the President, is the author of these broadcasts on geography, history and science.

With the new "School of the Air" year, beginning October 7th, Columbia is following the lead of the United States Government's efforts to cement relations among the American countries and is drawing heavily on the nations south of the Rio Grande for broadcast material, as well as Canada.

This year's New Horizons, subtitled "Waters of Life," will tell the story of water in the discovery and development of the Americas and unfold the dramatic history of the New World. Following a thrilling glimpse of preconquest civilizations, New Horizons will trace the discovery of gold, silver, and other natural treasures and portray the growth of the first settlements in America into mighty cities.

More than 15,000,000 school children in classrooms all over the Western World are expected to listen to these broadcasts each week during the next school year, according to Sterling Fisher, Director of Columbia's Department of Education. "This series has become one of the most used classroom radio features in the United States," said Mr. Fisher. "Designed primarily to aid in the teaching of geography, history and natural science, the series plays an important role in the integration of all the social studies. Teachers of English literature, government, art, music, and Romance languages find it particularly valuable. In thousands of elementary and junior high school classrooms, New Horizons has become a vital part of the weekly schedule."

The schedule is so arranged that listeners throughout the entire Western Hemisphere will be able to tune in at a convenient hour. See your local radio timetable.

The American Museum's New Horizon's program, featuring "Waters of Life," will occupy the Wednesday period of the five-day weekly "School of the Air" program for 26 consecutive weeks beginning October 9th. Representative titles are as follows:

October 9: "America Starts"
October 16: 'Ships on the Spanish Main"
October 30: "Passage to Cathay"
November 13: "Incas over the Andes"
December 4: "Key to the Great Lakes"
January 8: "Monument to the Might of Water"
January 15: "Stronghold of Buccaneers"
January 29: "Starving-time on the James"
February 26: "Frontier Days on the Ohio"
March 12: "Steam Conquers Wind and Current"
March 26: "Oil on Quiet Waters"
April 2: "Foods for the New World"
April 23: "Streams of Green Gold"

Recent Museum Publications

NOVITATES

No. 1070. Mammals Collected by the Rockefeller-Murphy Expedition to Tanganyika Territory and the Eastern Belgian Congo. By Robert T. Hatt.

1071. Descriptions of Seven New Birds from Venezuela. By E. T. Gilliard.

1072. Results of the Archbold Expeditions. No. 25. New Birds from the 1938-1939 Expedition. By A. L. Rand.

1073. Results of the Archbold Expeditions. No. 26. Breeding Habits of the Birds of Paradise: *Macgregoria* and *Diphyllodes*. By A. L. Rand.

1074. Results of the Archbold Expeditions. No. 27. Ten New Birds from New Guinea. By A. L. Rand.

1075. Three New Bats from Honduras and the First Record of *Enchisthenes harti* (Thomas) for North America. By George G. Goodwin.

1076. The Genus *Acridomyia* Stackelberg in North America (Diptera: Muscidae). By Fred M. Snyder.

1077. Two New American Whip-Scorpions of the Family Schizomidae. By W. J. Gertsch.

1078. Additional Species and Records of Stingless Bees (Meliponidae) from British Guiana. By Herbert F. Schwarz.

1079. A Revision of the Forms of *Stigmatomma pallipes*. By William S. Creighton.

1080. A New Bee from the Argentine Republic. By T. D. A. Cockerell.

1081. Two Neotropical Agrionine Damselflies (Odonata) from Mts. Duida and Roraima. By James G. Needham and Elizabeth Fisher.

1082. Mammals Collected by the Legendre 1938 Iran Expedition. By George G. Goodwin.

BULLETIN

Volume LXXVI, Article 9. Lagomorpha and Rodentia Other than Sciuridae, Anomaluridae and Idiuridae, Collected by The American Museum Congo Expedition. By Robert T. Hatt.

Volume LXXVII, Article 1. Herpetological Results of the Vernay Angola Expedition. By C. M. Bogert.

Volume LXXVII, Article 2. A Supplement to the American Land and Fresh-Water Isopod Crustacea. By Willard G. Van Name.

Volume LXXVII Article 3. A Revision of the Rotatorian Genera *Brachionus* and *Platyias*, with Descriptions of One New Species and Two Varieties. By Robert H. Ahlstrom.

Volume LXXVII Article 4. Studies on the Earliest Primates. By George Gaylord Simpson.

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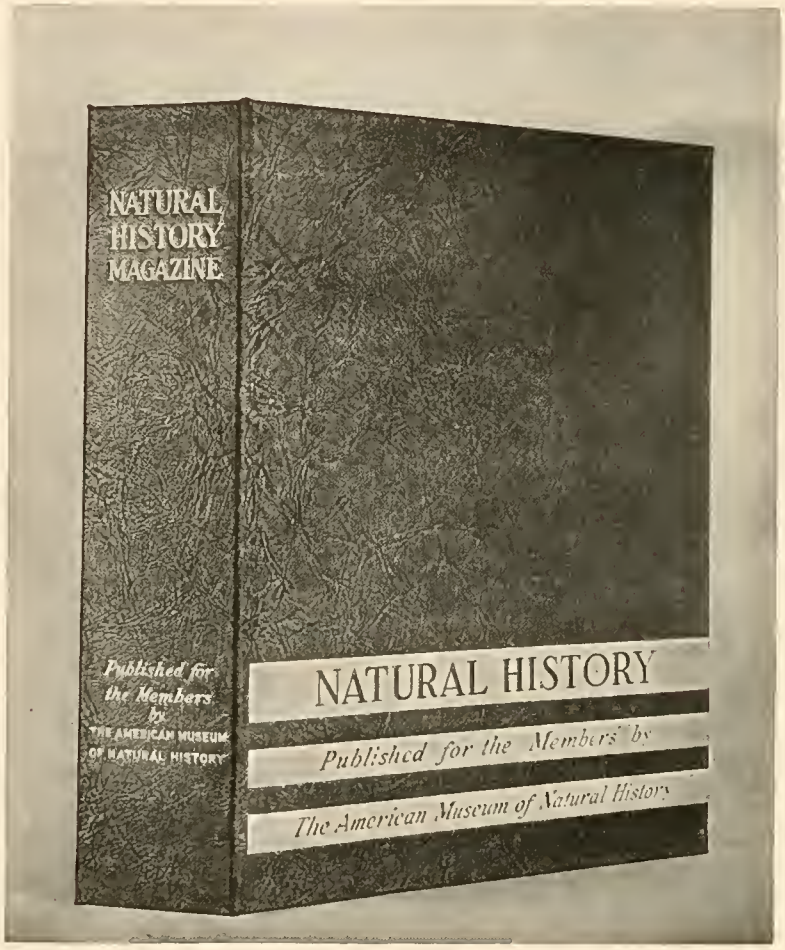

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ILLUSTRATIONS

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Above illustration from Bird Group of Hudson Bay Region in the American Museum of Natural History

LETTERS

SIRS:

To the editorial staff of the NATURAL HISTORY Magazine I wish to send hearty commendation on the introduction of two new features to the later issues.

First: the photographic cover designs rendered in full color. Being reproduced from a photograph, the subject is true in every detail. Adding the color feature lends depth and lifelikeness to the picture, which enhances its artistic value as well. May this valuable means be used to illustrate the covers of NATURAL HISTORY for a long time to come.

Second: the short biographical sketches of notable members of the Staff of the American Museum of Natural History, whose timely articles are so full of facts of such vital interest to members of the American Museum. Because it is physically impossible to have the great pleasure of personally contacting these staff scientists of the American Museum, the members are indeed fortunate in having an introduction to them through the pages of the NATURAL HISTORY Magazine.

May these features be an integral part of the magazine each month. . . .

E. B. POWERS.

San Diego, Calif.

* * *

SIRS:

. . . While I am writing I want to say that in all my wide experience I have never come across a more fascinating publication than your magazine, and I shall always be deeply indebted to my old friend, Mr. Martin Birnbaum, for persuading my husband to surprise me with a Membership in the American Museum of Natural History.

(MRS. J. LESTER)
LILLIE HERSHFIELD LEWINE.

New York, N. Y.

SIRS:

. . . I am an archaeologist and feel that your magazine is one of the most interesting on the market today. There is something very invigorating about this publication that makes one want to read every page at one sitting. . . .

FREDERICK W. SLEIGHT.

University of Arizona,
Tucson, Arizona.

* * *

SIRS:

. . . The continued improvement in your magazine is amazing and gratifying. You are now "tops" without doubt. Your book reviews are especially interesting and useful to me.

ROBERT BLESSING, M. D.

Fort Lauderdale, Fla.

* * *

SIRS:

. . . Please accept my congratulations on the appearance of the chart, "American Birds of Prey." The splendid presentation of this material makes it of special value to me in connection with the conservation club of which I am sponsor.

ARLENE I. WHITTEMORE.

Grand Rapids, Mich.

* * *

SIRS:

. . . Yours is a *beautiful* as well as an excellent and authoritative publication.

RICHARD WANLESS.

New York, N. Y.

* * *

SIRS:

In the article, "Rarest Trees of America," in the June, 1940, issue of NATURAL HISTORY, the section on *Sequoia sempervirens* (the redwood) is captioned, "The World's Tallest Tree." I believe you will find that the Australian eucalyptus, or gum tree, is the real possessor of this title, as it grows

Continued on page 247

YOUNG MOUNTAIN LION: A remarkable photographic portrait of a North American animal whose range once extended from coast to coast. By Charles C. Niehuis

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SHOOT THE CLOUDS

By CHARLES H. COLES

Chief Photographer, American Museum of Natural History

THE clear blue skies of winter are a tempting invitation to all who enjoy the out-of-doors and the beauties of the season's first snowy landscape. But the picture taker has learned that a few clouds generally add more to the scenic effect he desires than a limitless expanse of clear sky. Clouds lend interesting and varied detail and often assist in the composition to no small degree.

The photographer is interested in clouds in three different types of pictures in scenic views where the clouds are of secondary importance; in special compositions where the clouds take an important part among the other elements of the picture; and in photographs of clouds as such, used either for scientific study or subsequent use in scenic views by double printing.

Clouds at their scenic best

In earlier days the photographer frequently looked in vain on his negative for the beautiful cloud effect he noticed at the time that he took the picture; the film was not able to record it. But today, the graying of the blue of the sky, which used to be such a difficult task, is easily occomplished, and what was once considered a technical feat is now something that is expected of the average view. Modern films are so sensitive to all colors that clouds photograph without difficulty if they are visible to the unaided eye.

A color filter used over the lens will, however, improve the rendition of clouds sometimes even with panchromatic film. With orthochromatic film such as Verichrome or Plenachrome, a light yellow filter will bring the clouds out. Of course, a color filter does not add color to the picture but only helps the film "to see" colors with the same relative brightness as the eye. It helps to heighten the contrast between a bright, white cloud and a deep blue sky.

With panchromatic film, filters with deeper shades of yellow may be used. Orange and even red filters may be fitted to the lens, but with them the foreground of the picture is apt to suffer. Contrast will become too strong to be pleasant. Shadows are mostly filled with blue light from the sky, and since this is the color that the filters remove, the shadows go black.

For most pictures containing masses of green foliage or, for that matter, white snow, a medium yellow filter will give the most pleasing rendition of the whole landscape, including the sky.

Photos by Charles H. Coles

Red filter and Pola Screen brought out clouds in second picture. But while sky gains, foreground loses. Both negatives panchromatic.

Cloud studies

Where clouds form the major portion of the picture, with the other objects of the scene secondary in importance, the cloud must be given full emphasis. This is also necessary when clouds are being recorded for scientific purposes.

Near the zenith of a blue sky, a white cloud will require only a light yellow filter to outline it sharply and suppress the sky to a dark gray. As the cloud formations approach the horizon, the sky color becomes less blue and more white. A heavier filter is then required to produce the same darkening as the sky. An orange or even a red filter on a panchromatic film may be required to make the cloud stand out from the blue of the sky. It is to be remembered that the amount by which a filter alters the exposure varies widely with different films. A table of correction factors for various filters usually comes with the film, or it can be obtained from any dealer or reference book.

If a red filter will not produce the required darkening of the sky, the desired

Continued on page 247

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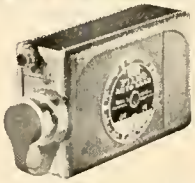

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THE MUSEUM AND WORLD CHANGES

THE function of a natural history museum as a mere storehouse of "finished" exhibits ended when the principle of evolution became generally accepted. It would be difficult to fix this date because the process was itself an evolution of ideas. Today, however, we refer to evolution as fact rather than theory, because it enjoys as nearly universal belief as any philosophy shared by mankind.

The effect of evolutionary thought upon man's whole outlook stemmed from the unity and order that it gave to the universe. It replaced a system of sheer magic with one characterized by law and relationship. Plants and animals, which previously had only present interest, acquired at one step a history and a future, both of which could be investigated by scientific methods. For such reasons dynamic museum exhibits are now required, exhibits that not only draw upon the immense wealth of the collections but which also make use of technical resources such as motion pictures, voice recording and moving parts. Their aim is to show what man can learn from his animal relatives, for the very reason that they are relatives.

Evolution is not an ethical code. Science is concerned with cause and effect, not with moral motives. But scientific demonstrations of what has been learned —not guessed—from nature are surely an antidote to the pseudoscientific nonsense rife today. We see the biological principle of "survival of the fittest" distorted into an excuse for mass brutality, in total disregard of all the spiritual aspirations built up since the glacial period produced modern man. In the symbolism of despotic leaders, far too much is made of the "struggle for existence," "superior race" and the like. The aim of emergence through ruthless competition has been glorified, although co-operation in nature is scientifically demonstrable throughout the ages. There are, indeed, deep-seated drives which can be explained not by individual advantage but only by the benefits conferred upon the associated members of a given species.

The geographer, Whitaker, has said, "—man alone of all creatures is able to worry about the future, and to make provision for meeting problems for which he did not inherit a solution." In other words, man has the unique privilege of being able to think out his own salvation. If he seems slow to learn, it is at least comforting to realize that he has dwelt on earth for less than a million years out of perhaps seven hundred million for the duration of life in lower forms.

The Museum is the one center in which the mighty record of life throughout the ages is preserved. The pioneer period of exploration and the discovery of new forms is drawing to a close. The highest task now is to make the most of what we have, and if this is done in the white light of modern science the Museum is in a unique position to minister to the wants of a distraught age. As preparation for well-ordered living in our changing world the natural sciences have crowded their way in among the "humanities" of the classical tradition and the economics of the modern day. The Museum can be a preserver of sanity if there is truth in the tested adage that one touch of nature makes the whole world kin.

Robert Cushman Murphy

The American Museum of Natural History

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — ROY CHAPMAN ANDREWS, Sc.D., Director

VOLUME XLVI—No. 4 ★ ★ ★ ★ ★ ★ NOVEMBER, 1940

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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.

ASSOCIATE: D. R. Barton.

ART AND PRODUCTION: 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 DEPARTMENT: Sherman P. Voorhees, Manager.

REPRESENTATIVES:
Frank S. Whitman, Chicago, Ill.
Warwick S. Carpenter, Santa Barbara, Calif.
Wells Constantine, New York, N. Y.

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The American Museum of Natural History wishes to express gratitude for the assistance in the promotion of the interests of NATURAL HISTORY that has been rendered by the Work Projects Administration.

NATURAL HISTORY is published monthly (except July and August) at New York, N. Y., by The American Museum of Natural History, Seventy-ninth 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.

Resurrection of the

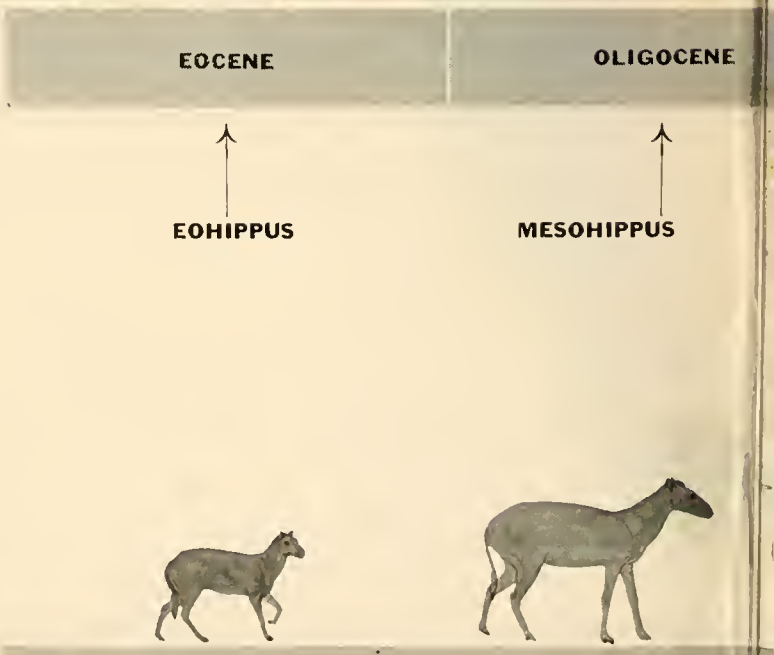
From the mists of incomplete knowledge and conjecture emerges the four-toed ancestor of our horse—testimony to the truth of evolution and to the stirring history of life

AMNH Photo

(Above) THE HORSE AS HE LOOKED some 50 million years ago: a restoration of Eohippus (*Eo* = dawn, *hippus* = horse) by the well-known artist Charles R. Knight, whose graphic portrayals have contributed greatly to popular knowledge of the vanished animals of the prehistoric past

IMMEDIATELY at right we see the dawn-horse in his rightful place at the beginning of horse evolution, approximately 50 million years ago. He was only the size of a fox terrier and had four toes on the front feet and three on the hind. These receded in the process of his evolution, until only one remained to form the highly developed hoof. Intermediate stages connect the modern horse with this ancestor unmistakably, as shown. At far right is *Equus scotti,* an inhabitant of the Ice Age and one of the nearest prehistoric relatives of our own horses

(Drawings by Louise Waller Germann)



DAWN-HORSE

By GEORGE GAYLORD SIMPSON*
Associate Curator of Vertebrate Palaeontology
The American Museum of Natural History

RESTORATIONS of prehistoric animals are becoming as familiar as pictures of living animals, and even those who make them tend to forget the long years of work, trial and error, fumbling and laboring slowly toward the truth, that made these restorations possible. Few restorations attract more atention than those of little *Eohippus,* the dawn-horse, "no bigger than a fox." Here stands the four-toed ancestor of our horses, testimony to the truth of evolution and to the stirring history of life. More than a century has elapsed since the first meager scraps of fossil dawn-horses were found. Only slowly over several generations were enough specimens and enough knowledge gathered to determine that these were, indeed, dawn-horses. Endless research brought the scattered and broken remnants together, thus making possible the life restorations that we are now inclined to take for granted.

The story of the restoration of the dawn-horse goes back to the year 1838 and to a place "situated by the side of the river Deben, about a mile from Woodbridge, in the parish of Kingston, commonly called Kyson, in Suffolk," England. Here a worthy man, William Colchester by name, was engaged in digging blue clay which he molded and burned to make bricks. Beneath the clay was a layer of sand, some of which was dug out and thrown aside in the course of operations. One day Mr. Colchester's keen eye observed in this sand a single tooth, smaller than a child's milk tooth, with every appearance of being an ancient fossil. This curious relic was dispatched to Charles Lyell, the leading geologist of that time and one of the greatest of all times, and by him was referred to Richard Owen, who occupies a similarly exalted place in the history of paleontology.

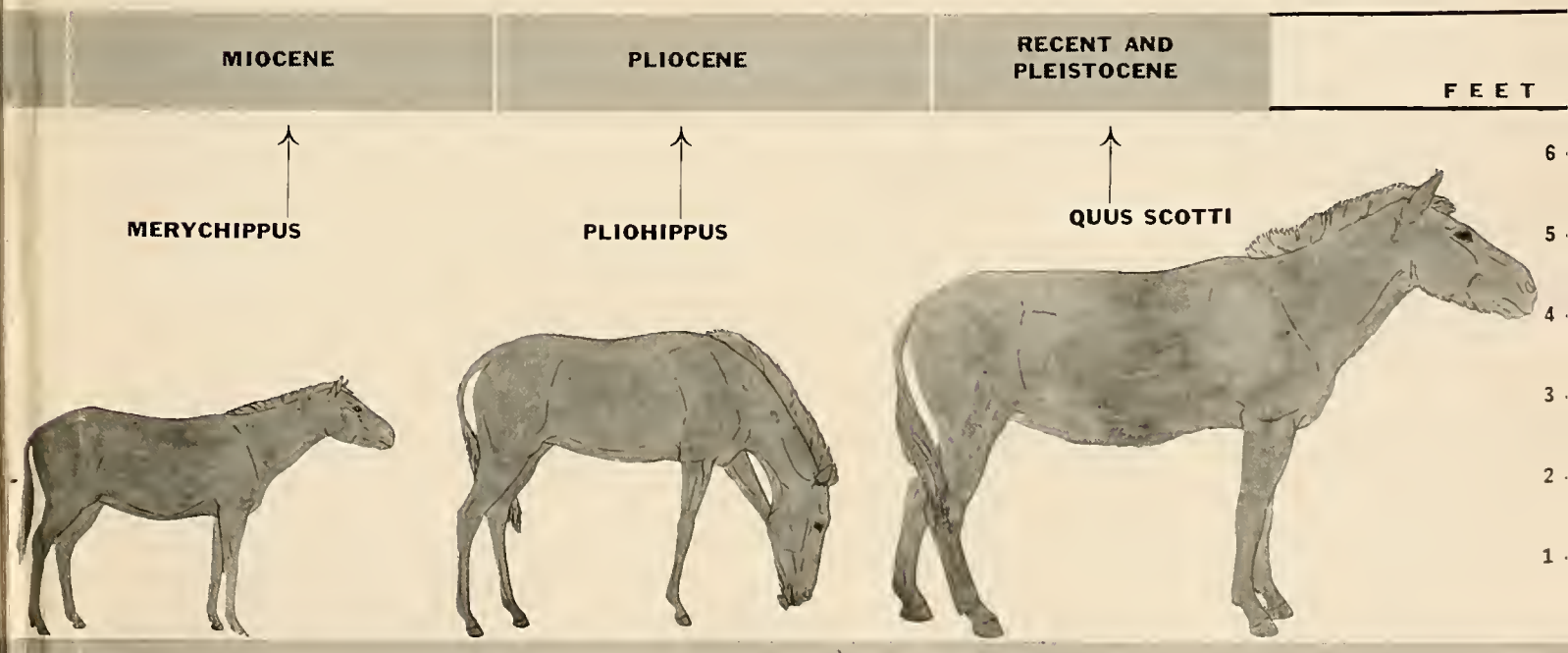
This discovery created so much interest, for reasons soon to appear, that a representative of the Geological Society called on Mr. Colchester and induced him to employ a boy to sift a pile of sand in search of other teeth. This effort was rewarded by a small jaw fragment containing the last lower molar of the same or a similar animal, which was also placed in Owen's hands.

With the advantage of a century of scientific progress, we now know that these two fragments constituted the first discovery of the earliest known ancestor of the horse. Owen then identified them as belonging to an extinct species of monkey. He did not go so far as to present a picture of the scene, but in words the first attempt to evoke the dawn-horse produced a monkey swinging through the tropical foliage of ancient England!

Scientists and public were alike amazed and delighted with this inference. The only sour note was sounded by a newspaper critic who suggested that "the supposed fossil might be nothing more than the remains of some monkey belonging to a travelling menagerie, which had died, and been cast out in the progress through Suffolk." This suggestion was promptly demolished by a barrage of polysyllables from the scientific big shots of the day, and quite rightly, too. No menagerie has yet presented a dawn-horse among its attractions.

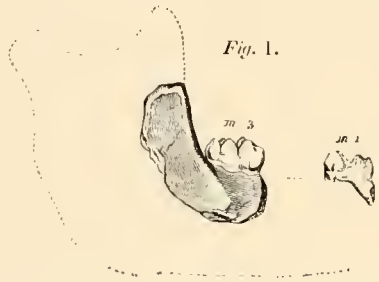
Owen's identification was almost as wrong as possible, but it was no stupid blunder. The teeth from Kingston, "commonly called Kyson," were completely unlike those of a modern horse, and the connecting links between the two were not yet known. To suppose the animals related, as they really are, would then have been the wildest of surmises, completely unjustified on any rational grounds. Owen was a brilliant anatomist and he was right in concluding that the fossil teeth were more like those of a monkey than of any other living animal. He could not know then, as we do now, that the reason for this is that the dawn-horse had exceedingly primitive teeth, similar to those of the ancestors of all mammals, horses

*The author's career and personality are recounted on page 244 in this issue.



and monkeys alike, and that the teeth of horses were later profoundly modified by evolution while those of monkeys have retained the primitive structure with little change.

Owen may, moreover, have been subconsciously predisposed toward this error by two scientifically irrelevant but personally impelling considerations. His French mentor and rival, the great Cuvier, had built a top-heavy structure of theory on the fact that no ancient fossil remains of monkeys had then been found. Owen's English friend and collaborator, Lyell, on the other hand, had predicted that such remains would be found. Lyell had written in 1830,



(From *A History of British Fossil Mammals,* by Richard Owen)

WHEN A HORSE was mistaken for a monkey: the first teeth of the dawn-horse which a century ago were thought to prove that monkeys once inhabited England

"We are led to infer from the presence of Crocodiles and Turtles in the London Clay, and from the Cocoa Nuts and Spices found in the Isle of Sheppy, that at the period when our older tertiary strata were formed, the climate was hot enough for the Quadrumanous tribe." "Quadrumanous tribe" was the mellifluous term then current in intellectual circles for what were and are known as monkeys to the vulgar.

Here Owen had fossil teeth that did indeed look very like monkey teeth and that came exactly from this London Clay which Lyell thought a good place to look for fossil monkeys. By concluding that they were monkey teeth, Owen at the same time confounded his rival Cuvier and made a prophet of his friend Lyell.

The next act in this drama also occurred in England and at almost the same time, in 1839, but at a place called Studd Hill on the coast of Kent. Here one William Richardson, Esq., M. A., F. G. S., viewed with melancholy interest the changes wrought since his first visit ten years earlier. Among these changes was the exposure of a stratum containing abundant remains of fossil plants, which, he says, led him to look "with strong expectation for the evidence of some form of animal life, whether of beast or bird, destined to be sustained by so rich a provision. I was justified in this expectation by the knowledge that nature ever directs her means, as well in number as in fitness, to particular ends." However that may be (and Mr. Richardson's confident interpretation of the intentions of nature is now less in vogue), he was justified a posteriori by the discovery of a large part of a fossil skull, containing most of the teeth in an excellent state of preservation.

This, too, gravitated into Owen's hands and he bestowed upon it the resounding name *Hyracotherium leporinum.* There was hardly more reason to consider this a horse than in the case of the two lower teeth from Kingston, but with this much more complete specimen Owen did not fall into the error of thinking it a monkey. He concluded that it was a hoofed herbivore, which is correct, but he wisely refrained from specifying an exact relationship to recent animals. Owen later observed that his supposed monkey teeth also belonged to *Hyracotherium,* and the mythical member of the "quadrumanous tribe" disappeared from the scene. Owen said little of the probable appearance of *Hyracotherium* in the flesh beyond remarking that "the large size of the eye must have given to the physiognomy of the living animal a resemblance to that of the Hare and other timid Rodentia." The description would not seem amiss if our mental image of *Hyracotherium* were not so colored by later knowledge that it was ancestral to the horse.

The scene now shifts to another generation and another continent. In 1872 E. D. Cope, who was to become one of America's greatest scientists and a pioneering explorer of the past, was traveling near Evanstown, Wyoming, and there his party found a fragment of lower jaw with one tooth. The actual discoverer was Cope's assistant Samuel W. Garman, from whom Cope soon parted in anger (although he was generous enough to ascribe the discovery to Garman in later publications). This fragment was part of a dawn-horse, the first found in America, although Cope was no more able to deduce its horse relationships from this fragment than Owen could from the similar fragment found in Suffolk. Like Owen, Cope also at first confused some of the teeth of dawn-horses and those of monkey-like animals, but in the more advanced state of knowledge of this later period he was quickly able to sort them out properly. Within a few years (by 1877) Cope recognized that these ancient American fossils, of which several species were then known, were closely related to Owen's *Hyracotherium* and that these animals were ancient allies, if not the actual ancestors, of the modern horses.

Thus the dawn-horse finally began to emerge as such from the mists of incomplete knowledge and conjecture. It is difficult to assign credit for the dis-

covery of the true nature of these fossils, and Cope and his rival O. C. Marsh bitterly contended for this honor, as they did over all possible subjects during most of their lives. Their feud reached epic proportions and still re-echoes among paleontologists, but now that the bitterness has died down it suffices to say that in this, as in many other contentious matters, both deserved credit and both detracted from it by refusing to share it.

Recognition that the dawn-horses were ancestral horses became possible only when a long series of intermediate forms was known and could testify to the profound transformation, so great that it is incredible when only the dawn-horse and modern horse are compared. By the 70's of the last century, this intermediate sequence was fairly well known, thanks largely to the work of Marsh, who long concentrated on the search for such specimens.

In the summer of 1876, the earliest ancestral horse recognized as such was a form called *Orohippus,* a primitive little animal but somewhat later and more advanced than Eohippus or *Hyracotherium.* It was then that the great English naturalist, T. H. Huxley, Darwin's defender and disciple, visited Marsh in New Haven. Huxley and Marsh discussed the possible earlier ancestry of the horse and agreed that a good name for the unknown ancestor prior to *Orohippus* would be *Eohippus,* a Greek compound that means "dawn-horse."

IN 1876 the great scientist Thomas Huxley deduced that a five-toed horse must once have existed, and laughingly drew this sketch. Science supports this theory today. Man, however, was not there to ride this ancient animal

As they talked, Huxley sketched on a brown sheet of paper and said, "This is my idea of Eohippus." "But," he added after a moment, "he needs a rider." This lack was quickly supplied and the two men laughed over the sketch.

Marsh decided that the rider, too, needed a name and asked, "What shall we call him?"

"Call him '*Eohomo,*' [dawn-man]," said Huxley, Marsh wrote the names below the sketch and left it as we reproduce it here.

Within a few weeks Marsh received his first specimens of real dawn-horses, such animals as Cope had been studying for several years and Owen had examined almost 40 years earlier, without discerning their full significance. With this preparation, Marsh was able to see that these were ancestral horses, and he applied to his fossils the name Eohippus, which he and Huxley had coined in jest for an imaginary animal.

Marsh was hesitant about revealing the origin of any of his fossils, and the names of the collectors of his Eohippus specimens, which brought him fame, have apparently never been made known. Marsh did not find them himself. He received specimens almost simultaneously from New Mexico and from Wyoming. It seems probable that those from New Mexico were found by David Baldwin, a colorful pioneer to whom space cannot be devoted here but whose memory deserves rescue from the obscurity into which it has fallen.

Marsh did not at first notice that his Eohippus was closely similar to some of Cope's prior discoveries and to Owen's *Hyracotherium;* but Cope's unfriendly scrutiny of everything that Marsh did soon brought this fact to light. To this day there is no general agreement as to whether the American species should be called Eohippus or whether the clumsier and less appropriate name *Hyracotherium* should be applied to them as well as to their English relatives. Technically it is probable that Eohippus should be abandoned in favor of the older name, but it is now so much more widely known that it will doubtless continue to be used, at least in nontechnical discussions.

Huxley's humorous sketch has been called the first restoration of Eohippus, but of course it was really a fanciful drawing of an imaginary animal and not a restoration of the real animal to which the name Eohippus was later applied. It will be noticed that Huxley's "Eohippus" has five toes on each foot. The fossil animals later named Eohippus by Marsh have four toes on the front feet and three on the hind. Everyone agrees with Marsh and Huxley that at a still earlier time the ancestors of the horses must have had five toes, but this most remote ancestor, the Eohippus as Huxley imagined it, has not been found

to this day. In 1940 we still do not know ancestral horses any older than those that were found in 1838, unless, as is possible but highly improbable, we are repeating history and actually have some fragments of these pre-dawn horses without recognizing them as such.

Even Marsh's placing of his Eohippus in the ancestry of the horse did not make possible a life restoration of these animals. Marsh revealed the structure of the feet and some other parts, but he did not have the material for a reconstruction of the whole skeleton, without which a scientific life restoration is impossible.

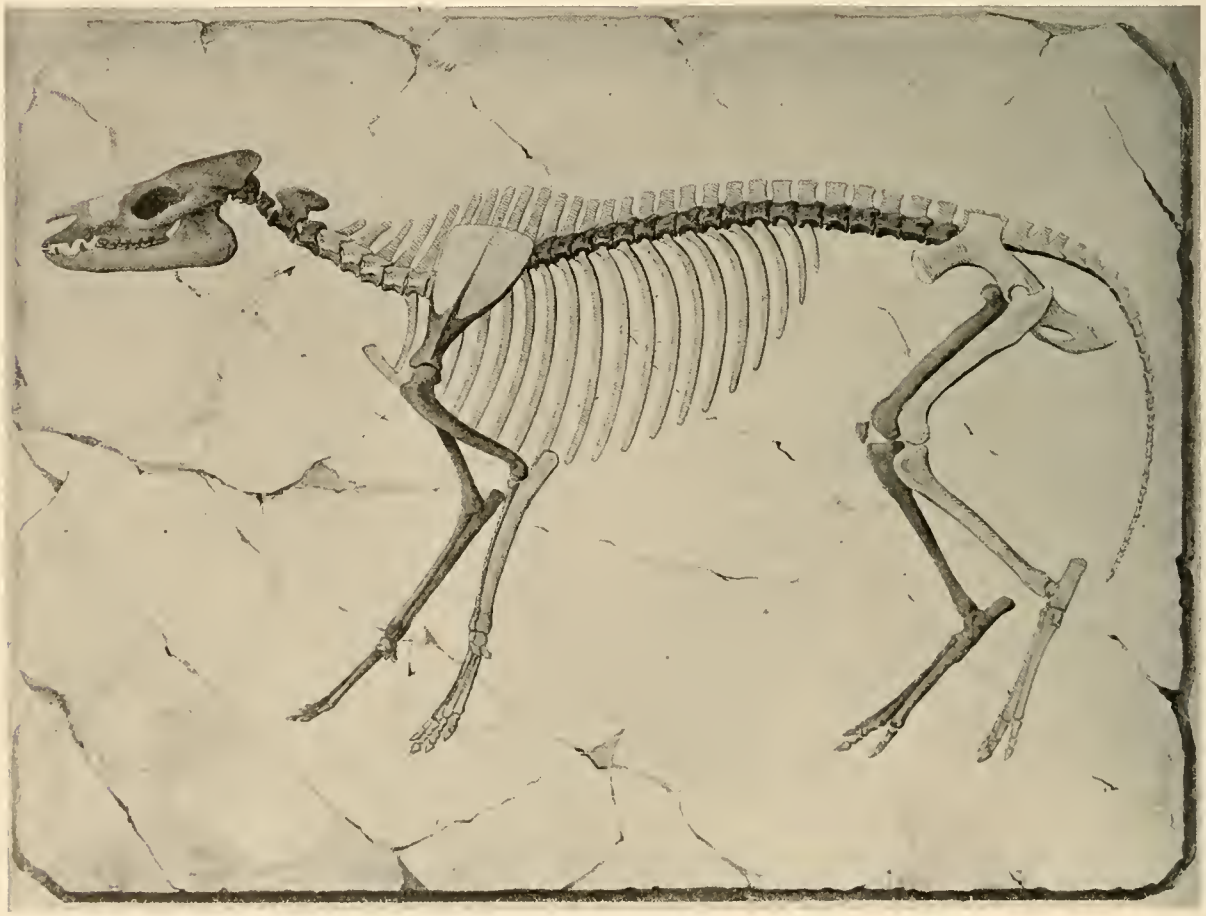
In this final act of the long drama, Cope again assumes the leading role. The antecedents of this great discovery were described by him in 1881 as follows:

"During the past summer [that is, the summer of 1880] I sent a party into the Wind River Basin [situated in west central Wyoming] under the direction of Mr. J. L. Wortman, already well known for his numerous important paleontological discoveries in Oregon. This gentleman made a thorough exploration of the bad lands, and probably obtained all the fossils found on the surface of the region . . . [later collectors will smile at the idea that anyone, however thorough, ever found all the fossils exposed in so large and rugged an area.]

"Mr. Wortman's explorations were not accomplished without accident, he having lost most of his outfit on his first crossing of the Wind River. The bad lands form a most forbidding region, mostly waterless, and at an elevation which is unfavorable to the sparse vegetation which is permitted by the dryness of the climate."

Among the specimens found by Wortman was the skull and much of the skeleton of a dawn-horse. By careful preparation and reconstruction Cope was able to produce from this the first drawing of the whole skeleton of one of these animals. This was published in 1884 as a handsome lithograph, two-fifths natural size, included as a plate in the volume of the U. S.

(Below) FROM "COPE'S BIBLE": the first drawing of a complete skeleton of a dawn-horse, published in a famous volume by the scientist E. D. Cope



Geological Survey known to later students as "Cope's Bible" because of its ponderous nature and fundamental importance in this science.

Here at last the dawn-horse stands resurrected and revealed, if not in the flesh at least in the skeleton. At last the artist has the information that he needs in order to picture the animal as it stood in life. A few other skeletons have since been found and reconstructed, but almost all the life restorations are still based on Cope's skeleton, which now belongs to the American Museum of Natural History and, remounted, leads its magnificent parade of the ancestors of the modern horse.

One of the first of these restorations, perhaps the first, was drawn by J. Smit and published in 1894 in the Reverend H. N. Hutchinson's book *Creatures of Other Days*. If this pioneer attempt now looks a little crude, we can excuse it with the thought that the art of restoration has advanced rapidly along with the science of reconstruction. Hutchinson rather naïvely noted that the restoration "is somewhat too large in proportion . . . but if drawn much smaller perhaps some of its features might be lost. We have no guarantee for the stripes. . . . The artist thought the stripes would improve the picture—as they do,—but they were not due to any suggestion from the writer."

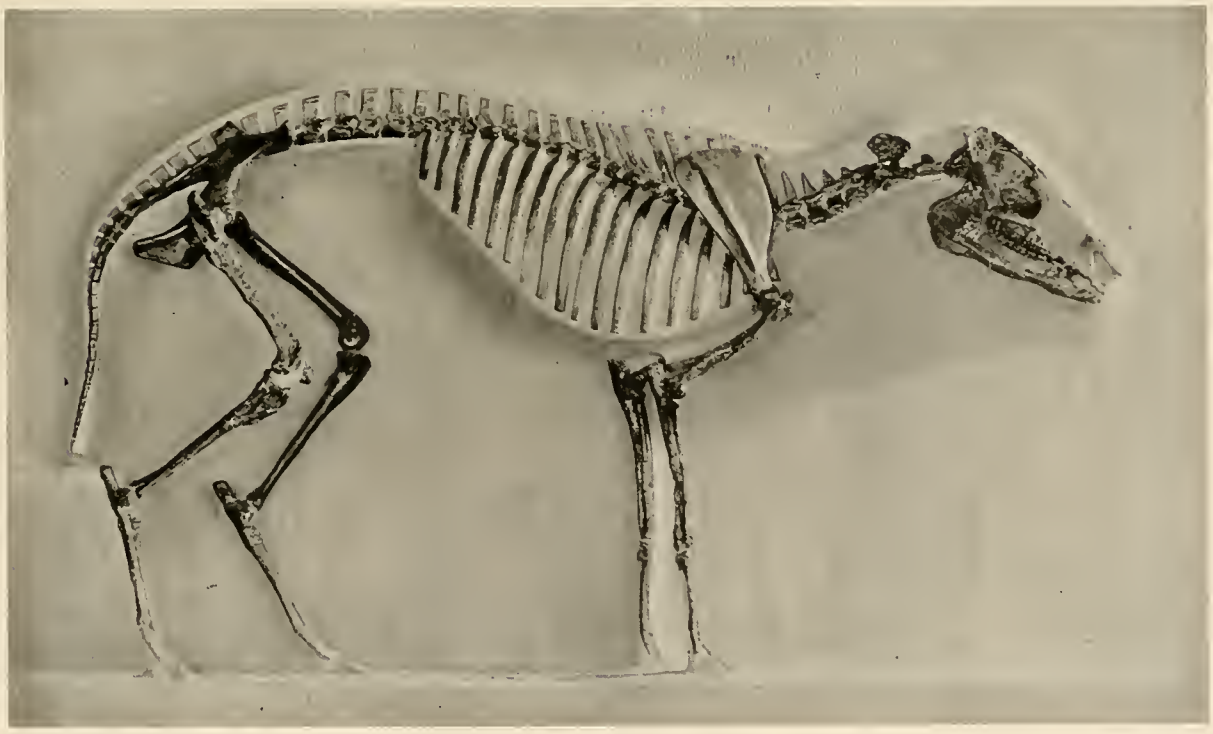
The more recent restoration of Eohippus reproduced beneath the title of this article was made by the well-known artist Charles R. Knight, whose paintings and sculptures of prehistoric animals are known throughout the world. You might say it looks little like the horse we know, but after all this little horse ancestor, the size of a fox terrier, lived some 50 million years ago, and he had only begun to lose his toes.

(From the Reverend H. N. Hutchinson's book, *Creatures of Other Days*)

THE SMALLER figure in this picture is perhaps the first drawing ever made showing the dawn-horse in the flesh

(Below) THE ACTUAL SKELETON of Eohippus, restored: Cope's original specimen, remounted in accord with the most expert modern technique in the American Museum of Natural History, where it is on display to the public

AMNH Photo



SEÑOR SPARROW

By FRANK M. CHAPMAN
Curator, Department of Ornithology, The American Museum of Natural History

From an original drawing by Louis Agassiz Fuertes

Melodious songster and colonizer of our sister-continent, its affinity for man is expressed in a variety of names from Guatemala to Cape Horn, and its 22 subspecies tell a story of adventure in bird science

WHEN Theodore Roosevelt was crossing the campos of inner Brazil and facing the perils of the unknown, he heard a half-familiar bird voice which aroused in him glowing memories of home. "It was a simple song," he writes in *The Brazilian Wilderness,* "with just a hint of our northern Whitethroat's sweet and plaintive melody and of the opening bars of our Song Sparrow's pleasant, homely

lay. It brought back dear memories of glorious April mornings on Long Island, when through the singing of robin and song sparrow comes the piercing cadence of the meadowlark; and of the far northland woods in June, fragrant with the breath of pine and balsam fir, where sweetheart sparrows sing from wet spruce thickets and rapid brooks rush under the drenched and swaying elder boughs." The country through which he was passing, with its wealth of novel sights, aroused no more graphic description than his response to the appeal of the South American sparrow's song.

The hearts of other Americans have been reached by this musical reminder of home scenes. Alex Wetmore writes of this song from the Argentine: "In some of its inflections it suggests the notes of an eastern meadow lark *(Sturnella magna)*, but on the whole has a closer similarity to the utterances of *Zonotrichia leucophrys* [white-crowned sparrow]."

But the claims of this bird to distinction as a songster do not rest only on the resemblance of its notes to those of North American birds. I can testify to their charm as I have heard them in many lands, and Hudson, who knew neither the white-throated nor white-crowned sparrows, pays this tribute to the Argentine bird: "The whole air, on a bright spring morning, is alive with their delicate melody. . . . They also sing frequently at night and in this dark silent time their little melody sounds strangely sweet and expressive."

A hispanic bird

From Guatemala to Cape Horn, in more or less temperate altitudes and latitudes, one will find this quietly attired songster an inhabitant of plains, campos and llanos. It is also common in city parks and in gardens, and, as though it had a special message for man, it seeks his society, or, as Hudson puts it, "wherever man builds a house and plants a tree there it comes to keep him company."

Birds that seem to have an affinity for man are usually common as well as friendly and for both these reasons become part of his life and language. Thus, throughout the Argentine our sparrow is known as *chingolo,* which, in Chile, becomes *chincol.*

In Paraguay it is the *chipín tapé,* the latter being a Guarani word meaning "house" in obvious relation to the bird's choice of haunts.

In Eastern Brazil it is *tico-tico,* probably a native name. In Caracas its terrestrial habits are reflected in the name *correporsuelo.* In the Mérida region of the Venezuelan Andes its frequently elevated crown-feathers are the basis of *copetón,* or pompadour. Its fondness for wheat wins for it, in Colombia, the title of *afrechero.* That it also eats corn is indicated by its Costa Rican name of *comemaiz.*

Few purely native names, like *kotumari* of the Arawak Indians of southeastern Venezuela, get into books, where, without explanation, they would convey no meaning. But when the naturalist calls this sparrow *Zonotrichia capensis* he speaks a language which, at least, his colleagues understand and is interpretable to anyone with access to the needed reference books.

But this technical designation is not merely the nomenclature of taxonomy. The generic term *Zonotrichia* is an expression of its bearer's relations to other members of this genus, not alone through its song, but because it resembles them in form, proportions, pattern of coloration, and other characters. There are four additional species in this genus—the white-throated, white-crowned (with its races), Harris', and golden-crowned sparrows; every bird-lover knows at least two of them. But these birds, we observe, are all inhabitants of northern North America, whereas *Zonotrichia capensis* is unknown north of the mountains of Chiapas at the southern tip of Mexico. Why, we ask, is it so widely separated from congeners to some of which it appears to be so closely related that we must believe they were once associated? This belief, in connection with the chingolo's preference for a temperate climate, seems to warrant the conclusion that at some time the bird was an inhabitant of temperate North America. If that be true, we have a starting point at which with, I hope, properly balanced measures of fact and theory, we may begin to present a history of its travels.

Fugitives from the glaciers

When we remember that remains of the now Arctic musk ox have been found in Virginia, Kentucky, Oklahoma and Texas, and of the walrus, in Georgia, we are more impressed by the effects of glaciation than by glaciation itself.

If our sparrow was, in truth, a preglacial inhabitant of temperate North America it must, with other forms of life, have been affected by the falling temperatures of the advancing Ice Age. Here, then, we have a plausible reason for its forced invasion of Central and South America. After entering the funnel of Mexico only one way of escape was open to it. It sought only a home where, in climatic surroundings to which it was accustomed, it might pick up a living —but armed with an irrepressible fecundity, it colonized a continent. Reaching Patagonia the chingolo encountered seasonal climates which enlarged the habitable area of this region in summer and decreased it in winter. The bird's power of flight enabled it to take advantage of this circumstance. In the summer, therefore, it nested in the more southern latitudes suitable for its occupation only at that season. With

the return of winter it retreated northward toward the equator. Through the annual repetition of the maneuver there was established the habit of migration which persists to this day.

Conforming to the seasons of the southern hemisphere, the chingolo of Patagonia nests from November to February—the equivalent of June to August in corresponding latitudes of the northern hemisphere.

Its fall migration begins, therefore, in March and it reaches northern Argentina early in that month. Later it continues northward to southern Bolivia, 2000 miles from the southern limits of its range on Cape Horn. It is an interesting coincidence that as the chingolo arrives in northern Argentina on its fall migration to winter quarters, our bobolink is leaving this region on its spring migration to nest in the United States. Whether the Ice Age induced it to spend its winter so far south is a subject for speculation, but the origin of the habit of migration in the Patagonian chingolo seems open to explanation.

Colonization was undoubtedly rapid

There is no means of determining how long a time was required for the chingolo to occupy Central and South America. We do not know the date it started, how many birds there were in the invading army, or whether its advance was continuous. But when a country is open to occupation, and competition with other species is absent or limited, it is remarkable how rapidly a bird may extend its range.

Just 50 years ago 60 European starlings were released in Central Park, New York City; and the following year 40 more were freed. The descendants of these 100 birds now inhabit the United States east of the Rockies and throughout most of this area are more common than most of our native birds. If the chingolo was equally successful it must have reached Patagonia and spread over a large part of South America in a few hundred years. At the end of whatever time was needed, its frontier had disappeared and there were no new lands open for settlement. Only the sparrow inhabiting Patagonia was migratory; the others became more or less permanent residents of the areas they had colonized.

Since that period in the chingolo's history there have been no marked changes in either the climate or appearance of South America and hence no reason to believe that the range of the chingolo has changed greatly since its original migration was completed.

Meanwhile the naturalist has arrived on the scene. Early in his study of the chingolo he attempts to make at least a preliminary map showing its distribution. Such a map should not be based on hearsay, native names, travelers' identifications, and similar unreliable data, but on properly labeled, carefully named specimens of the birds themselves. At once, therefore, a need arises for specimens and still more specimens. We must have representative collections from every country the chingolo is known to inhabit. In some instances we have found it in countries from which it was before unknown. Illustrating the generous spirit that prevails among museums, we now supplement our collections by borrowing specimens from sister institutions. This habit of loaning for purposes of study makes, in a sense, the collections of one the property of all and adds greatly to the scientific value of our collections as a whole.

In this manner I have assembled 1267 specimens of *Zonotrichia capensis*. At once I hear a protest from the conservationist. This, he says, is not science but slaughter. But I can assure him that the gathering of these specimens has had no more effect on *Zonotrichia's* countless billions than would the plucking of so many leaves affect the foliage of a great forest. Moreover, they have been acquired over a period of not less than 50 years and from throughout the sparrow's range.

Color and range

With a specimen in hand we now not only have a dependable evidence of the bird's occurrence at a given locality on a stated date, but for the first time we can form a definite concept of its appearance. So we observe that the average *Zonotrichia capensis* has a gray crown bordered laterally by black stripes, a brownish back streaked with black—a real sparrow back—a rufous collar on the back of its neck and more or less of a black one on the front of it, while the rest of its underparts are largely white.

When we examine our collection more intensively we find wide variation in these markings. In some specimens the black stripes on the crown are missing and the head is plain gray; in others the back may be dark brown or it may be pale sandy. Some birds have the black foreneck collar complete; in others it is almost absent. The wing may be short and rounded or it may be long and pointed. In fact there seems to be no limit to what at first glance appears to be purely individual variation uncontrolled by law.

But when we place like with like, order emerges from confusion. All the gray-crowned birds come from one region, all those with complete neckbands from another. The dark brown birds are never found with the pale sandy ones, and the rounded wings are not associated with those that are pointed.

Acting on this hint we proceed to classify our specimens not by markings, color and form but by locality. To handle them all at one time would be confusing and prohibit the close, intimate comparison which

will reveal the minute differences or "speciations" so significant to the student of evolution. So the birds of the countries represented are placed in shallow trays, one for each country. Thus we have a tray for Guatemala, another for Costa Rica, a third for Colombia, and so on down the Andean side of South America to Cape Horn and eastward through the campos of Brazil and Argentina.

Instead, therefore, of having to compare specimen with specimen we compare tray with tray, or as the classifying scientist phrases it, series with series. This method makes it possible not only to handle large numbers of specimens readily and effectively, but, viewed in series, the features of the single bird become cumulatively more evident and we discover that the variations we had considered "individual" are in truth geographic. Thus we find that the completed black band on the foreneck is practically restricted to the birds of Santo Domingo; that gray-headed birds are characteristic of Patagonia; that the migratory birds of that region have long, pointed wings while sedentary birds have short, rounded ones; that pale sandy birds are associated with the more arid areas, the dark brown ones with humid areas. We also discover features for the appearance of which environment offers no explanation. For example, the sparrows of southeastern Brazil have the edge of the wing or wrist, tinged with yellow. It is a faint but unmistakable marking, and we are at a loss to account for its presence until we remember that a similar marking is found on the wing of our white-throated sparrow and also on that of other members of the genus *Zonotrichia*. Apparently, therefore, the Brazilian bird has not originated this character but has inherited it from remote ancestors. For countless ages this color trait has lain dormant and now, under favorable conditions, which we are unable to name, it reappears. It is also exhibited, faintly, by the Santo Domingo race.

An abundance of specimens, experience, an eye for color, patience, judgment and time are needed before

THE GEOGRAPHY OF A SPARROW

THE RACES of
ZONOTRICHIA CAPENSIS

1. septentrionalis
2. antillarum
3. costaricensis
4. huancabambae
5. peruviensis
6. carabayae
7. pulacayensis
8. antofagastae
9. venezuelae
10. insularis
11. roraimae
12. macconnelli
13. capensis
14. tocantinsi
15. matutina
16. subtorquata
17. hypoleuca
18. mellea
19. chilensis
20. sanborni
21. choraules
22. australis

our sparrows are properly classified and assigned to their distinctive ranges. Some of the characters on which we base our decisions are very slight and not always apparent to the amateur, but the classifier or taxonomist is a trained expert. It is his business to discover the very beginnings of races, or budding species; to distinguish between individual, and geographic variation. The smaller the differences between allied forms the nearer we are to the point at which they begin to diverge. It is essential, however, that the characters on which a new subspecies is based be constant and diagnostic; if they are, a name is applied to the birds possessing them and a new subspecies is born to science. Finally, our collection is identified and the ranges of the various races, as defined by our specimens and the localities whence they came, are mapped. This might be called sparrow geography. A census follows and we discover that *Zonotrichia capensis* now numbers 22 subspecies.

How science christens the animals

To acquire standing in the Class Aves each one of them must have a name. How does he get it? Who gives it to him? An adequate answer calls for a treatise on zoological nomenclature. For that there is neither time, space nor demand. Let us try an inadequate one.

Binomial nomenclature dates from Linnaeus in 1758. He first consistently applied two names, a generic and a specific, to the forms of life known to him. This system, revised and modified, prevailed until about 1875 when it was discovered that in the course of its evolution a species might develop a subspecies for which a third, or subspecific, name was required. Consequently, the binomial system was succeeded by the trinomial system.

Up to this time zoologists, in naming new species, had not been governed by the same set of rules, if indeed by any. But the need for uniformity became so urgent that in the early 90's the International Code of Nomenclature was drafted and subscribed to by zoologists throughout the world.

The fundamental principle of this code, as well as of its predecessors, is known as the "law of priority." This states that the first name applied to a species is the one by which it must be known. This is obviously a just law, but the attempt to apply it has resulted in endless confusion, for it has not always been possible to connect an author's description with the animal he was describing, or to be certain that a given description is actually the first one applied to the animal concerned.

The greater number of these questions, however, has been settled and if the International Code is uniformly observed, the nomenclature of the future will be far more dependable than that of the past. Moreover, the zoologist of the future will be more widely informed than his predecessors and hence less likely to describe as new, species which have already been named.

Our suggestion that before its southward migration *Zonotrichia capensis* numbered but one species with no subspecies is, of course, an assumption, but at least we may compare our results with those of the first ornithologist to enumerate the members of this group of birds.

This was Bowdler Sharpe, Keeper of Birds of the British Museum and one of the leading bird students of his day. In 1888 he published, as Volume XII of his museum's great catalogue of the *Birds of the World,* a monograph on sparrows. From this authoritative work it appears that the British Museum contained 59 specimens of our sparrow. Sharpe referred them to two species.

Just 50 years later the group was again reviewed, on this occasion by Dr. C. E. Hellmayr, first authority on neotropical bird life. Dr. Hellmayr included 16 subspecies of *Zonotrichia capensis* in his volume on American finches issued by the Field Museum.

In 1940, with additional specimens and more time in which to examine them, the American Museum of Natural History published a paper by the present writer entitled, "The Postglacial History of *Zonotrichia capensis,*" in which 22 subspecies were included.* Verily our modest little sparrow would be surprised if it should learn how much space it occupies in the annals of ornithology.

The difference between Sharpe's results and those of his successors is due to lack of specimens and to his failure, with others of his time, to realize the importance of naming geographic races or subspecies.

Importance of valid subspecies

Certainly it was much easier to identify a neotropical *Zonotrichia* in Sharpe's day than in ours. He offered us only two possibilities, the sparrow of Patagonia and the one from the rest of the continent. But the aim of our intensive studies of large representative collections is not ease of identification but thoroughness of investigation. Every subspecies is a tangible expression of one or more creative factors, and only when we have recognized the effects may we hope to discover the cause. Therefore, the larger the number of valid subspecies described, the nearer do we come to associating an animal with the forces responsible for its existence.

**Bulletin of the American Museum of Natural History,* Article VIII, Volume LXXVII.

MIRACLE ON WINGS

By J. Rodger Darling

Illustrations by Felicien Philipp

Watch your feathered protégé fly unerringly to its goal, perhaps to win a prize, and you will understand why prince and pauper have trained pigeons from earliest times,—birds whose remarkable accomplishments range from acrobatic exhibits to orderly flights of many thousands of miles

To the average person the word "pigeon" conveys only a picture of the feathered urchins that scramble hungrily around the city streets; or perhaps he thinks of the "carrier," a bird most amazingly endowed with the mysterious power to deliver a message to a given address and return posthaste with a reply!

Such are the fallacies of life! Here, a hundred thousand fanciers are industriously raising 130 individual breeds, racing them, exhibiting them at pigeon shows that rival dog shows in size, and preparing them for market use—while the man in the street murmurs, "Pigeons? . . . What do you keep 'em for?"

Take this racing business, for example. From supposedly learned sources we sometimes hear that "John Doe races carrier," or "passenger pigeons." Well, Mr. Doe is either prevaricating or else he doesn't win many races, for the only bird that can home with any speed and endurance is the homing pigeon. These pigeons perform many practical services, such as carrying news photos from remote places, serving as message carriers in military, naval, and rescue services; but remarkable as they are they will return only to the loft from which they have been trained. This is no mean feat, considering that many of them can cover 600 miles in a day. (The record distance flown is over 7000 miles, though not at this rate.) Such proficiency can only be the result of well-planned conditioning and training, for although the homer is born with the latent homing instinct it must be developed by regular practice and exercise.

A fancier will assemble a group of about twelve young homing pigeons that he believes have real potentialities and confine them to a section of the loft which is equipped for racing. He accustoms them to punctual feeding at 3 p.m. and always announces dinner by a series of sharp whistles.

Now, on their first day of training the birds are liberated at 2:45 p.m. After they have all eagerly rushed out for a turn about the heavens, the fancier drops the "bob wires" in place. These are light rods that hang down in the pigeons' entrance to the loft and are so hinged as to swing in when pushed, allowing the birds to enter but not to leave.

Then the fancier scans the sky to see if his homers are all awing. They must not be permitted to land on the roof tops, for this will be the beginning of a bad habit. Much as a pigeon is energetic and likes to fly, he loves nothing better than lounging on a sunny roof. So most fanciers, in order to keep their birds aloft, have a long, light bamboo pole with a cloth or streamer on the end, which they wave violently to

frighten the birds up when they show signs of landing.

Promptly at three o'clock the fancier gives the whistle to "come and get it" and places the grain in the loft. The homers are quite hungry by now and, landing on the loft entrance, they soon find how to push the bob wires aside in their frantic haste to get to lunch.

This is repeated daily, each day lengthening the flying time a little, until the birds fly steadily for one hour before they are "dropped" and "trapped," as racing men call the above procedures.

Now the homing flights begin. These young candidates are placed in baskets and are transported to a point one mile from the loft. Here they are liberated and quickly return home. Next day they are again taken one mile away, but now they are liberated at five-minute intervals so that they will learn to home individually and not follow the flock.

This method of single and group flying is continued at two, three, four, five and ten mile distances, and then the flights are given weekly; and if the birds have learned enough to navigate alone, the group flights are omitted.

By the process of elimination the better birds are now quite evident, and these are trained further at fifteen, 25, 50, and 100 miles, which completes the schooling of seasoned homing pigeons, ready for their first outside competition.

Entered in a club race the homer is taken with his many competitors to a point about 200 miles away. On each bird's leg, next to the owner's band, the club affixes a removable hard rubber band marked with a secret number, which is recorded by the secretary. At a given time all the racers are released simultaneously.

Back at home the owner is fretfully waiting. Suddenly a black spot materializes in the distance. Flying with great speed, the returning homer wings up to his loft and, hardly slowing, slides across the landing platform and explodes through the bob wires into the coop. Here, without the loss of a second, his nervous owner quickly removes the rubber band, drops it into a sealed timing device, turns the crank, and the actual time of arrival is safely recorded. Later all these timing devices are turned in at club headquarters, where distances and elapsed times are calculated, and some proud fancier is informed that he has a winner.

Now you see the need of the complicated dropping and trapping process and the breaking of pigeons of the roof-landing habit. Every second counts until that band is in the timing clock. Truly there is nothing more guaranteed to give a rabid racing fan hardening of the arteries, apoplexy, and falling hair, than to see a superb homer returning with a new speed record under his wing only to settle down coyly on the neighbor's chimney for a brief siesta, while the precious seconds tick away!

Racing pigeons have but two enemies, hawk and hunter. The breeding of white homers is discouraged because of the high visibility of this color to birds of prey. Darker birds are well camouflaged.

Homing pigeons are now being better protected from their other enemy, the hunter. All too often

disgruntled "sportsmen," having missed their daily quota of ducks, take a shot at a returning homer simply to keep in practice, with absolutely no thought of retrieving the victim.

Although Army and Navy birds are already protected, we can see the need of further legislation when we realize there are 25,000 fanciers of homing pigeons alone in the United States. In prewar Belgium there were 350,000 fanciers, and in happier days taxes from this national pastime were one of the major sources of revenue for the Belgian treasury.

The war is playing havoc with the European pigeon fancy, where for centuries it has been most highly developed and fostered, but within a few years the United States will probably rank first in all branches of the pigeon industry, for most of the famous strains and studs are represented here by winged refugees from the European holocaust.

Now that we have given credit where it is due, we must explain about the true carrier, who is no flier. He is a heavy bird wth a tremendous bill that looks for all the world as if it had been thrust through a little shriveled apple. This cluster of flesh about the bill is known as the "wattle." Carriers are tough customers, and to keep them from doing one another damage they are generally kept in individual cages. The successful breeder must always be prepared to stop some husky male from turning on his loving wife and beating her roof in.

As for the passenger pigeon—no such bird exists. It is some years since great flocks of these wild doves darkened the skies for hours on their migratory flights. These splendid birds were hunted with such avarice that they are now totally extinct.

This hunting instinct of man has found a harmless outlet in New York City in an activity sponsored by a local pigeon club. Each year what is known as the "annual chuck-up" takes place at a Queens airport. Last year on the appointed day 200 owners arrived at the airport together with their 5000 assorted pigeons in assorted containers. These birds ran the gamut from pedigreed racers and show birds to common street pigeons that had adopted someone's loft. Each bird was tagged with its owner's name, address, and telephone number. At a given signal 2000 noisy spectators saw the birds liberated en masse. In the attendant confusion the birds milled wildly above the flying field and then began to depart in squadrons. The homing ability of pigeons varies greatly, so some of them were content merely to follow others. At the lofts the owners waited to see their birds return, perhaps bringing others with them—or perhaps not returning at all. The eager fanciers dropped and trapped the pigeons as fast as they arrived, and all day phones rang busily as gloating fanciers called each other, announcing that they had one another's birds and were "holding them for ransom" (25¢ and up). Of course,

it was all in fun but it was beneficial in promoting acquaintances and sportsmanship, while many sales were made and the club and hobby both received much publicity.

Another pigeon in the same group as the carrier is the barb. This bird has a wide ring of flesh around each eye, giving the appearance of large rosettes. In this breed the bill is shortened to such extent as to be practically nonexistent, necessitating the use of long-billed foster parents of another breed for feeding the young. This is because the babies are fed by regurgitation and one bird, either parent or young, must have a long bill to insert into that of the other. This "wet nursing" is accomplished by switching the eggs from one nest to another. It always works, but I have often wondered over some long-nosed father pigeon's thoughts as he busily pumps gruel into his very short-nosed babies.

Observing the home life of pigeons is most entertaining. A pigeon has but one mate, and this union lasts for life or until separated by accident or man. After a pair have "taken the plunge" they go into housekeeping. The hen selects the site for the nest, and the cock begins gathering material with which to build it. Long years of domestication have ruined the pigeons' architectural flair, for I have had some birds cross three or four twigs on the floor and consider it a work of art, while others embarked on a ceaseless search for more and more material of every imaginable nature and frantically piled it up in one corner of the loft until the nest began to assume the look and proportion of a good-sized junk heap. However, with a little diplomacy the fancier can generally fashion a half-decent nest for the blissful newlyweds.

At length the first egg arrives, and such proud parents were never seen before! The second egg (there are two to each setting) will not come for another day and a half, and it is interesting to note how Nature has instructed her children in the science of incubation. During this interim between the eggs the adult pigeons, sharing equally the duties of parenthood, set on the first egg in such a manner as to keep it just warm enough to retain life in the embryo without starting it on the way to rapid cell-division. As soon as the second egg is laid, the incubating bird sets "way down" on the two eggs so that they are exposed to all the body heat available and speedy development begins. This retarding of the first embryo is done so that the eggs will hatch almost simultaneously, thus giving the youngsters an equal start. This is important, for during the first three days after hatching, baby pigeons practically double their size every 24 hours, and because of the helplessness of the newborn, the youngster that emerged a day and a half late would have a very poor chance at life.

There is something that happens in my loft that I have never heard nor read about elsewhere. When an egg hatches, it always breaks in two around the middle; and although I've never seen it actually done, my birds take these two sections and somehow fit them tightly one within the other and then carry this "souvenir" over to my back porch or window sill and

Continued on page 240

ACROSS

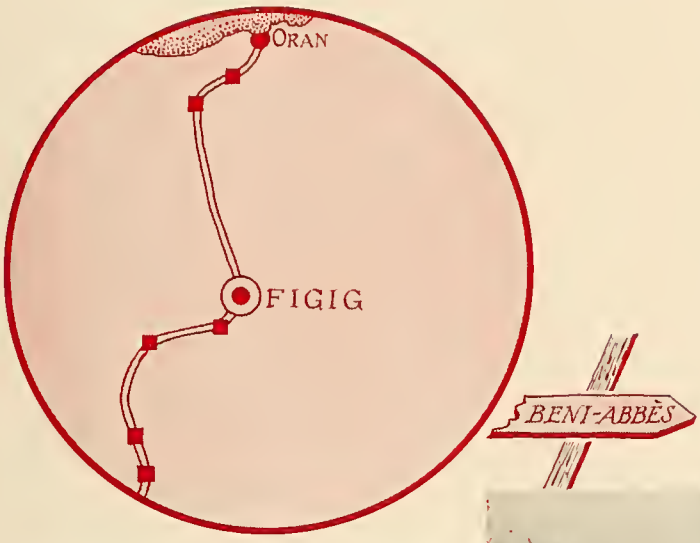
As the spotlight turns on Africa, its age-old caravan trails take on new meaning. The ship of the desert steps aside for the swift wheels of the motorcar, and the problem of water becomes primarily one of gas and oil. Yet this story of a trip across the Sahara from north to south shows that many of the difficulties of desert travel remain, as well as much of its romance

(Left) THE AUTHOR'S ROUTE across the Sahara Desert took him through the center of the great bulge of Africa, at the middle of which he was 1000 miles from the nearest seacoast in any direction

(Below) A STREET SCENE in Figig, a native town near the border between Algiers and Morocco, where modern conveniences have been left behind and the visitor finds recompense in the mysterious, twisting streets and picturesque architectural vistas

THE SAHARA TO KANO

By Martin Birnbaum



Like every imaginative boy playing with sand or mud, I was in the habit of building little villages surrounded by deep moats and high walls, filling their crooked, narrow lanes with strange castles or fortresses, little dreaming that some day I would be roaming through a city stranger than any that my fancy could evoke, and that I would cross the Sahara to reach it. Born as I was, close to the immense Hungarian plain or Puszta, it was not unnatural that later in life my trips to Egypt, Algeria, and Morocco should fire a spark which could not be extinguished and arouse a violent desire to see other desert regions.

A new passion for Africa was in my blood, and when a chance newspaper item announced that an extra person could be accommodated in a car that was to travel directly across the Sahara Desert and on to Lake Tanganyika, the intense longing would not be denied. The Koran had already warned me that three things never return—the sped arrow, the broken word, the lost opportunity—and I became a passenger without delay.

(Right) AN ATTRACTIVE OLD WATCHTOWER guards Figig with its valuable oasis. Hot springs also bubble up beneath the palms for native laundry work

Dangers, I said to myself, were practically nil. The prodigious hardships and narrow escapes of René Caillié and Charles Doughty were things of the past. Wireless apparatus, airplanes, swift motorcars, military outposts, wholesome, canned food and an ample supply of bottled drinking water now reduce the hazards of a desert journey to a minimum. So we started from Oran on the coast of Algeria with light hearts.

Having first looked into its noisy fonduks and strolled through its arched streets, we slept the first night at Tlemcen under a crescent moon which hung in exactly the right spot over the minaret of its old mosque. At dawn we were already speeding swiftly past the ruins of Agadir. Crested larks flew across

the tortuous road to Oujda, but no time was to be lost if we expected to reach Figig according to our schedule. Mirages in the liquid haze became frequent, camel caravans passed us, and gazelles, disturbed by the rumble of our huge International Harvester car, bounded into the air and disappeared like flashes of light. The rose and blue twilight of this barren region was exquisite and of an ineffable purity, but it offered only slight consolation when we found that the Hotel Transatlantique at Figig was filled to overflowing by military officers and we were obliged to spend the night some distance beyond, in the chilly rooms of an uncomfortable hostelry at Beni Ounif.

Wishing to see as much as possible of the country, I struggled up the neighboring hills for a bird's-eye view of the region, with Mustapha, a pertinacious village urchin. The climb up the black, jagged rocks was hardly worth the effort, but the distant splendors of its green palmery tempted me to become better acquainted with Figig.

The caid of the town was absent, but Abdoslem Ben Ahmed, an attractive child of ten, who was one of his sons, accompanied me through the lively market place. His long cape and spotless violet undergarments, his grace and gentility, at once distinguished him from the ragamuffins who followed in our train, alert to scramble wildly in the dust for coppers they hoped would be thrown to them. This village had its picturesque lookout towers and mysterious, twisting streets, a miserable ghetto, and the usual quota of beggars and blind vagrants. Over and over again we saw children whose eyelids were covered with flies. To spare us from such distressing encounters, our charming guide led us to the hot springs where the women did their laundry work. The water bubbled up in a hollow at the edge of the luxurious grove of date palms, but as the women were unveiled while busy at their tasks, Abdoslem asked me not to approach them.

The arid Sahara

We were now forced to hurry from one oasis to another, unless we were prepared to sleep in the open. This country, 200 miles south of the Mediterranean and on the inland side of the Atlas Mountains, was real desert. Rain had not fallen here for over six months, and we had to start as early as possible each morning, before the pitiless sun began to beat down on us.

The undulating sand dunes which had fascinated me near Biskra were conspicuously absent in this boundless, waterless waste, but wonderful light effects, which converted the black hills into masses of brilliant orange-gold against the background of a cloudless, azure sky, were a worthy substitute and recompense. All morning we whirled along the monotonous, gritty *piste*, reaching Colomb-Béchar, a dazzling white town in an emerald setting, in time to see the desert men busily trading their unhappy looking sheep and goats. While we stopped here to conform to official regulations imposed on all travelers through French Equatorial Africa, we were besieged by omnipresent mendicants and persistent villagers offering to sell us, among other useless items, iridescent green click beetles (Elateridae) which they use as ornaments. The desert we were crossing now seemed to be a plateau, sprinkled with stratified rocks reflecting the hot rays of the sun; and just when we began to ponder over the fate of unfortunates who might be lost in this desolate expanse, we came suddenly upon a lonely French military post or *fort de secours,* surrounded by barbed wire. It was in charge of a gallant officer, who seemed prepared for our arrival and who, in turn, announced our hasty departure by wireless to the next station. In this way our safety was watched over and assured while traversing this treacherous region. The monument to Claverie, murdered just beyond this point as recently as 1928, was a grim reminder of the risks we were facing, and our driver was jealous of even the few minutes necessary to stop and read the inscription on the column raised in memory of the ill-fated hero and his band of men. Nor were we allowed to linger at the cool oasis of Taghit. We were promised our fill of palm groves if we successfully negotiated the dry, rocky ravines and gorges heralding our approach to the town of Trouerta and to the first smooth, billowy dunes which we had as yet seen.

Some miles farther on was the fort of Igli, where the hospitable commander showed us through his lonely abode and treated us to a pleasant survey of the date palms and the native town precincts before we were off again for Beni-Abbès, one of our main objectives. This endless, inscrutable plain was as uninteresting as a piece of dirty blotting paper, and its incomparable monotony probably made the oasis, when we reached it, seem more beautiful than it actually was. Green was never more restful, and as for the Hotel Transatlantique, no stopping place in vast Africa could ever take its place in our weary eyes and hearts. On its roof we could sit comfortably and admire the huge hollows of polished, shifting sand which protected the magnificent groves, crowned with waving, rustling fronds, from the strong wind. No paintings of such scenes have the necessary fluidity of form and tone. The hotel boasted a charming, arched patio, gay with pots of flowering marigold; and an enclosure imprisoned a pair of those exquisite fragile gazelles which we had had no hope of examining at close range when we startled them in the desert.

Crystal water and stately palms

Taking advantage of our well-earned rest, we promenaded up and down the little main street, where Jewish silversmiths plied their trade and black Sudanese loafers played at dominoes. We roamed under the graceful palms as far as the refreshing spring of abundant crystal water, where boys were washing their bronzed bodies and veiled women came to fill their earthenware jars. "*Sbal cher*" (Good day), we cried in friendly greeting, hoping in vain that they would pose for us. Their ample figures were swathed in orange-colored stuffs, their necks were weighted down with strings of beads, and large, white rings were attached to their hair with black wool. They would have made attractive pictures, but the

tempting offers of our guide Mohammed Ben Hassan were unsuccessful. We strolled up the hill, past the mud or clay huts, to the hermitage built in memory of the saintly pioneer Foucauld, one of many French colonial martyrs.

The shrine ought to have reminded us all that our discomforts and petty trials were ridiculous when compared with the sufferings of the first African explorers. But our little company had reached the grumbling stage, and although the terrace offered sublime views of the starry canopy of heaven, most of us retired to digest suppers and be ready at dawn for the long trek over the inhospitable stony plain to Adrar, a military post. We had already learned to dread the relentless sun's rising, and nothing could be more profoundly hostile than the hilly landscape to the south, even though it had a stark beauty all its own. If we stopped to extricate our car from a deep rut, I amused myself by studying the tracks of birds and insects which I discovered near the patches of withered ground thorns, but I was denied the doubtful pleasure of seeing one of the giant scorpions which are said to abound here.

Hour after hour we sped along the *piste,* now marked with crude cairns and winding like a serpent among the barren, unfriendly hills. Distant sand ridges of a fiery purity, covered with lovely ripples by the gentle wind, cast long, velvety shadows as the glowing sun left its meridian. Our thirst was unquenchable. Saliva became froth and dried completely. The wind scorched us, and the stray carcass of a camel served as a silent commentary on our gloomy thoughts. How fortunate that we had no sick animals to look after and that we did not encounter the dangerous fanaticism of nomads! When dust rose and our road was obliterated by encroaching sands, this arid, implacable waste could be remorselessly cruel, and such possibilities became a nightmare to my nervous companions. I merely wondered for how long a time the French desert guardians can stand the dreary monotony and strain of a remote outpost like Timmoudi or worse still, of Foumel Kreneg, the stopping place for Sundanese laborers who repair the road. At last ahead of us there arose the great Adrar gateway leading into an immense parade ground surrounded by houses and barracks.

A military post

Deep water wells, carefully covered, had been dug in this square, at one corner of which stood our hotel. After rooms had been assigned to us by the Sudanese manager, I noticed that some of the black servants wore large, silver rings in one of their ear lobes. A similar custom had prevailed in a great Moroccan sheik's *kasbah* near Marrakech, where I visited a few years before and I was then informed that although the notorious trade had come to a timely end, these marked servants were, for all practical purposes, still slaves, and that their children usually remained for life with the former owners of their parents. The place certainly had a strong old African flavor in spite of the presence of genial French officers who welcomed us.

As Reggan, our next stop, was only 90 miles distant, we were spared the usual preparations for departure before dawn and enjoyed the drilling of a platoon of meharists on their proud, swift camels. The lines of animals, some pure white, were carefully matched in color, and their maneuvers were brilliantly executed. Caids, resplendent in long, red capes, blue undergarments, and white burnooses, came from neighboring districts to pay their respects to a French general who was expected to arrive the next day to review the troops. We, alas, had to spend that afternoon speeding over a hot barren plain. The fortunes of the especially attractive hotel at Reggan —named after the hero René Estienne, who was killed in 1927—were presided over by Monsieur Bardet and his handsome, blond wife, who received us barelegged in the latest Hollywood shorts, accompanied by Wolf and Savia, a fearless pair of watchful German shepherd dogs.

Road wiped out

We started before sunrise the next morning on the difficult journey of evil repute to Bidon Cinq. The stars were our sole guides across the sandy waste, for a light wind, the thing we always feared, had wiped away all signs of our road, and we were like sailors lost at sea without even a compass. Daylight revealed a limitless plain with confusing, trembling mirages, always tauntingly ahead of us. The sand was soft and treacherous. The car with its heavy burden would sink into it and refuse to budge until we unloaded and, with the aid of boards under the wheels, dragged it to a more solid spot. We considered ourselves fortunate if we covered 18 or 20 miles in an hour. The ugly corrugated, galvanized iron emergency shelters, marking the distance we had traversed, aroused no interest. Not a single weed or living thing was to be seen, with one strange exception. When I carelessly spilled a few drops of water on the hot sand while drinking, a butterfly appeared miraculously out of nowhere to sip it.

At Reggan we had already left behind one of our traveling companions who was too ill to continue, and now another passenger was a victim of alternating blistering heat and biting cold, and he began to make arrangements to leave us at the first opportunity and return by plane to civilization. We were repeatedly losing our way, and it was fortunate that an experienced pilot, who had followed us from the Hotel Estienne in his Transsaharienne Postal automobile, caught up with our car, helped us out of our difficulties and showed us the right track to follow. Even with his aid, there were so many delays that we decided on a picnic supper in the desert, knowing that we would not arrive at Bidon Cinq until late that night, if at all.

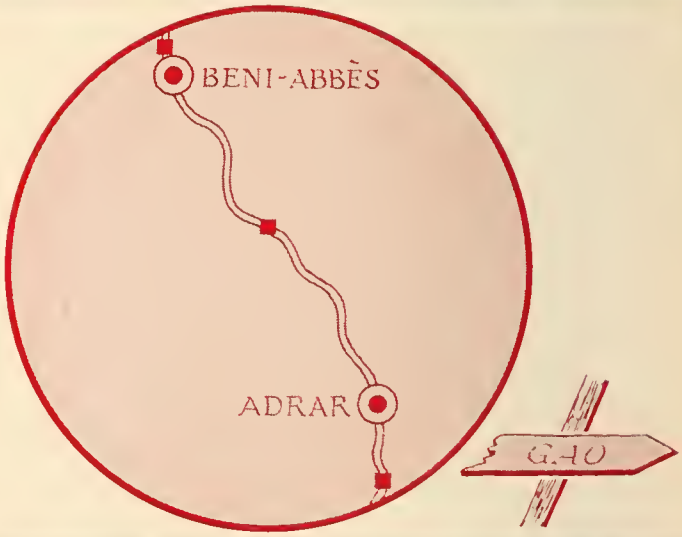
The vast circular horizon and the stars hanging low in the heavens were overwhelmingly beautiful. To escape the complaining chatter of my companions, I wandered off alone as far as I dared, thrilled with the sublimity of oblivion and the unfathomed immensity of night encompassing me, but I confess that I felt relieved when a distant speck of artificial light proved to be Bidon Cinq.

(Upper left) LIKE MOST SETTLEMENTS in the great arid north of Africa, the location of Beni-Abbès is determined by its natural sources of water. The woman shown is making her way to the springs in the palm grove at this important stop on the trans-Saharan route

(Upper right) A SCENE JUST OUTSIDE the native quarter of Beni-Abbès, a desert city boasting a charming hotel, many interesting native types, and a principal thoroughfare where Jewish silversmiths ply their trade

(Below) THE GREAT ADRAR GATEWAY leads into an immense parade ground: a post with a strong flavor of old Africa in spite of the French barracks. The deep water wells, carefully covered, are discernible on the right

(Lower right) SWIFT DROMEDARIES, or meharis, of the French Colonial army executing battle drills under the skillful guidance of their meharist riders, at Adrar



STRANGELY ENOUGH, near the center of the Sahara Desert the party had to build a fire to keep warm, and a shivering family of Bedouins joined them *(at right)*. Progress at this point, north of the new military post of Aguel'hoc, was painfully slow, being impeded by soft sands and unexpected boulders

FAR OFF IN THE INTERIOR of Africa the travelers met the upper waters of the Niger River, where they encountered the natives below on a sandbank near the settlement of Gao, which is the gathering place of many tribes. The women are pounding grain to make flour

GAO

(Below) THE EQUIVALENT OF ORANGE BLOSSOMS AND RICE on the banks of the Niger River: a reception committee waiting to congratulate the bride and groom who are being married inside the hut

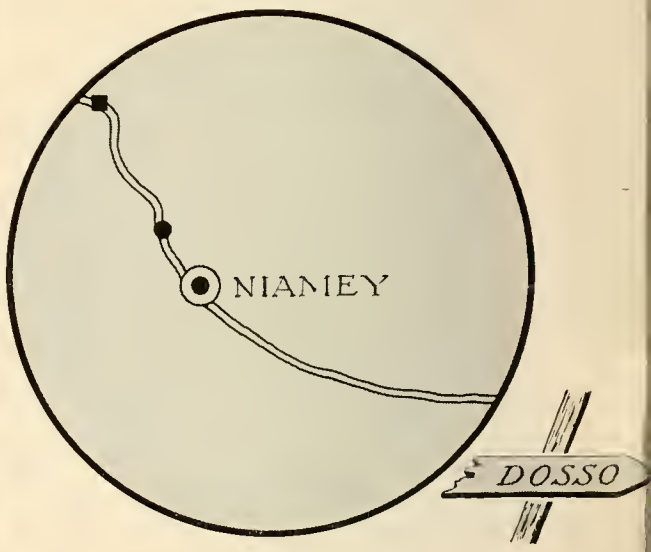
TILLABERY

(Below) THE NATIVE TYPE of the Niger Basin differs sharply in physical appearance from the desert tribes to the north. Being non-Mohammedan they dispense with the veil for women, as illustrated by this native belle standing in her doorway in the pretty village of Tillabery

NIAMEY

TILLABERY

(Left) THE VILLAGERS of Niamey peacefully bathe themselves and wash their clothes in the Niger River, a stone's throw from a boisterous conclave of native chiefs and the siren voices of barterers and tradesmen vending their wares in the noisy market place

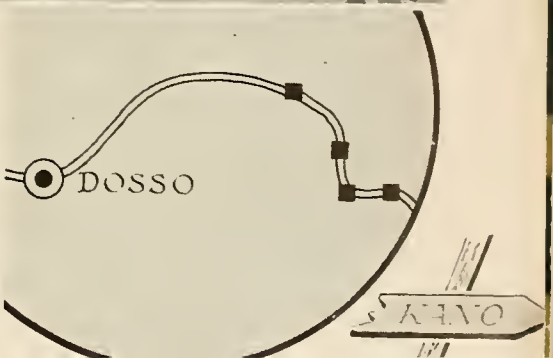


THE BUTCHER SHOPS in Niamey observed the quaint custom of employing male singers and female musicians to attract customers, as shown at left. Niamey is the seat of the French Governor's palace, and in honor of the visitors the Governor arranged a native tam-tam, in which endless dances were enacted against a background of flaming torches

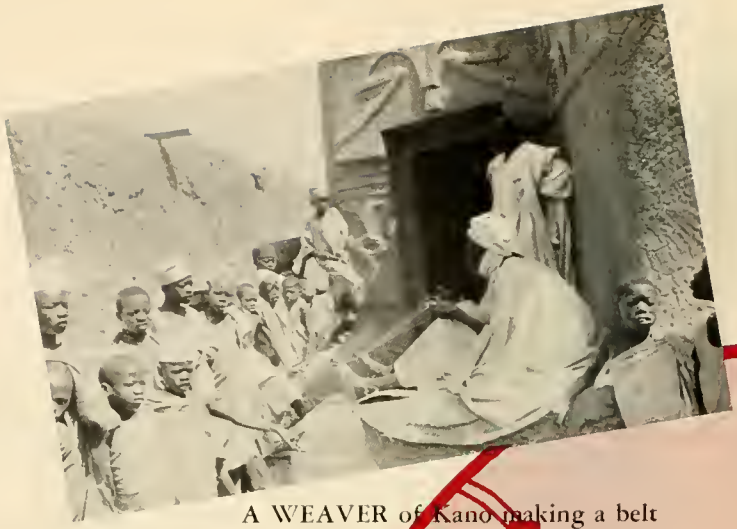
NUMEROUS TRIBES from the Niger Basin congregate at Niamey to barter their wares, including raw cotton, taro, peanuts, dried peppers and gumbo, printed clothes, and various cooked foods

HORSES ARE VALUED PROPERTY among the native nobility in the region of Niamey and, elaborately caparisoned, give their riders the air of personalities out of the *Arabian Nights*. The horse shown above belongs to the Chief of Niamey, Zibou Salifou

QUILTED ARMOR, curious helmet, and medieval crusader's costume give the cavalryman of Dosso greater barbaric splendor than any natives previously met on the road to Kano. *(Left)* Musicians in the entourage of Djermakoy, the most enlightened and important chief in French Nigeria



THE GOAL: A gateway of colorful Kano



A WEAVER of Kano making a belt

(Above) A DOORWAY showing the distinctive architecture of this almost legendary city in the heart of Nigeria

(Below) A STREET SCENE in Kano. Merchants passing a pretentiously decorated doorway

KANO'S indigo dyers near the vats

CENTURIES OLD,
Kano remains little changed

KANO

(Right) ONE OF KANO'S FINEST, a member of the city police force

(Below) THE MAN WITH THE STICK, clown of the city's market place, is followed by the usual throng of entertained onlookers.

Though a hard-won goal to travelers approaching from the Mediterranean, Kano with all its colorful history, is in the imagination of many the rival of Timbuktu

Is any lighthouse in the world more lonely than this stopping place? Small wonder that several of the caretakers are said to have been driven insane by the enforced solitude. The sleeping quarters, which were like bunks on a small vessel, were so cramped that I preferred to curl up for the night on the back seat of our car; and before the break of dawn, I was shaving with hot tea from my thermos bottle to conserve our precious bottled water.

At the center

All of us worked like trench diggers that day, pushing and pulling the car out of ruts, losing time to allow the motors to cool, and searching for road tracks which had disappeared under shifting sand. If the wind blew it seemed to come from a furnace, only it was filled with sand instead of smoke. When we could make any headway, we protected our eyes, nostrils and parched throats from the thick dust, with broad bandages, which made breathing difficult. This was the nortoriously dangerous Tanesruft, a synonym for complete desolation, where stones which we drove over caused the heavy vehicle to bump severely. The larger rocks were often shaped like mythical wild beasts. In the distance were the mountains of the inhospitable Ahaggar where, not long ago, the dangerous, veiled Touaregs were in the habit of hiding, to pounce on intrepid travelers and sell them into slavery. We were now at almost the exact center of the great bulge of Africa, about 1000 difficult miles from the nearest seacoast in any direction, and 1300 miles inland from the port of Dakar, which has figured so prominently in the news.

We struggled bravely south and at last reached a region where mirages gave way to cheering signs of genuine vegetable and animal life. The high-leaping antelopes springing up gracefully from patches of desert grass were particularly lovely. Thorny mimosa with cascades of powdery and perfumed yellow blossoms, and many purple flowering leguminous plants, assured us that the worst of our desert journey was over. By this time, however, night had again fallen, and with the road to Aguel'hoc continually disappearing, we did not venture to face the menacing obscurity ahead, so we again camped in the bitterly cold desert.

It was fortunate that we had adopted this course, for it took almost an entire day to cover the few remaining miles. When we built a fire to keep warm and boil water for breakfast, a family of shivering Bedouins joined us. We were struck by the remarkable eyes, perfect teeth and stately carriage of one of the women. Not a scrap of our leftovers remained uneaten by them. They seemed so hungry and miserable in this unfriendly land, and yet what phenomenal endurance these wandering nomads have! My sympathy for them was probably superfluous for they would have suffered keenly from homesickness had they been forced to emigrate to a fertile country. Hardly had we left them behind when we struck more soft sand and unexpected boulders, and it was late afternoon before we reached our destination.

Aguel'hoc is a new military post, not even shown on recently published maps. The womenfolk were modest and attractive and took pride in the metal amulets, or *cadenas*, with curious locks and keys, presented to them by their spouses. The village of rude, straw huts, one of which was assigned to me, was very interesting, being filled with native soldiers, some negroes with their hair tessellated in the fashion of the nomadic Besharin between the Nile and the Red Sea, and a mélange of Arab types. Nude children, some of them playing on hand lyres, were as numerous as kids. Two very tame, inquisitive ostriches followed us on our tour of inspection. A tawny caravan of veiled, intractable Tuaregs, once so feared, rested near my hut with their proud camels.

In the meanwhile the laughter, quarrels and dissensions of the villagers kept me wide awake, but that did not matter much as we had agreed to leave at half past three in the morning. That drive was a very strange one indeed! Our powerful headlights attracted birds, rabbits, gazelles and jumping jerboas, and we would undoubtedly have seen a remarkable fauna, had a small swift car, traveling ahead of us, not frightened most animals from our path. We actually ran into a fiendish pack of howling hyenas, and when our wheels broke the hind legs of a straggler, we stopped to shoot it and put it out of misery. When the merciless sun arose, the heat became almost unbearable and we were grateful for the shade offered us by the ruined walls of Tabankort, an abandoned post. Beyond Kidal, the roads were excellent. At Gao we registered at a hotel managed in part by the American cousin of my old friend Richard Glaenzer.

The Niger River

Gao is the gathering place of many tribes and the market presented a scene of great activity and interest. The town spreads along the banks of the great River Niger, which aroused memories of the explorer Mungo Park. We lost no time engaging pirogues and black men to paddle us across the famous stream. Its shallow reaches passed through rice paddies, and many clumps of beautiful rose, violet and white water lillies. To bathe in these waters meant that you would eventually go to paradise, so I leaned over the side of our dugout and dipped my entire arm into the river. Water poppies, tall rushes, and mallows clogged the shores, which were alive with egrets, kingfishers, ducks, geese, and other aquatic birds. The broad, unruffled stretches of the stream were like mirrors reflecting the red hills on the opposite bank, where we found curiously primitive villages. The women, always with babes hanging at their breasts, seemed to be doing all the work—weaving, pounding grain, and building low hemispherical houses of bent wood held together with colored cords. Some of the girls were beating hand drums and playing a single-stringed instrument with a bow. Their kindly chief ordered them to dance for us, and a clever crippled boy joined them. All wore bangles and large, flat white beads like the women at Beni Abbès, and they dressed their hair in strange fashions.

Fanleaf palms, termite hills, and gigantic baobabs —those thick-stemmed monsters of the vegetable kingdom—now become familiar features of the landscape. These trees, known also as monkey-bread trees, were leafless, but their dried fruit was still hanging from the branches. For the most part we followed the course of the great river, passing through Ansongo, and the pretty village of Tillabery, where the house roofs were shaped like Annamite hats and African greyhounds raced with our car until we left human habitations behind. The physiognomy of this region took us by surprise. Although never far from the Niger, we now crossed tablelands and rocky hills. Bird life was very rich. Pigeons, partridges, stupid flocks of tough guinea fowl (which we ran down and tried to eat later in the day), black-and-white crows, egrets following small herds of browsing cattle, lovely plantain eaters and bee eaters, ducks, waders, and even a magnificent eagle, were noted in my journal. There were also many rabbits, ground squirrels, and lizards, but large animals listed in Malbrant's *Faune du Centre Africain Français* were evidently frightened away by our car for we saw none between Gao and Niamey, the seat of the French Governor's palace. Here a conference of native notables was just coming to an end.

Out of the Arabian Nights

Zibou Salifou, the chief of Niamey itself, was imposing in a voluminous white cowl embroidered with yellow and wore a talisman against all maladies and misfortunes. The representative from Birni had a black headdress, and his fine steed was ornamented with green and white harness and accessories. Another portly leader, who looked like a voluptuary from the pages of the *Arabian Nights,* wore a robe of brilliant orange-figured silk and an enormous turban. The bustle of their departure and the shouting of their admirers made the animated market place near the river bank seem almost peaceful by contrast. Every merchant was determined to drown the voice of his rival. There were Puehls, Djermas, Hausas, Beris, and other tribesmen. There were noisy animal traders and vendors of raw cotton, taro, peanuts, dried peppers and gumbo, printed clothes, pancakes, and cooked foods, and cheap European products. The most entertaining places were the butcher shops, for they employed male singers and female musicians to attract customers. A stone's throw away men were bathing their horses, and women were washing themselves or their clothes in the Niger. We had an opporportunity to admire the elaborate fashions in hairdressing and noticed that some men, especially those from Birni, used hidden tubes to build up their hair into ridges, but the women added strings of silver coins and coils of red beads to enhance the beauty of their high glossy coiffures.

After Monsieur Pepin, the hotel manager, had regaled us with a delectable fish luncheon, we repaired to the palace of the Governor, who invited us for a cool, restful motorboat ride on the great river; and that same evening he arranged a tam-tam in our honor with Zibou Salifou. That picturesque figure received us in an open field, surrounded by an escort of his bodyguard in showy red and white uniforms, each man holding a blazing torch of rushes to light up the scene. The dancing, obviously erotic, was in no way remarkable. A fellow would roughly pull a girl out of the crowd and persuade her to dance, while the musicians pounded on their drums and the native audience roared their approval, especially if the foreigners threw donations on the ground. The scene presented by the chief against a background of flaming torchbearers was quite exciting, but the continual deafening encouragement of the audience was too much for effete tourists who had to start bright and early on the following day for Dosso.

Nigeria's biggest chief

Here a far more striking reception was prepared for us. As we made a turn on the road, there burst into view the colorful company of Saidou Djermakoy, the most enlightened and important chief in French Nigeria, waiting for us with his amazing bodyguard. Although he was in the shade of a regal umbrella I recognized in him the original of one of Alexandre Jacovleff's incomparable portraits, made when the Russian genius was the artistic head of the Haardt Citroen Croisière Noire. I can hardly resist digressing here to pay a tribute to that lamented artist, who, it is safe to predict, will ever remain the classic painter-interpreter of all the remote regions he visited in the course of his too brief career. In their curious helmets and medieval crusader's costumes, armed with long spears or halberds and mounted on horses caparisoned with quilts made of black, white and red lozenges, or protected by chains and strange armor, they made a picture of barbaric splendor. The foot soldiers had shields of oryx hide decorated with colored leather, and the savage music of their chief's orchestra on the opposite side of the road, added a wild, festive note to the occasion. Djermakoy, who had been to Europe and spoke French fluently, took special pride in his great war drum, the boom of which could be heard for miles, and he told me that only an executant with remarkable physical power could make it sound properly. Sitting on his dappled gray charger, waving farewell as we started to move on over the dusty road to Birni, the famous chief was a dignified, memorable figure.

We had covered 81 miles of uninteresting roadway in the morning and now we suffered an afternoon of uninterrupted dullness aggravated by hot, dry wind and blinding dust, which penetrated our eyes, lungs, every nook and cranny in the car, and even ruined the contents of our carefully covered valises. We stopped only once to marvel at a baobab of exceptional girth, the hollow trunk of which was the home of a cloud of bats, with thin, translucent wings. When we disturbed them, they fluttered blindly into the sunshine. At Birni we were offered a guard and a simple resthouse, which had no doors or privacy but looked attractive under a tamarind almost as large as any baobab. On my hard cot under a mosquito net, I was kept awake, not by the primitive nature of our shelter, but by the excitement of

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THE PHILIPPINES

Garden of Rice

By FENNO JACOBS

All photos from Three Lions

GEOLOGICALLY the Philippine Islands form the crumpled edge of Asia's continental platform, separated from the mainland by roughly 500 stormy miles of China Sea. Upon their shores these waters have rolled up successive waves of Asiatic humanity, Indian offshoots, Malayans, Arabs, Chinese, and later Japanese—all superimposing rich cultural layers on an aboriginal race of pygmy-like Negritos.

The resultant civilization, though still fluid, is very old in terms of Euro-American culture, which forms its latest overlay. Today the islands support the whole range of their cultural history, from abysmal black pygmies through descendants of old Spain to the local Harvard Club, making them possibly the happiest ethnological hunting grounds this side of paradise.

No visitor, whether scientist or layman, can fail to stand in awe of the irrigated rice terraces of Luzon. Their grandeur testifies to the strength of the pre-European culture and, all things considered, they represent perhaps the greatest agricultural achievement on earth.

Lacking even the simplest industrial tools, to say nothing of engineering science, the primitive tribes have transformed entire mountain sides into fertile fields for their staple crop, rice. Gazing upon them, one wonders how greatly our own crop yield might be increased if irrigation and "vertical agriculture" were intensively developed in desert and on hillside

CLOSE-UP OF THE TERRACES, with a seed planter in the foreground. These soil-strips are actually rimmed water basins, designed to catch and retain the rainy season's downpour. They are buttressed by mortarless stone walls, which sometimes reach the height of 50 feet and have withstood typhoons for centuries. This trick of engineering art was invented ages ago in southeastern Asia. But necessity mothered the perfection it ultimately attained in Luzon. Driven to the hills by constantly encroaching immigrants, the Ifugao tribe found level ground almost non-existent and were forced to develop their skill far beyond its original scope

FILIPINO CIVILIZATION is a rice culture. A Filipino not only eats rice, he thinks rice. Rice is a form of money, the chief concern of religious ceremonies, a man's dearest possession. Like the American's U. S. Steel Preferred, it is the bellwether of prosperity, leading all other crops in size, distribution, and prestige. The whole way of life of dwellers in huts like those above is conditioned by the waving fields around them

THE HARVEST: a time of back-breaking, blistering toil, to be followed by traditional celebrations. On Negros Island all the work is done by hand. Only the cheap trade clothing and steel knives are modern innovations

(Left) THESE TEPEE-LIKE STRUCTURES are the "threshing machines" of Negros Island. Rice is pushed through the slatted platform; the wind blows the chaff to one side, while the grain falls in a heap directly beneath

BUT THE ANCIENT METHOD of trampling out the grain on a woven mat is still practiced *(below)*

HERE a woman winnows the rice by jiggling a flat basket endlessly in the wind

(Below) ANOTHER thrashes bunches against a stone. Any of the three foregoing photographs might be the Biblical Ruth laboring in the alien corn

(Above) IN LUZON mechanical threshers have been introduced, but these women thriftily winnow the leftovers by hand

ANOTHER FRUGAL NATIVE is sweeping up after the threshing. Not a single grain must be lost, for though rice far outranks any other crop, there is never enough to go around, and millions of dollars' worth are imported annually

VARIOUS OUTSTANDING PHYSICAL TYPES found in or near the Philippine rice fields are shown in the following character studies. In their faces can be seen traits of the black, brown, yellow and possibly the white race. All have contributed their share to a community soon to become an independent nation.

The woman of Luzon at left is carrying a jack fruit on her head. Her countenance is predominantly Asiatic, although it is difficult to say whether her ancestors came from China, Japan, or the Malay Peninsula

(Below) A CHRISTIAN FILIPINO. Roman Catholicism was brought to the Philippines by the Spanish, Protestantism by America. But as early as the 14th century, Mohammedan Arabs made thousands of converts in the islands

MOHAMMEDANISM, a religion extolling fanatical courage, lent impetus to the rise of the warlike Moro tribes. The Moros have been called the Vikings of the Orient. Their pirate fleets were the terror of the Sulu Seas for generations, and but for the coming of the Spaniards (1565) they might well have dominated the entire archipelago. As it was, they held their own until early in the present century. The story of their subjection by the U. S. Army is perhaps the darkest chapter in America's brief imperialistic history. Today the Moro sails his native waters on more peaceful missions. The days of head-hunting and piracy are happily gone forever but international piracy is by no means dead in the Orient. Under Philippine independence—effective July 4th, 1946—what will be the Moro's fate?

(Left) A MORO WOMAN OF TODAY. Her unsightly teeth are the result of filing and chewing betel nut, a mild narcotic favored widely in the East Indian islands

(Right) A ROBUST young Negrito rice worker. Note the double curve in the line of her breast, a racial characteristic which is almost never found in European women

AN INTERESTING NEGRITO TYPE: a descendant of the earliest settlers, the pygmy Negritos, who still exist to the number of about 20,000 far in the interior. Though her rosary bespeaks Christianization, most of her racial kin remain pagan

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1 CHINESE influence may be discernible in the remarkable camera study at left, although this aging rice worker is obviously a mixed type

2 THE YOUNGER GENERATION: a little girl of the Igorot tribe, who may trace her Asiatic features from one of the swarm of Chinese merchants who came to the islands soon after the Spanish Conquest

3 A BOY of the Philippines sitting astride a carabao, or water buffalo

4-5 AN OLD COUPLE still hard at work in the rice fields. Their seamed faces tell of a life spent in toil and the ability to endure it

6 NOT INFREQUENTLY the Filipino's diet, from weaning to death, consists of practically nothing but rice. The withered old gaffer below munches his bowlful, which is probably highly seasoned with various spices. The Filipino recognizes a hundred different kinds of rice, each with a special name. The word for rice on the stalk is altogether different from that for rice in the pot, just as we have one word for cattle, another for beef.

Whatever happens in the near future in this Garden of Rice, it seems quite certain that rice will continue to play a major role in the destiny of the world's most thickly-clustered archipelago

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A SNAKE IN THE HAND—*is worth two in the grass for medical research, and the job of capturing and keeping them sheds interesting sidelights on their habits and peculiarities*

By ROSS ALLEN *as told to* MERLE PARK MERRYDAY

A LIFELONG interest in wildlife has led me into what many persons consider a most terrifying vocation. Yet the study of the life of any wild creature opens up new worlds of interest, and I want to tell some of the things that make the study of snakes one of the most fascinating occupations.

I had been doing taxidermy work in Florida about fifteen years ago when one day a man came into my workshop and ordered 250 diamondback rattlers for a pharmaceutical laboratory in the North. Though I had less than two months in which to gather them, my younger brother Oliver and I captured sometimes as many as ten a day, and we filled the order. Since then the demand for rattlesnake venom has grown.

Our method of capturing rattlesnakes in the Everglades was to look for gopher holes, for the snakes take refuge in them, especially in cold weather or in case of forest fires. We covered the holes and put flags beside them so that we could find them again. The reason we covered the holes was because I had learned that uncovering them later usually caused the snakes to crawl out so we could catch them.

A companion and I once took turns digging into a gopher hole. As we dug a gopher frog popped out, followed by a gopher. Then the shovel struck something soft, which I was sure was a rattlesnake, but it turned out to be a possum. Johnson took the shovel from me, and while he was digging, a rabbit ran out. Finally, when we were almost discouraged, we struck a rattlesnake.

The gopher is a friend of the rattlesnake, and I have never seen a rattlesnake willingly strike a gopher. In captivity I have seen gophers crawl over rattlesnakes and push them about without irritating the snakes; and I have seen rattlesnakes coil over gophers.

On early summer mornings, diamondback rattlesnakes crawl along sandy trails in their search for breakfast or to seek cool, sheltered places beneath palmettos. In order to catch a rattlesnake, I try to make it coil. Rattlesnakes usually coil tightly with the head extended ready to strike. I drop my right hand to attract the attention of the snake. Then, bracing my feet far apart I reach directly over the rattler's head with my other hand, still moving the right hand slightly to attract its attention. Next I drop the left hand quickly and tightly on the snake's neck just behind the protrusion of the jaws. The snake doesn't have many bones at the neck. I had to learn just where and how to hold one, because if injured the snake will die in several weeks. Contrary to popular belief, the rattlesnake is one of the most delicate creatures. Its skeletal structure gives the appearance of a symmetrical lacework, and it is so delicate that the weight of the snake's body while being handled sometimes causes it to be injured.

The captured snake usually thrashes about, trying to free itself and to sink its fangs into the hand, so I catch the coils with my free hand and push them into a finely meshed bag that I carry attached to my belt. The snake's head goes in last, and I close and tie the top firmly. Several times I have captured a snake long enough to brace its tail against the sack bottom and, instead of dropping when I released its neck, the snake shot up again. It was then necessary to drop the bag and recapture the snake. In one day, Johnson and I once captured 33 diamondback rattlesnakes, besides a number of other species.

Seven feet is a safe distance from a snake. A coiled rattlesnake can strike two-thirds its length. My record diamondback rattlesnake measured seven feet, three inches. The longest rattlesnake fang I have ever seen measured an inch. Nature gave snakes the instinct to strike rapidly moving objects. If you hear a snake rattling near you and you remain still, you are not as apt to be struck.

During the period when snakes shed their skins, they are always nervous because they don't see well. Before shedding, their eyes look milky, then they clear up for a few days; and again they look milky as they shed. My observation has been that rattlesnakes shed their skins from three to six times a year. Being cold-blooded, the frequency of shedding depends upon the weather: when it is hot their metabolism increases, and when it is cold it decreases.

I have been asked how to distinguish a harmless snake bite from a poisonous one. A harmless snake bite leaves a series of small scratches, caused by the teeth as distinct from fangs. A poisonous snake bite always leaves a definite puncture, usually two. Poison fangs, which are much longer than normal snake

teeth, are attached to the upper jaw, and are curved, movable, and hollow. The venom flows through the fangs and out of a hole in the side near the sharp point.

I have often been asked why there are no more deaths from rattlesnake bites. I think first of all this is because the snake strikes only to defend itself. The condition of the snake is important. If it has fed, there is not as much danger; also, only one fang sometimes penetrates the flesh. Furthermore, the poison does not seem to be absorbed as quickly as many people think. Contrary to the general belief that snake venom kills very quickly or not at all, we have records of people who have died from ten days to two weeks after they were struck. The most rapid deaths from venom have occurred when the snake bite is near the face of the victim.

A victim's own story

The following exceptional account of a rattlesnake bite is given here as written by my friend, Dr. C. H. MacDonald, of Coral Gables, Florida, who suffered a very severe bite from a diamondback rattlesnake—and lived to tell the tale.*

"My greatest thrill is being alive today. In March, 1936, I was asked to go snake hunting near Hollywood, Florida, and I took a young fellow with me who had never been in the 'Glades nor seen a rattlesnake outside of a zoo.

"He found the first rattler. I rushed through the muck and mud to reach the tiny knoll upon which the big snake was lying in a coil, perfectly still. I told the boy to get the sack. I pinned the snake down with the butt of my .22 rifle. It measured exactly 62 inches in length and was very heavy. I had great difficulty in packing it into a small sack. Just as I snapped its head down and away with a quick twist into the bag, it bounced against my leg, and I was struck a terrible blow above my kneecap. The fangs held momentarily in my flesh before the snake could extricate them. They felt like two hot hypodermic needles jabbed into me. Two streams of blood trickled down my leg.

"I had the boy steady me while I quickly applied the regular army tourniquet above the wound. With a specially devised lance for snake bite first aid, I cut deeply from fang to fang all around the puncture until the blood was pouring from the cuts. I used the suction cup on the wound and believed I had done everything that could be done. After about fifteen minutes I released the tourniquet and cut deeply again and repeated the suction process.

"I had about a quarter of a mile to walk to our car, but I managed to lug the live snake in the bag, buzzing furiously all the while. The throb began before I reached the car. We drove as fast as the 'Glades road would permit, but each bounce was excruciating. Finally we reached a drugstore in Buena Vista, and I had my first shot of antivenin injected into my abdomen. I was eager to get home, ten miles away, but pain and increasing throbs and the fast stiffening of my leg made me decide to go to a hospital for a check-up. When I arrived I was rushed up to the operating room, where another session of deep cutting took place—with no hypodermic either!

"By this time I felt so uneasy that I asked the house physician his frank opinion. I realized that something very wrong had happened to my vigorous first-aid treatment and that I had received a whale of a shot of venom. This doctor had been in on the famous case when the Curator of the St. Louis Zoo was bitten by a Gaboon viper. He said, 'MacDonald, you are in bad shape, and getting steadily worse.' As a professional man myself, I wanted the truth about my own case, which was the reason I got it.

"My blood pressure began to drop and the blood cells to break down. I felt peculiarly apprehensive but not in the ordinary sense afraid. I was very feverish and burning inside, which the throb increased. When I took a sip of ice water or a piece of ice, I would spew pure blood.

"It was 2:00 p. m. on a Sunday afternoon when I was struck by the snake, and I was admitted to the hospital about 4:00. Late Sunday night my family was called for blood tests for transfusion. No one was permitted to see me, and the quietness and 'shushing' only confirmed my suspicions that I was in for it. My leg was swelling rapidly and turning a darkish hue, and the pain was intense. Although I have suffered pain from accidents, this pain was different. I have seen many rabbits and white rats die from rattlesnake venom, but I had never realized the amount of suffering from it. My blood pressure was still falling and blood cells breaking down, and every few hours hypodermics were shot into me. Every half hour, blood tests were made by one of the best toxicologists in Miami, who is a friend of mine.

A radical experiment

"When I entered the hospital, I requested the truth about my case with no evasions. I then asked for an experiment. They gave me, which I believe is the first time it has ever been done, 40 cubic centimeters of antivenin intravenously (enough horse serum and rattlesnake venom to kill a crocodile). However, I was still vomiting blood and had a terrible burning nausea, which I cannot describe. I have never suffered

*The full report of this incident was published in *Field & Stream* for December, 1939.

so much in my life, and really hoped that something would happen one way or the other.

"They decided to try one more measure. The doctors punctured my chest wall and shot 1500 cubic centimeters of saline into me. This, I firmly believe, is what saved my life, as the internal hemorrhage ceased a few hours after this was done. I was afraid to drop off to sleep for fear I would not wake up. Two physicians came in and applied stethoscopes to each arm, *but they could not detect my pulse.* I could tell from their faces what they thought, because they were old friends of mine. While I do not mean to appear dramatic, it is a queer sensation to know that you are about to die. It is strange how calm one becomes when one has to face it.

"The doctors had a hurried consultation and returned with adrenaline and other powerful heart stimulants. Under the effect of the powerful drugs, I finally dropped off to sleep. When I awoke, the doctors and nurses were standing around me, looking quite elated, because I had made at least one hurdle.

"Then I was told what I had really feared deep down in my heart all the time: my leg would probably have to be amputated. The leg was then black and swollen to the size of my waist. At the same time I knew and the doctors knew that I could not stand an amputation. Instead, they made a drain in my thigh, with my leg elevated. Slowly I began to snap out of it.

"By this time my case had spread over Miami, and doctors from other hospitals came to take a look. They could not believe their eyes when they saw my leg and read my chart. So I am truly living on borrowed time.

"What, you may ask, is venom, that it can cause such terrible shock and devastation to the body tissues, the heart, and the blood cells? Medical science knows very little yet, as bad snake bite cases are so rare that definite procedure is unknown. Here in south Florida, where snake bites occur from the huge diamondback, few survive. It leaves one badly banged up if he does. If I can warn hunters not to take liberties with the heaviest poisonous serpent in the whole world, I have contributed something. I also believe that I have been a darn good guinea pig!"

Discovery of medical use of venom

The first experiments with snake venom were conducted early in the present century. It is said that the first discovery of the medicinal value of venom was made when an epileptic patient was bitten by a poisonous snake. Two physicians, Samuel M. Peck and Nathan Rosenthal of Mt. Sinai Hospital, New York, and another doctor, Desmond Fitzsimmons of Port Elizabeth, South Africa, discovered almost simultaneously that snake venom possesses properties that make it useful in medicine. Diamondback rattlesnake venom is being used in experimental work for the relief of pain in cancer and arthritis and other diseases, in place of morphine. The venom relieves pain more slowly, but is not habit-forming. The venom of the cottonmouth moccasin is being used in treating hemorrhagic conditions of the blood, to prevent bleeding.

The full contents of the rattlesnake venom gland is worth 20¢ when desiccated, a price for which many persons would not be willing to capture the snake and extract the venom—especially when one realizes that one or two drops of it is enough to kill the operator. The largest quantity of venom I have ever extracted from a diamondback rattlesnake is four and a half cubic centimeters, approximately one teaspoonful.

When I first started milking rattlesnakes I did not have a regular pen, so while I milked one snake I put the others on the ground beside me, warning the spectators to keep their distance. Sometimes they would crowd too close. On one occasion, one of the rattlesnakes, instead of waiting to be milked, started toward one of the spectators, a fat, elderly woman. In spite of her size, the lady leaped backward with the swiftness of an athlete and landed in a sitting position in my water-filled turtle pen. I hastily pushed the snakes back into their cage and, amid giggles and roars of laughter from the crowd, tried to assist the lady to rise. She was lodged firmly, with her feet stuck straight up in front of her. It took three of us to free her, and when she was released she laughed as heartily as the rest.

In the milking pen, I concentrate on not being bitten, on not injuring the snake, and on not wasting the venom. I watch the moccasins particularly for side movements. The coral snake is especially dangerous to milk because it has a little round neck that is hard to grasp. We have supplied some coral snake venom, but there is not much demand for it.

Never bitten

I usually milk about 150 poisonous snakes an hour. My fastest record is 150 in 44½ minutes. I have milked around 40,000 poisonous snakes but have never been bitten. I don't count my experience with the moccasin in the moving picture, "Catching Trouble," because I received no venom.

My first rattlesnake pen was screened over in such a way that I could not stand upright when inside. One day when I was in with 200 rattlesnakes, an excited spectator started striking the screen wiring with his cane. The snakes, feeling the vibration of the blows with the delicate nerves of their abdomens,

started crawling toward me in such numbers that I could not make a path from the pen. As soon as the snakes came near me they coiled to strike. I was not wearing snake-proof boots, and there was no exit from the pen at my corner, so I had to work fast. I asked the excited spectator to remain quiet, and by carefully lifting and pushing some of the less infuriated snakes out of my way, I managed to escape from the pen without injury to any of the snakes or myself.

The copperhead, although a slow traveler and inclined to retreat if possible, is very quick to strike in self-defense. I have found that these snakes respond to gentle treatment in captivity and will become tame and good-natured. However, I do not advise anyone to handle a venomous snake unless thoroughly acquainted with the technique, and even then a venomous snake should be handled carefully.

Faith and a copperhead

During August, 1934, I was at Camp Cloudmont for Boys, on Lookout Mountain near Mentone, Alabama, acting as Aquatic Director and Nature Instructor. During our hikes we collected a few snakes, including a copperhead. One night as part of the evening's program, I milked the copperhead for demonstration purposes. It yielded a good quantity of venom, even when I did not massage the glands thoroughly.

Four days later, at noon, a rough-looking crowd of men, about 50 in number, came hurriedly into camp asking for the "Snake Man." To my surprise, I found that they had a preacher with them who wanted to demonstrate his faith by playing with my copperhead which, he claimed, would not bite him, and if it did would not hurt him. Faith or no faith, I told him that I could not permit such a risk. But the men were all insistent and would not accept my refusal. Finally, after they agreed to assume all responsibility, I reluctantly consented to let them use the snake.

The two-foot copperhead was put out on the ground, and the preacher, a dark, thin man clad in overalls too large for him, stepped forward. The men eagerly gathered around in a circle, but at a safe distance, and watched with excited anticipation. The preacher looked at the coiled, docile-looking reptile, and then looked up to the sky, mumbling indistinguishable words. One impatient man hollered, "G'wan, Preacher, pick 'im up like ya said ya would."

The preacher muttered, "Quiet, I'm awaitin' fer the Spirit to guide me." Then, pointing to the sky and to the snake, he stepped closer and repeated the same motion. Clapping his hands, he reached down and picked the snake up by its tail, and let it fall to the ground. He pointed his left hand up to the sky and his right at the snake's head, which was gradually coming closer.

Suddenly, quick as a flash, the copperhead struck him on the index finger; the fangs caught and the preacher flung the snake off. I rushed in and picked up the snake and asked the preacher if he would let me treat him, but he said, "No." Some of the men in the group turned away and some laughed. His finger started to bleed, and the venom soon began to work. He seemed to be in great pain and looked frightened. Finally he consented to treatment.

I had him lie down while I went to work with Doctor Benedict's suction outfit. A tourniquet was tied, and three cuts made in the wound caused by the fangs. I then began using the squeezing method to remove blood and venom, as the area on the side of the finger was too small to use the suction cup. His hand became swollen. After 30 minutes of preliminary treatment, I sent him on to a doctor.

I heard later that he had recovered, but had lost his faith. If he had known anything about snakes, he could have handled the copperhead without having been bitten. The snake was quiet and unexcited, but when he grabbed it by the tail and dropped it to the ground, the snake, of course, became angry and struck him.

Another close shave

On January 12, 1937, we received a shipment of assorted snakes, including some copperheads. Harold Williams, who was checking the shipment, dumped the snakes into the bin. Thinking that the poisonous ones were all out of reach, he started to pick out the harmless ones. Quick as a flash the largest copperhead made a strike at him, sinking both fangs into his index finger. Bob Rouhe ran for the snake bite outfit. I tied a tourniquet about Harold's wrist, then made incisions. One incision bled well, but the other didn't, so I made a deeper cut, penetrating the vein.

Harold described the pain as a red-hot burning sensation around the bite, followed by more intense pain as the poison spread. Within fifteen minutes his hand had become swollen. The poison was spreading fast, indicating that the venom had been injected into the vein. We applied suction, released the tourniquet for a minute, then made more cuts on the back of the hand. The swelling had increased and spread up to the forearm. We rushed Harold to the doctor. More suction was applied, more cuts made, and ten cubic centimeters of antivenin were injected, some near the bite, some in the other arm.

By now the patient had become nauseated. The doctor stitched the cut vein together. An hour after

the bite, the patient was in bed. A few more cuts were made and suction applied. The incisions were kept open by warm, wet applications of saline solution made from Epsom salts dissolved in water. The results of the suction were encouraging, as pale serum and blood were removed, and the pain and swelling reduced. We let the patient rest for ten hours and again resumed the same treatment, reopening the original cuts. By this time the arm was swollen to twice its normal size up to the shoulder and was very stiff and painful to move. After another 30 minutes of painful suction treatment, another dose of ten cubic centimeters of antivenin was injected. Suction treatment was continued every few hours.

By the end of the third day, the patient showed improvement. His arm felt much better, and the swelling subsided. But other complications apparently caused by the antivenin, began to set in. The patient broke out all over his body in an itching rash, his face became so swollen that he couldn't talk, and his hands and legs stiffened. This condition lasted several days. After sixteen days the patient recovered. Eleven cuts had been made from the bite to the elbow. The finger healed up in good shape; but it was an expensive accident, costing $115.

The copperhead is not as dangerous as the cottonmouth moccasin, which lives in streams, swamps, rivers, lakes, and marshes, where fish and other food are available. When disturbed the cottonmouth moccasin coils and throws back its head, opening its mouth and displaying the whitish membrane lining, which gives the snake its name. Like most water snakes, it is able to bite under water. I hunt moccasins at night with a light. We paddle along the canal, blinding the snakes with headlights we wear strapped to our foreheads. As fast as we capture them, we pile them into sacks along the banks. My record hunt occurred one night in the Everglades when one companion and I captured 350 moccasins.

Swimming for snakes

I capture many water snakes by swimming. Choosing a likely locality, I usually find the snakes hiding around roots and low limbs. So as not to disturb the snake, I swim toward it slowly. When my hand touches the snake's body, I work my fingers toward the reptile's head, seizing the neck with a firm grip. Then I swim back to the boat. When a swift current necessitates use of arms as well as legs in swimming, I hold the back of the snake's head in my teeth.

We have recorded 42 moccasin bites, two of which were fatal. All the victims of these bites suffered painful and sickening effects, sometimes ugly, slow-healing sores and a stiff joint, and at other times gas bacillus and gangrene. The cottonmouth moccasin often has these germs in its mouth. It is capable of jabs powerful enough to pierce soft shoe leather. In experiments I have found that baby snakes one week old have more powerful venom than the adults, though less of it.

The cottonmouth moccasin's venom, as I learned from experience, causes severe smarting if it enters the eyes, but treatment with an eyecup and boric acid relieved the condition in two hours. On another occasion I tasted snake venom, when it was accidentally squirted into my mouth. Frequently since then I have tasted the fresh venom by dipping my finger into it. Fresh venom mixes with water, has no odor, and tastes slightly sweet. A glass of moccasin venom looks like lemon juice, rattlesnake venom like orange juice. Venom spoils in a few hours, as milk or egg white does. When dried it loses 20% of its weight and appears as white or yellow crystals, which are soluble in water. Cold has no effect on these crystals, but heat reduces their potency. Twice I have swallowed half a teaspoonful of moccasin venom, and once I swallowed a whole teaspoonful, but this last dose caused my mouth to pucker unpleasantly for six hours and left my lip irritated for over a day. Moccasin and rattlesnake venom, being protein, are digested and the poisonous properties are destroyed.

Snake against snake

In November, 1936, Kenneth Freeman, of the University of Florida, and I, began some experiments with venom. It is generally known that the king snake is immune to the poison of the rattlesnake and of the cottonmouth moccasin. Little is known, however, about the effects of venom on other snakes. Our experiments were by no means conclusive, but give certain indications. The subjects chosen were normal, healthy specimens.

What we found was that, whereas four cottonmouth moccasins *(Agkistrodon piscivorus)* all survived injection of 100 milligrams of venom from their own species, another cottonmouth was killed in three hours by a 50% greater injection (150 milligrams). The snakes that recovered weighed from five and a half to eight ounces, and the one that died weighed eight ounces. The venom used was desiccated and diluted with distilled water just before each injection. Swelling and discoloration from bloody coagulation beneath the skin were observed as an effect of the poison.

A still greater quantity of the same venom (cottonmouth moccasin), namely 200 milligrams, failed, however, to kill either a king snake or an indigo snake, weighing respectively one and a quarter and one and

a half pounds. The king snake showed no ill effects, the indigo practically none.

Two hundred milligrams of the venom, on the other hand, killed a one-pound diamondback rattlesnake *(Crotalus adamanteus)* in 30 hours. A Congo water snake *(Natrix cyclopion floridana)* weighing one-half pound, and itself not poisonous, survived 100 milligrams of the same venom without apparent difficulty. But many more experiments than we have performed will be necessary in order to draw definite conclusions.*

The venomous pygmy

In one of our snake pits, a coral snake once apparently disturbed a pygmy rattlesnake, and the pygmy immediately bit it behind the head. In a few minutes the coral snake lay still, and swelling was noticed, which greatly increased in a few hours. Twenty-four hours later the coral snake was dead. So it can be definitely said that some snakes can and sometimes do kill other snakes with their venom. Twenty-five milligrams of moccasin venom were sufficient in one of our experiments to kill a pygmy rattlesnake in about ten hours.

This smallest of all rattlesnakes, incidentally, is equipped to strike almost from the moment it is born. The babies are about six and a half inches in length at birth. I once experimented with the effect of a baby pygmy's bite on a chameleon 30 minutes after the snake's birth. The chameleon crawled only a few inches before it became paralyzed. It was unable to proceed, and in three minutes it was dead. We have recorded seventeen pygmy rattlesnake bites since 1935, none fatal. The venom causes pain and swelling, and of course demands careful treatment.

Ignorance may not be bliss

Fear is a healthy reaction when one meets a snake whose habits are unknown. Mere guessing or hearsay as to a snake's identity is risky, as illustrated by the case of a man who came to me carrying a little paper bag. I opened the bag and said, "Coral snake!" This snake's venom, drop for drop, is deadlier than that of the diamondback rattlesnake. The man turned pale and told me that he had held the snake carelessly in one hand while driving the car several miles to a filling station, where they gave him the paper bag. Some men had told him it was harmless—a "thunder snake." He came back later that night to ask if there were any possibility that he could have been bitten without knowing it.

Those who work with snakes learn to respect them as marvelous creatures effectively equipped to lead the lives for which Nature intended them. A snake almost never strikes a human except in self-defense, and self-protection is the right of any living creature. We should not hate the snakes, for they are useful animals which destroy many other forms that might otherwise increase out of bounds; and they provide medical science with a useful organic product. I feel that Nature balances different beings against each other so that all may contribute something to the welfare of the world.

*Some additional information is given by E. Ross Allen in "Florida Snake Venom Experiments," published in the *Proceedings of the Florida Academy of Sciences*, Vol. II, 1937.

DO NOT MISS

In the next issue of NATURAL HISTORY you will have the thrill of a voyage back into the remote past, into a world of prehistoric creatures, when you read Dr. Edwin H. Colbert's story of the **SABER-TOOTHED CAT**, a distant cousin of the "civilized tiger" that purrs on your softest cushions. Eight-inch ivory daggers would seem the best sort of old-age insurance for this prodigious member of the cat family, yet the dramatic scene which Doctor Colbert scientifically reconstructs shows one form of peril, at least, against which these cruel sabers afforded no protection.

To round out the picture, **ROY CHAPMAN ANDREWS** contributes a delightful pen-portrait of his own cat, Lord Jitters, a stone-deaf but superbly beautiful dandy who epitomizes the ever-fascinating qualities which have endeared the feline species to mankind.

Readers of NATURAL HISTORY will soon make the acquaintance also of **PARKY**, an engaging young walrus who became a shipboard pet after his parents fell prey to hunters in the land of the Eskimos.

Where is the highest waterfall in the world? No book in the English language will tell you. For only recently have explorers corroborated a tale that drifted out of the interior of South America about a waterfall twice as high as any other on earth. It all began with the exploits of a free-lance aviator in quest of gold, and it ends with the systematic exploration of a **NEW LOST WORLD** by an American Museum expedition, of which Thomas E. Gilliard, who tells the story, was a member. Readers who recall his previous article, "A Lost German Colony," will know that when he speaks he has an exciting story to tell.

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leave it there. There must be some significance to this inexplicable act, but as yet I am baffled.

The young pigeons, known as "squealers" because of the shrill cry they continually make, grow rapidly. In four weeks a tiny, ugly blob of yellow fuzz is transformed into a handsome, full-sized pigeon. During this time the young consume tremendous quantities of food from their harried but happy parents. The old folks share the work equally, mother tending the nursery during the night and early morning, father taking the day and evening shifts, with little spells in between.

The site that the pair now occupy is most jealously guarded. Woe to any trespassing pigeon who accidentally lands on or near the nest, for he will be dispatched forthwith by two of the angriest pigeons you ever saw.

In my loft this sincere regard for property rights is very marked. Each family has its own little domain, the boundaries although invisible being nonetheless protected. Two birds will stand a foot apart, the imaginary line passing between them, and will feint, sneer, and growl threats all day long, until some days the loft assumes the appearance of an armed camp. However, it is mostly a game of bluff, and no one ever gets hurt.

Back to the subject of the various breeds—there is another bird quite similar to the carrier but with much better manners. He is known as the dragoon. This pigeon exhibits no surprising phenomena but is of such popularity that it bears mentioning.

Now of course all pigeons can be eaten, but most folks wouldn't care for a racing homer, whose muscles must be like spring steel, and few people would relish a dainty little show pigeon if they realized it cost $100.00 or so. Therefore a special class of pigeons is raised especially for market purposes and they are known as "utility pigeons." The most common of this type are the Mondaines, Carneaux, Kings, and runts. The first three of these weigh from 24 to 32 ounces, which is darn big as pigeons go. The Mondaines and Kings are white, while the Carneaux come in white, red, or black. All these birds breed very well and possess the most luscious meat that ever graced the gravy. But as for the runt—someone with a sense of humor named him, for this little fellow weighs between two and one-half and three pounds and looks like a good-sized chicken. When he lands on the roof the plaster cracks!

Probably the most popular family of pigeons are those known as the tumblers. The name comes from the characteristic method of flight, an occasional flip-flop while flying about. It has been said that aviators learned the technique of looping the loop by studying this pigeon's antics. How the bird learned to do it is quite a mystery. One theory is that originally these pigeons were kept in tight confinement for considerable lengths of time, and being so frisky upon liberation they zoomed and zipped with reckless abandon. It is claimed that birds similar to these amused the Pharaohs of ancient Egypt.

At any rate, this has little to do with the present-day tumblers, for they are all bred to show-standard rather than for flying purposes. The group has two major divisions, clean-legged and muffed.

The clean-legged are not particularly striking but are very gentle, hardy, and excellent breeders. They come in a variety of solid, mixed, checkered, and barred colors. Some have white heads and are known as baldheads (like the bald eagle), and some have a white neckpiece and are descriptively called "beards." All have ball-like heads and white eyes.

But the muffed tumblers are a remarkable group. Their natural beauty is augmented by elegant muffs, or pants, of feathers that completely cover their legs and toes. The thick feathers in these muffs often reach the surprising length of four inches. The muffs have a circular form, tapering off to the rear, thus giving this handsome bird a most streamlined appearance.

I have often had folks inquire as to whether these heavily feathered birds suffer from heat in the summer, and likewise, how do the other varieties fare in the chill of winter. Never yet have I seen a day too hot or cold for an adult pigeon. On days when my fingers would freeze tight onto the doorknob, or on days when I would be melting slowly into the shimmering heat vapors, I have watched my pigeons wooing, cooing, and chewing just as violently and ardently as their little constitutions would allow.

A pigeon's tight coat of hard, smooth feathers, lined with flannel-like down, is such an example of perfect insulation that I doubt they greatly appreciate the difference between hot and cold weather. Because of this, pigeons can exist in any climate suitable to man.

There are others of the pigeon world who are true acrobats in no mean sense of the word. Take the parlor tumbler, for instance. These birds are no good at flying, but place one of them on the floor and he will somersault his way twelve feet across the room.

Then there are the rollers—nothing special in looks, but can they shake a mean wing! A kit (about 20) of these pigeons will circle about for great lengths of time, flying a few hundred yards, then falling into a fast, tight roll for perhaps a hundred feet, spinning so rapidly as to look like a large doughnut gliding through space.

When stamina is desired, look to the tippler, a very plain pigeon, quite small in size but not in fortitude. This bird will take wing in the gray hours before dawn, rise to such heights as to be visible only with a field glass, and fly continuously until long after the sun has set. In fact, the North American record is seventeen hours, eighteen minutes of solid flying. This was accomplished in Canada where high latitude gave a long period of daylight. Even then the birds were forced down by rank darkness. The "pigeon calories" expended in an endurance contest like this must be a prodigious item indeed.

Calories remind us of feeding, and before I forget I would like to tell you about Jack. He was a monstrous, jet-black "mutt" of heterogeneous ancestry, ugly as sin and tough as nails. He was the first youngster I ever raised, and, because his parents mysteriously vanished I had to complete the last two weeks of his weaning by hand feeding. These trying circumstances of his own youth affected him, I think, for he always had a soft spot in his heart for all baby pigeons. Even after feeding his own young, which was no simple job itself, he would sneak furtively about the loft feeding every other youngster he could get at. He did this in violation of the "pigeon property rights," and received many a violent peck and cuff by outraged parents who would brook no interference in their domestic affairs. It was quite touching to see this battle-scarred old buzzard tenderly feeding every squalling baby in sight, and he was so proficient as a nurse that I had occasion many times to put young orphans in his nest, so that often he was caring for as many as four squealers in his own nest, in addition to this free-lance work.

One day after his mate died, Jack's

wild ancestry asserted itself and he flew the coop. Occasionally he would return and look around to see if any youngster was hungry. I like to think of him now as flying about the hidden nests of the street pigeons, seeing that none of their young, who really have a hard time of it, are in want.

On acrobats again, another one, rather new to this country, is the Oriental sharpshooter. This bird must be kept in a loft with a very large opening, and in a place free from obstacles. The trainer enters, touches one of the inmates, who immediately takes off and flies steadily upward until it is a mere speck in the heavens. After a while the trainer signals to the bird by waving a large cloth or other object. At this point the pigeon simply folds his wings—and plummets downward! Now, a pound and a half of dead weight falling from such a height soon reaches the point of maximum velocity, and this dive is so fast as to cause a shrill whining sound like a speeding shell. A short distance above the loft the pigeon opens his wings, backpedals violently, and, still speeding at a great rate, bursts into the coop, lands on his perch—and sits as if in a daze. Well—who wouldn't?

Speaking about birds from the Orient brings us to the Oriental frills. These dainty little fellows are without doubt the most beautiful of pigeons. Being largely white in ground color, their wings and tails display some of the rarest color effects to be found in Nature. The very edges of the side feathers are trimmed with deep red, black, blue, silver, or bronze, while the main portion is almost a pastel shade. The twelve large tail feathers are generally slate blue, but each one, a little bit in from the end, is marked with a large square of white. When the tail is spread, this forms a perfect white arc and is known as a "moon tail." The eyes are ruby red, and the bill is very small. A peaked feather crest rises jauntily to a sharp point at the back of the head. The plump little chest displays a mass of daintily curled tufts, making as neat a ruffle as anyone could ask, while the aristocratic little feet are "stockinged," or groused, as pigeon men say, meaning that the limbs and toes are covered with thick, short feathering. Now, put all that together, add a dash of arrogance, and you have the Oriental frill. Even the names of the varieties—Satinettes, Blondinettes, Blue-laced Silverettes—conjure up images of beauty.

In this same group, being somewhat similar in general but lacking some of the crowning glories of the frills, are turbits, and Chinese and African owls. All these birds are supposed to have originated in Africa and the East.

The fantail is very popular and justly so. This neat little ball of feathers with its great fanlike tail is a product of Scotland. It is quite a sight to see these graceful dandies pose for the judge—chest thrust out, head back to the base of a glorious "fan," and dancing daintily on tiny tiptoes in a manner which recalls to mind minuets and pompadours.

But talk about primpers! Take a

look at the pouters—from the pygmy to the big Bohemian. Pay these fellows the slightest attention and puff, up goes the chest with its swelling crop full of wind. He puffs and he blows and grunts and groans until his eyes pinch shut and he seems nothing more than a tremendous globe of air balanced upon two long, jittering, stockinged legs. Just give him a wee bit more attention and it goes to his vain head so much that he inflates even beyond capacity. At last he topples over backwards, and with a vast sigh the wind escapes from his crop like a punctured balloon, while you are transfixed with a morbid eye. Alas, pride hath its fall!

Other pigeons that puff and blow are the trumpeters, English and Bokharan. Instead of retaining the air and assuming balloon-like proportions, they expel it noisily and sound for all the world like a trumpeter practicing on a bass instrument.

There are countless others: the bronze Archangel; the jacobin, whose head and neck are adorned with such a tremendous array of curls that its eyes are all but hidden; nuns, with their hoods; Ice Pigeons covered with a coat of blue powder; gaunt, lanky magpies; stubby Hungarians; giant Kangaroos; Duchesse; Modenas; Lynx; croppers; Priests; swifts; swallows; Helmets; and so on down the list. Over 130 individual varieties to choose from! Even the most pernickety pet raiser can find at least one type that pleases him completely.

And all this is a vast tribute to the science of selective breeding. Every last one of these varieties originated from a common progenitor, the blue rock dove *(Livia livia)* of Turkestan. Of course it is to be understood that all these types were not established at once nor by the same methods. From the original ancestor no doubt many branches were produced by Nature herself through her processes of natural evolution and mutation. Then these types, and others as they were evolved, were worked upon down the centuries by their domesticator, man, until by the process of planned evolution the present strains came into being. By this theory all pigeons are descended directly or remotely from the blue rock dove. Proof of this is often evident when fanciers attempt to establish a new breed.

For example, a fancier mates a muffed tumbler with a jacobin and calls the product a "muffed jacobin." The bird lives up to its name in that it is both muffed and crested, but the muffs are smaller and inferior to those of the muffed parent; and the crest likewise. This new hybrid can hardly be called a "breed" until many generations of careful, planned line- and inbreeding have elapsed and these outstanding characteristics become somewhat fixed. If this is done it is quite possible to produce a new breed.

On the other hand, if genetic science is not employed, the evidence of blue rock ancestry is quickly seen. In a few generations the colors and other characteristics that were the pride of the hybrid's parents fade away until all the offspring begin to look like the ordinary street pigeon. This common pigeon can hardly be called true *Livia livia* but is quite the nearest thing to it in the modern world. This "backsliding" has been the downfall of many careless fanciers, for if even the most highly specialized stock is allowed to breed indiscriminately it will quickly revert to this original ancestor.

Now that you have become a walking encyclopedia of pigeon lore perhaps you would like to try your hand at the game. Pigeons can be raised if for no other purpose than the fun of it—and goodness knows we could use a little fun today. From personal experience I can guarantee there is nothing like stepping into a loft full of softly cooing doves to alleviate any case of "headline horrors." You'll be amazed how the hours and the worries slip away as you quietly watch the feathered inhabitants busily cope with

their own tremendous affairs. A perfect prescription!

The more technically minded will find pigeons an excellent medium for scientific experimentation, especially in breeding. Pigeons can easily produce two generations annually, and the birds are less trouble than most laboratory animals, making fine pets in the bargain.

The United States Army is also trying to develop a night-flying homer; and among civilian experts a hot debate is continually in progress concerning the effect of radio waves on the ability of homing pigeons. In one case, a Canadian fancier claims to have liberated some of his birds beside a broadcasting station early in the morning before transmitting activities began and observed them to go immediately home. Later in the day, when the radio signals were being sent out, he repeated the experiment with the same birds and found that they would do nothing but circle near the transmitting tower until a slight break in broadcasting (which the fancier was checking with his auto radio), when the birds broke for home. This field alone offers considerable material for interesting experiments.

And then pigeons may be raised for racing or exhibition. There are many large, national organizations* fostering these activities, which are only too anxious to help the novice get a start. Not wishing to cast any reflections, I believe I can say from experience at pigeon, dog, cat, poultry, and other livestock shows, that pigeon fanciers are by far the most co-operative and friendly with the beginner. At a dog show at which I recently exhibited I saw a perfectly respectable, dignified lady, whose dog was unplaced by the judge's awards, favor the judge with that well-known "cheer" which originated in a New York borough. It's a small item but it is something that wouldn't happen at a pigeon show.

Because of this co-operative spirit, I would advise obtaining your birds from a breeder recognized in the field you are interested in. He will be only too glad to help you in every way possible, while a regular poultry dealer is somewhat inclined to be more interested in what's in your pocketbook.

And this brings up the subject of prime importance—the price. If you want pigeons just for the sake of having pigeons, you can pick up some individuals for 25¢ apiece. If you want the very best, I recall that a bird not too long ago brought its owner $7000.00. However, there are a few prices between these extremes, and I believe you will find some very nice stock birds of racing, exhibition, or breeding type between $5.00 and $10.00 a pair.

The only other expense item is grain, and this is very reasonable, costing but 2¢ or 3¢ per pound in 25- or 100-pound quantities.

Pigeons are best kept in a roomy, draft-proof but well-ventilated loft, which can be located anywhere from a dry cellar to a penthouse roof, including the fire escapes on the way up. Cleanliness is easily maintained by keeping an inch or two of coarse sawdust or shavings on the floor. If this floor covering is raked weekly and renewed occasionally there is absolutely no detectable odor. This is a wonderful asset in keeping the neighbors kindly to your pets.

While most cities have different rulings, some authorities can prohibit pigeon raising in congested areas. This usually occurs, though, through the fancier's own fault, for his charges should be of general interest to his community. In the case of a crabby neighbor, the raising of a few racing homers is recommended, for these birds are under the protection of the War Department, and military authorities are often willing to put in a good word with the local officials.

If you raise good racers, by all means join a nearby racing association and enter your champion in one of their meets. The races vary from 25 to 600 and more miles, and the competition is enlivened by prizes and pools.

If you have purchased good show stock and bred them true, you should exhibit at any of the nearby fairs or poultry or pet shows. At a recent Boston show there were over 1300 pigeons in competition, some having been shipped from as far away as California.

If you can go to a pigeon show and not come out bitten by the bug, you are positively superhuman. In the vast, well-lighted hall you will see countless long rows of uniform, individual cages, each containing a breeder's masterpiece out for class prizes, silver trophies, group prizes, or the coveted "Best in Show." Here, before a larger cage stands a judge, a veteran of the game, studying a class of yellow fantails. With his peculiar, telescoping judging stick he gently prods one little hen, and up she dances on dainty tiptoes, posing. Outside the fenced-in area stand the anxious owners, forbidden to speak to the judge, nervously awaiting

the great man's decision. They have every right to be anxious, for some of them have devoted a decade to the scientific breeding that has culminated in one of these lovely little balls of feather.

The steady rippling undercurrent of muffled cooing that floats through the hall is broken by a startled whir of wings and exclamations of spectators. A clumsy attendant has let a prize baldhead tumbler get away from

*For example, the American Pigeon Club (Richard Whitney, Secretary-Treasurer, 40 Wales Street, Dorchester, Mass.), and the American Racing Pigeon Union (Edward Barnes, Secretary, 214 Congress Street, Jersey City, N. J.).

him. Its owner hastens over and with a soft, musical whistle coaxes the excited pigeon down from the glaring lights, to the amazement of all the uninitiated.

Over here, behind this column, two perspiring, shirt-sleeved men are frantically giving their entry a last minute grooming. A silk cloth rubs a sheen on its feathers, a pinch of powdered chalk whitens its wattle, a nail file trims its bill, a dab of Vaseline adds luster to its legs; and one of the men furtively pulls a tiny pair of scissors from his vest and furtively snips some off-color feathers from the pigeon's head. These fanciers think that champions can be manufactured rather than bred, but their error will show when future generations turn up with all the faults that are being hidden now.

When we return to our own protégé we find that the kind, wonderful judge has honored him with a blue ribbon! Thrills? Say, meet me at the next show!

This love for pigeons is nothing new, for pigeon racing has been one of man's hobbies and businesses ever since he clambered down from the ancestral tree. Pigeons are mentioned in Genesis; they were common in Babylon, Egypt, ancient China; in fact, the whole wide world. Princes and potentates have spent fortunes on elegant lofts, while beggars and paupers have shared their humble hovels with their feathered friends. Pigeons have been with man in peace and war. It is even rumored that one of the Pilgrims smuggled a pair of pigeons over to Plymouth Rock; so if some pigeon strutting along the street seems extra cocky, don't be surprised. No doubt his ancestors came over on the Mayflower.

An Invitation

TO LISTEN TO NATURAL HISTORY RADIO PROGRAM

Friends of the American Museum of Natural History and all who are interested in exploration and natural science are invited to listen to a new radio program on alternate Saturdays through the winter. A coast-to-coast hook-up over the Blue Network of the National Broadcasting Company will carry these dramatizations. The title of the series is MAN AND THE WORLD.

The program schedule is as follows:

Alternate Saturdays from 8:15 to 8:30 p.m., E. S. T.

Nov. 2: "Defying the Depths"—The story of a diver who became a guinea pig. From an article by John D. Craig.

Nov. 16: "Capture of a Rhineodon"—The story of the exciting capture of a gigantic whale shark. From an article by E. W. Gudger.

Nov. 30: "Jungle Magic"—A true story of black magic in the Ecuador wilderness. From an article by Richard C. Gill.

Dec. 14: "The Story of Spices"—How spices founded empires and led to the discovery of new worlds. From an article by Virginia S. Eifert.

Dec. 28: "New Guinea Adventure"—An airplane expedition to a stone-age world. From an article by Richard Archbold and A. L. Rand.

Jan. 11: "Civilization and Sudden Death"—A jungle expedition finds no high blood pressure among Indians. From an article by William Hall Holden.

Jan. 25: "The Congo Peacock"—A mysterious feather plucked in the Congo started a 7000-mile bird hunt. From an article by James P. Chapin.

Feb. 8: "The Ocean Gladiators"—Mr. Swordfish turns the tables on fishermen. From an article by E. W. Gudger.

Feb. 22: "The Story of Fire"—The influence of fire on man's march from caves to skyscrapers. From an article by Virginia S. Eifert.

Mar. 8: "The Nature Trail"—The greatest naturalists have been amateurs. Story of Audubon. From an article by Donald Culross Peattie.

Mar. 22: "Black Knights"—A mystery of shiny medieval armor in darkest Africa. From an article by L. C. Thaw and Margaret S. Thaw.

Apr. 5: "Medicine Bones"—Fossil hunters in China's drugstores. From an article by Walter Granger.

Apr. 19: "The Story of Paper"—Paper was man's passport from savagery to civilization. From an article by Dard Hunter.

The Hands of
OSA JOHNSON
First Lady of Exploration

Osa Johnson and her husband Martin won world honors for their camera record of vanishing wild life, during 27 thrill-packed years in Africa, Borneo and the South Seas. Her book and motion picture, "I Married Adventure," tell of those years. Now Osa Johnson carries on, and the good wishes of millions will follow this little lady with the strong heart on her first safari to the jungles, alone.

Osa Johnson's watch is a Longines Coronation

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BONE-DIGGER IN A LOST WORLD

How George Gaylord Simpson gathered new evidence of South America's much disputed geological history and rescued some of the earliest animal ancestors from oblivion

By D. R. Barton

When Sir Arthur Conan Doyle deserted the narcotic atmosphere of Holmes' Baker Street residence for a South American pipe dream involving resurrection of the Age of Reptiles, he opened up a fictional vein that has yielded almost as handsomely as the "discovery" of canals on Mars.*

Since the publication of *The Lost World,* popular interest has readily attached itself to expeditions routed for South America. One merely has to hint darkly that the expedition is to penetrate unexplored territory *cut off* from the surrounding region. The public reacts instantly and hopefully: Sir Arthur's Lost World is surely going to come into its own. At long last, living tyrannosaurs will rear and grimace in the local zoo, and the prehistoric animal halls in our larger museums will promptly go out of business.

Repeated disappointments apparently do not shake this hardy faith. When the expedition returns without living dinosaurs, the public simply turns away in supreme disgust and waits to pin its hope on the next band of adventurers bound for the land of gauchos, the tango, and W. H. Hudson.

Yet, like many myths, the Lost World has its basis in discernible fact, and it was not by sheer whim that Sir Arthur set his locale in the southern part of our hemisphere. Long, long ago, before even the mighty Andes had arisen, South America was indeed "lost" with respect to the remainder of our planet. Some think it slid away from Africa, others regard it as having been attached to Antarctica, still others to Australia Moreover, there was some dispute as to whether this orphan continent consisted not of one but two separate islands, which would have given it a double advantage in the role of Lost World, since insulation is the primary requisite for the development of anything resembling Sir Arthur's weird animal characters. These, like their setting, are not altogether divorced from fact. Even today the living fauna of South America is, with the probable exception of highly insulated Australia's, the funniest on earth—funny, that is, because it doesn't look like anything we're accustomed to. Though there are many other features in South America's distinctive fauna to attract the specialist in living mammals, its peculiarity results largely from the survival of living fossils like the anteater and the armadillo. Such creatures have survived unmodified, or practically so, from an ancient era, whose life we can ordinarily reconstruct only from bones.

Bachrach Photo

George Gaylord Simpson

Animal necrology

One of the principle aims of an investigation of this remote age has to do with discovering the rightful parents of this orphan continent. There remains so little purely geological evidence bearing on the matter that the burden of proof falls largely on the paleontologists—those bone miners who have served so well as our special correspondents to the unknown past. Gradually and by dint of endless labor, far exceeding anything the public generally imagines, these patient men, working in many parts of the world, have been closing in on the great "detective story" of the earth.

With South America, the story is too long and complex to be lumped into a general summary, and it is by no means finished. As far back as 1898 Barnum Brown, now Curator of Fossil Reptiles at the American Museum, made the first collections this institution had secured from the wind-lashed badlands of Patagonia. And as recently as the last decade, George Gaylord Simpson led the two Scarritt Expeditions to these same wastes, braving a revolution, a homicidal cook, and the appalling Patagonia climate in order to broaden our knowledge of historical geology and to bring back specimens of a long dead fauna, little-known or new to science. These expeditions, together with a third one, made by Doctor Simpson last year to Venezuela, have helped to settle the question of South America's origin.

Three principal questions had been raised. (1) When did South America become "lost," that is, disconnected from any other mainland? (2) With what land-mass had it formerly been connected: North America, Africa, or Australia? (3) Once disconnected, did it become one or two islands?

The evidence accumulated by Simpson indicates that the connecting land bridge broke down at the end of the Cretaceous, or roughly 60 million years ago. And when his fossil specimens were compared with all pertinent material previously collected, there seemed small likelihood that the extinct life of South America bore sufficient relationship to that of Africa or Australia to qualify either as the continent of origin. The evidence pointed to North America as the original sister continent of South America. Nor did Doctor Simpson find much to support the hypothesis that South America consisted of two islands. The supposed

* See "He Brought the Stars to America," by D. R. Barton, Natural History, June, 1940, p. 59.

northern "island" (Venezuela, Colombia, etc.) has apparently always been a legitimate part of the southern continent.

From a superficial viewpoint, then, nothing much seems to have happened. South America didn't slide away from Africa but was connected by a land bridge to its northern neighbor, which, of course, is the situation today.

Through discoveries far more penetrating than these seemingly simple facts, the career of George Gaylord Simpson already indicates a knack of wading into a mass of contradictory data and emerging with something reasonable, clear-cut and carefully though unpretentiously documented. At the age of 25, he had become the world's outstanding authority on the incipient mammals of the Mesozoic, those strange shrew-like creatures which all modern mammals, including ourselves, should revere as ancestors. So far-reaching was his clarification of this ancient group, that many colleagues regard intelligible Mesozoic mammalogy as having started with Simpson's two-volume monograph on the subject. Yet the man himself deprecates this and other achievements. He has seen no evidence that anything really begins or ends with an individual. Scientific progress, like the universe itself, is probably a continuum, and he believes it safe to say that no one person ever invented anything.

Doctor Simpson's predilection for simplicity goes back to college days at the University of Colorado, where he took up the study of geology for no loftier reason than that it was reputed to be easy. But under the stimulating persuasion of a great teacher he was soon neck-deep in the science and vainly thumbing the catalogue in search of advanced courses in the allied field of paleontology. Eventually this quest led him to the city of New Haven, seat of the Peabody Museum of Natural History, and incidentally of Yale University, in which he enrolled, a bit late for tap-day, as a senior. He managed to make the acquaintance of perhaps twelve classmates before commencement. But the purpose of his transfer was not "contacts." Simpson entered the graduate school and staked out a scholarly prospector's claim on the Mesozoic mammals which, with the aid of a National Research Council fellowship, he mined so thoroughly that he had to abandon it for lack of new specimens.

For all the wealth of living specimens to be studied in South America, Simpson wouldn't think of changing places with the student of modern animals. He has a genuine affection for his small, not too clever, and markedly unspecialized friends of the Mesozoic and their immediate followers, whom no man ever saw or ever will see, but whose fragmentary bones have been organized into an orderly scheme of life through his efforts. The student of extinct fauna is like a historian, tracing known phenomena back to their source. Simpson delights in looking backward. By following the development of a large number of species through a million years or so, he feels he is really getting his teeth into the broad pattern of evolution.

After completing his investigations of the Mesozoic mammals, Doctor Simpson turned his attention to the far more numerous mamals which followed in the succeeding era. From the evolutionary standpoint, these long-vanished creatures afford fascinating study. In that dim age, they were trying out the many uncultivated talents with which Nature had endowed them. Jacks-of-all-trades, they could climb trees fairly well, or run on the ground. They ate practically everything and, like a crop of young internes, were just beginning to think of specializing. As time went on, a few emphasized meat in their diet and gradually acquired the nascent characteristics of our modern carnivores, others set out on a vegetarian career to become ungulates or hoofed animals, while some not too distant relatives were taking to the trees as monkeys or to the waves as primitive whales and porpoises. And when these strains began to make their appearance there was, in the words of the late Doctor Matthew, "a more or less marked increase in the size and complexity of the brain, which correlates the various activities of the animal, and corresponds to the switchboard of a telephone exchange, indicating by its size and complexity the growth and elaboration of the organization that it controls. This growth of the brain culminates in man, and from this viewpoint it justifies his claim to represent the highest stage in the upward progress of life, as he is the latest to appear in geologic history and the most completely dominant type known in the history of life."

Lesser men might hesitate before attempting to penetrate these early mysteries in the long chain of events leading up to Man. But no one who reads Doctor Simpson's chronicle of the dawn-horse on page 194 of this issue can doubt the fascination of the adventure, or brand as a dismal science that exercise of the mind which leads from a single tooth to reconstruction of the creature in its entirety.

Yet here is no royal road. The formula $i\frac{0}{3}, C\frac{0}{0}, P.\frac{3}{3}, m\frac{3}{3} \times 2 = 30$, taken at random, gives some idea of the baffles that block the layman's innocent entry into the literature of paleontology. But to Doctor Simpson or any other worker in the field, it is merely an ordinary dental formula succinctly describing the tooth arrangement of some long-dead animal. And since form, size, and arrangement of teeth tell, among other things, what kind of an eater and fighter the animal was, the formula is of the utmost importance. So are the many other more complex mathematical measurements and descriptions, with the result that the technical paper is frequently a bristle of figures. Sometimes, indeed, the bristles obscure rather than reveal.

This regrettable fact offended Simpson's penchant for simplicity to the point of goading him into collaborating with his wife on a mathematical handbook for all types of biologists, called *Quantitive Zoology,* which showed his colleagues how to reduce the bristles to a meaningful minimum. This work has been hailed as a unique contribution to scientific methodology and is expected to prove a deterrent to the plethora of "illogical and non-unit measurements" compiled into "long tables . . . that prove nothing and the publication of which was unnecessary, expensive and really a discourtesy to other students."

In the field

But paleontology cannot be conducted exclusively within the confines of library and laboratory. It is fundamentally an exploratory science and when, in 1930, Doctor Simpson discovered a generous patron in the person of Mr. H. S. Scarritt, he lost no time packing up field equipment and double-strength tents to fend off the Patagonian winds, and soon he was aboard ship bound for the Argentine, where he came face to face with the perils not of the wilderness but of civilization.

Within a few hours after landing at Buenos Aires he was literally in the thick of a revolution. In trying to make his way about the city, he found street after street barricaded or buzzing with richocheting bullets. Once

under a particularly heavy burst he took refuge in a doorway with a very dignified civilian patriot who suddenly drew out a gun and advanced around a corner of the building. A moment later, Simpson stepped out cautiously and discovered all that was left of his erstwhile companion—a high choker collar in a pool of blood. In another place a man was sabered before his eyes by the local brand of Cossack.

The populace had gone crazy. Simpson dodged his way from shelter to shelter nearly always falling in with a few non-belligerent souls similarly engaged. One terrific splatter of machine gun fire turned out to be the work of a carefree civilian who had broken into an arms shop and was simply putting the gun through its paces for the fun of it. As matters went from bad to worse, Simpson was in constant dread of being accosted. At this time he was only beginning to learn Spanish and he feared that his accent would be deemed an excuse for immediate execution. Finally he was waylaid and very nearly executed, but in the end his antagonist contented himself with a few spine-chilling jabs of a gun barrel and sent him on his way.

After this introduction to the Argentine, usually a quiet oasis in a revolution-minded continent, Simpson was prepared for anything. But, undaunted, he got his expedition together and sailed down to Patagonia. This barren country, first explored scientifically by Darwin on the cruise of the *Beagle* and celebrated in story and legend, may possibly derive its name, "Land of People with Big Feet," from the envious respect in which the early Spanish explorers held the pedal extremities of the aborigines. These Latin adventurers, like their successors today, were small men with small feet (contemporary Nordics experience some difficulty in getting South American shoes large enough to fit them), and they exaggerated the size of the "giants," even now popularly but erroneously supposed to inhabit Patagonia. These Indians rarely ranged much above six feet in height, as has been proved by the archaeological record, and were probably at best no taller than certain contemporary African tribes.

Nowadays, apart from some oil fields which have been developed by the government, the country is a sort of collective ghost town left in the wake of what was once a wool-raising bonanza. The surviving sheep-herders are penniless and occasionally slovenly a few surpassing the degradation of our own denizens of *Tobacco Road*. Simpson found that only the exceptionally stolid, unimaginative type withstood the cheerless squalor of life in that bleak land, where the velocity of the wind can actually keep a modern airplane at a standstill and force a man to crawl on his hands and knees. The country is filled with people who came to get rich quickly and stayed to disintegrate slowly when the ill-starred wool boom vanished. At any rate, if much of Patagonia is destined for some time to be an undeveloped frontier it can render great service to the world, as Simpson has demonstrated, by remaining a sort of safe deposit vault for fossils, yielding its treasures to anyone who takes the trouble to learn the combination.

How true this is, Simpson proved by the abundance of theretofore unsuspected mammals, reptiles, and birds which he rescued from oblivion, some of which can be seen in the Museum today. Perhaps these will seem tame enough to readers of the *Lost World,* and certainly they lack the fearsome mien of the more terrible dinosaurs, but they will find a fit audience among avid followers of each succeeding installment in the long serial of evolution.

As to the dinosaurs, they impress by immense size. Simpson is as much awed as the rest of us but he sees in them an end-product. They represent the full flower, the maximum achievement of a particular line of evolutionary development, the end of a story. And what has always interested Simpson is the beginning, the first discernible laying down of the plot, the first hints of things to come. Moreover, the sheer f. o. b. bulk of the dinosaurs makes their collection an expensive and hence exclusive hobby. Simpson calculates that he has gathered all his little friends among the early mammals for the price of one complete edition of *Tyrannosaurus rex.*

With pick and pen

In sorting over the Patagonian spoils, Doctor Simpson brought his simplifying powers to bear upon the nomenclature and classification of these ancient mammals, for which task his paleontological colleagues acknowledge a debt of gratitude. But his reputation as a penetrating observer has reached even the portals of the anthropologists. On his recent expedition to Venezuela, he was commissioned to study a previously uninvestigated Indian tribe and has just dispatched the resulting manuscript to a publisher.

Little attention has here been paid to Simpson's colorful experiences in the field. But this lack has been amply filled by his own hand. For Doctor Simpson writes extremely well and indeed entered college determined to become a man of letters. That was, of course, before he took up geology as a soft touch. Furthermore, he has left his literary mark on the University of Colorado, where he started a periodical of *belles lettres* and the College's humorous magazine. The name of the latter publication, The *Dodo,* might suggest that even then his muse had begun to fossilize, but it can perhaps more accurately be taken as indication that dry wit lasts longest.

His pen, if not mightier than his pick, has brought him a good share of fame. Out of the field diary of the first Patagonian expedition blossomed *Attending Marvels.* This book, which owes its somewhat mystifying title to Herman Melville, has just about everything one could ask for in a popular narrative of exploration. Characters, incidents, and locale are faithful to life, yet set down with the grace and wit of a top-flight novelist. No prior interest in Patagonia or paleontology is required. The author compels a delight in both from the first chapter on.* Among the high spots are robust and frequently unconventional observations of life in a frontier society—the brawls, the dietary delicacies (e.g., sheeps-eyes), the customs and taboos—as well as personal sidelights, such as the author's confession of having made many a good meal (while failing to collect a single specimen) of a species of fish later found to be undoubtedly new to science.

Although it is six years since he has set foot in Patagonia, Doctor Simpson still enjoys the camp-formed practice of drinking maté, a South American beverage vaguely akin to tea but considerably richer in stimulating alkaloids. We can only hope that the brew may one day inspire him to write the story of his second expedition. One attending marvel certainly deserves another, or rather several others for, granted an amelioration of the world's affairs, many fruitful years of exploration, research and illuminating popular summary may confidently and justly be expected of him.

* Three sections of *Attending Marvels* have appeared in NATURAL HISTORY Magazine; "Children of Patagonia," November-December, 1932; "A Day in Patagonia," March-April, 1933; "Patagonian Oasis," October, 1934.

SHOOT THE CLOUDS

Continued from page 190

effect may be achieved by adding a polarizing filter to the red filter. As a final effort in separating a faintly blue sky from a white cloud, infra-red film with a red filter will produce the maximum darkening of the blue. So strong is this combination in resulting contrast that on the brightest day it is often possible to take a scene which in the finished print resembles moonlight.

Thus the use of infra-red film in ordinary cameras offers the enthusiast the opportunity to make some highly unusual pictures. The film may be obtained in several of the more popular roll film sizes and used in any camera that has a f:5.6 lens or larger. Almost any red or orange filter may be used. Inasmuch as the eye cannot see infra-red light, nor, for that matter, does the exposure meter react to it, no way of gauging the exposure can be suggested except by trial and error. However, in bright sunshine, an exposure of 1/25th second at f:5.6 with a red filter will produce an acceptable negative.

Cloud formations made with infra-red film show an amazing amount of fine detail around the edges of cirrus formations. Heavier clouds such as stratus and cumulus clouds look imposing indeed when shown against a very dark sky.

Negatives made of such cloud formations may be held against the sky portion of a landscape negative and both printed or enlarged together. The clearness of the sky background in an infra-red negative makes it easy to print through the two at once, resulting in an interesting combination print, in which clouds have been added to enhance a sky deficient in this respect. Be careful that the light direction on the clouds and on the landscape will be the same in the finished picture.

Why not try some cloud pictures? A good collection of cloud negatives is not only interesting from a meteorlogical point of view but forms a most useful series of available clouds to put into the blank sky of an otherwise perfect scenic view.

LETTERS

Continued from page 189

to a height of 400-500 feet, as compared to "over 350 feet" for *sempervirens*.

JAMES J. PATES.

Batavia,
Netherlands Indies.

Four scientists out of five questioned by NATURAL HISTORY denied that the eucalyptus can claim greater height than the redwood, and L. H. Bailey's *Standard Cyclopedia of Horticulture* says of the tallest eucalyptus *(E. amygdalina* var. *regnans)*: ". . . 325 ft. or less high. . . . Earlier reports of 400-500 ft. for this tree were erroneous . . ."—ED.

* * *

SIRS:

I am writing to ask if the excellent article, "Hawks Aloft," by Richard H. Pough can be had as a separate article in pamphlet form.

I met a stubborn man in Montana who thought that all hawks were harmful. I didn't make much headway with him, but if anything could convince him to change his opinion, Mr. Pough's article might do it. . . .

JOSEPHINE COLGATE.

West Orange, N. J.

* * *

SIRS:

Would you be able to send me another map which accompanied the article, "Hawks Aloft," in the October issue?

ANDREW R. MCCOWN.

Philadelphia, Pa.

NATURAL HISTORY Magazine regrets that no reprints of the article itself are available; but a very limited number of the pictorial chart which accompanied it are procurable at 10¢ each.

The five other charts which were offered for special sale in the October issue of NATURAL HISTORY were all asked for within a few days after the magazine appeared. However, a few copies of the conservation map, "S.O.S. for a Continent" are still available at 10¢ each; also "Cycle of Life" at 5¢.—ED.

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SIRS:

On glancing over the fine chart, "American Birds of Prey," in the October issue, I should like to offer the following additional information.

First, concerning the peculiar feature of the beak of all falcons, which is commonly called the "tooth." According to the chart, it enables the falcon to cut its food. May I add that it also makes possible the manner in which falcons kill their prey? This method is not generally known. It consists in the falcon's gripping the spinal column of its prey between the tips of the upper and lower mandibles of the beak and bending the head sharply to one side. This is done by wild and vigorous birds with a decided snapping action, which may cause the head of the prey to shoot off to a considerable distance. I have had occasion to observe this once when trapping falcons, and several times to a lesser degree with tamed falcons. My interpretation of the tooth, then, is as a non-skid projection preventing the neck vertebrae from slipping during this snapping process.

My other point concerns the measurement of the prairie falcons, male and female. The idea that both have the same wingspread is absolutely wrong, and is due I am sure to lack of data. It will be found, I think, that there is at least as much difference in the prairie falcons as in duck hawks. I have not measured their wings but have weighed them. The results are that usually the males weigh about a pound and the females slightly less than two pounds. Unless something is wrong, this should mean at least a five-inch difference in wingspread.

WILLIAM F. RUSSELL, JR.

New York, N. Y.

NATURAL HISTORY is grateful to receive this information from Mr. Russell, who is the author of the recent book, *Falconry—A Handbook for Hunters*.—ED.

APPOINTMENT

Dr. James P. Chapin was elected President of the American Ornithological Union at its fifty-eighth annual meeting, held at Boston in September. Doctor Chapin is Associate Curator of Continental Old World Birds in the American Museum of Natural History.

 Continued from page 219

the anticipation of at last seeing Kano, the rival, in my imagination, of Timbuktu.

The great Sahara lay entirely to the north of us now, a memory of heat and hardship that sharpened our appetite for the greener, equatorial lands ahead. We were skirting the vast basin of the Niger River, and when we crossed the border into Nigeria at Jibia the roads became better, though the heat continued. When we arrived before the high clay walls of Katsina, I thought we had reached my long awaited goal, Kano, only to be told that we still had 108 miles to drive.

The next morning we entered this most extraordinary native city, a city which takes the visitor instantly under its spell and carries him in imagination back through the colorful history that is its background. Everything about Kano fascinated me. Built centuries ago, the city is surrounded by a deep moat and crenelated walls, sometimes 40 feet thick. Its ancient Hausa founders left vacant areas for future growth and to serve as farmlands in case of siege. It covers so much ground that a small lake, the Jakara, and a hill or citadel over 100 feet high known as the Dala, are contained within its walls. These walls, reaching a height of 50 feet, are between twelve and fifteen miles long and are pierced by thirteen or fourten gates, each of which is in charge of a special keeper. The "Gate of Swords," the "Women's Gate," the "Gate of Horses," are a few of their picturesque names.

Although Heinrich Barth, the German explorer, made an extended stay as early as 1850, and visitors have come to Kano in increasing numbers since the British overcame the Emir Alieu in 1903, whites are still objects of curiosity. Indeed, our presence attracted such crowds that Sergeant Adamu Kura, who regards himself as king of the market place, provided us with barefooted police guards, strapping men in uniforms of long red and blue coats, full white trousers, high turbans, and striped belts with metal buckles. We needed and appreciated their services for the floating population is immense and the market was an agitated, swaying mass of dark humanity. Even before 1911, when Kano became the northern terminus of a railway connecting it with the coast at the Gulf of Guinea, the city was the seat of an emir, and the principal commercial center of Kano province. The population of this province, mostly Mohammedan, numbers over 2,500,000 souls, belonging to distant races and speaking different languages. Sooner or later all these people find their way to the city of Kano and its great market, which spreads over many plazas, into the streets and beyond the walls.

As soon as we passed through the gateway nearest to our railway station bungalow, we were in a strange, black world. Half-naked men and women were dipping and dyeing raw cotton goods in huge vats or cisterns filled with indigo. While we were watching them, the prying crowd was joined by Daukama, the market clown, wielding a wooden sword and hoping that his antics would be rewarded with cash from the foreigners and applause from the natives. Separate zones were occupied by the basket and belt weavers, the shrewd money lenders, the men who fashioned the red felt Mohammedan fez, the shoemakers, cloth merchants, and the traders in morocco leather, which is one of the principal products of Kano. The blacksmiths, honored because they make swords, have a hill of their own. The most beautiful booths were those in which artists sold costly, elaborate trappings for horses; but a far more active business was done by the vendors of kola or gourounuts. These seeds of a large genus of African trees of the chocolate family (Sterculiaceae) are about the size of a chestnut. They contain caffeine and are still esteemed as a stimulant against fatigue and an antidote for diarrhea. At one time entire caravans loaded almost solely with kola nuts packed in green leaves to prevent shriveling, would arrive at stated seasons to be bartered for salt, which was carried back to saltless regions and exchanged for slaves. So precious was salt, that in certain parts of Africa, it was practically the currency of the country. Now the invading whites have done away with its scarcity, but even in Kano's market place, jubilant natives devour salt at the booths, just as our children eat ice cream.

The philter and medicine shops are also very popular. Here, vulture beaks, hyena hides, alligator claws, reptile skins and antelope hoofs were on the stock list. Rare powders in queer little bags, whch rendered desert lovers irresistible, and amulets of fabulous potency were offered us. Without having exhausted their list of potions, we rambled on to examine the stands where ivory, ostrich feathers, calabashes, and provisions of all kinds were sold. Ginger, pepper, taro, leaks, tomatoes, peanuts, dates, and sugar cane were favorite commodities.

Conveniently situated near the Hall of Justice, a rather impressive piece of savage architecture, we often took refuge in the office of Adamu Kura. Here my friends Milicent and Carl Werntz, enjoyed a few comparatively quiet moments in which to pose and draw obliging models, but the inquisitive rabble outside did not grow tired waiting for us, and we were the cynosure of all eyes in a surging sea of black woolly heads as soon as we made our reappearance. Now and then a pink and white albino, or an even stranger copper-colored *bala* was seen. Hausas, with rather elongated heads and lines and dots tattooed near the mouth and nose, were in the majority. The wavy-haired Fulanis or Fulbes, with skulls also naturally elongated, were distinguishable by their pale yellowish skins, for they are not really negroes. There were Nupe women from western Nigeria, who sold nuts brought from a great distance, a few veiled Tuaregs, Yorubas with slashed foreheads, from whom many American negroes are descended, Beri men with a cross scarified on each cheek, Ibo tribesmen, Kanuri from Lake Chad, and many others with peculiar designs tattooed and slashed on their faces and bodies for tribal, decorative or curative purposes. Some day a progressive coiffeur will visit Kano and return to Europe with novel fashions in hairdressing. At twilight, when the less attractive features of the city are covered as if by a veil, when black faces and shadowy white figures melted at our approach in the embrasure of decorated doorways, and files of natives returned to their homes, the thoroughfares had an exotic beauty and took on a peculiar air of mystery.

We drove back and forth on the road between our bungalow and the city gates, losing no opportunity to steep ourselves in this alien life. The animal traders outside the walls always held our attention. This malodorous quarter was very picturesque but was no place for sensitive, squeamish noses, unaccustomed to the musky odors of Africa. Sheep and goats, great horned oxen refusing to be led to slaughter, stupendous zebus in corals, and restive, wild-eyed horses were offered by the hundred. When we wanted to escape from the babel and activity, we would follow natives

on their braying, cantankerous asses, delivering produce in to dark interiors lighted by furnaces, where anvils pounded and sparks flew; or we caught glimpses of hard-working, full-breasted women, who banged their pestles carelessly up and down, while their men were weaving belts with the help of their toes.

Such is Kano. To assimilate it all was impossible. When we learned that our road to Lake Chad was still closed by floods, we left hurriedly for Fort Archambault. This last, long drive, became an endurance test through vibrating waves of heat, over more bad roads, all the way to Damatrou. Here we slept at a thatched resthouse in the shade of another giant baobab, an appropriate, if uncomfortable place in which to reflect on the extravagant contrasts and surprises of this African adventure, which had taken us directly across the Sahara from Algeria to Nigeria and was destined to carry us eventually through the tropics, down to Lake Tanganyika and east as far as the sources of the Nile.

DO NOT MISS

From an English correspondent, Eric Hardy, F.Z.S., comes an extraordinary firsthand account of animal behavior under conditions of modern warfare. **ANIMALS IN AN AIR RAID** will tell what happens to the wild creatures of England and her surrounding waters when the sirens announce the arrival of a fresh wave of Nazi bombers.

The geographers say that an island is a body of land entirely surrounded by water. William Monypeny Newsom will show in a forthcoming article that the strange island of **ANTICOSTI**, in the Gulf of St. Lawrence, has also been surrounded by shipwreck, disaster, bad luck, and misinformation. On an expedition to it for the American Museum of Natural History, Mr. Newsom collected specimens of its animal life and delved into its unusual history. His narrative becomes a vivid story of a piece of land which through the centuries has been the scene of many adventures. Two and one-half times as large as Rhode Island, it is one of the few large sections in the modern world to come into the possession of a single person. When Henri Menier, the "Chocolate King" of France, built his manor on this lonely island, he installed sixteenth century Flanders tapestries and furniture from the period of Louis XIII.

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 252.

1. The passenger pigeon
(a) Is one of the most valued members of the U. S. Signal Corps
(b) Does not now exist
(c) Never did exist

2. The Philippines are scheduled to become a free nation within
(a) Six months
(b) Six years
(c) Sixteen years

3. Though a deadly poison when injected, rattlesnake venom may be drunk without serious result.
True..... False.....

4. The Sahara Desert has never been crossed by motorcar.
True..... False.....

5. The breed of pigeon known as the barb
(a) Is the only one that refuses to become domesticated
(b) Can never raise its young
(c) Is the pigeon from which all the scores of known breeds were developed

6. If you hear a rattlesnake's warning buzz, the best thing to do is
(a) Start running
(b) Stand stock still
(c) Shout, to scare him off

7. The Philippines are the world's leading exporter of rice.
True..... False.....

8. Since the eggs are laid at different times, how do two young pigeons get an equal start in life?

9. In crossing the Sahara Desert you would expect to find mountains.
True..... False.....

10. What bird that is not valued for its flesh, feathers, or eggs, provided the Belgian treasury with one of its major sources of revenue?

11. The only pygmies in the world live in Central Africa.
True..... False.....

12. The most ancient known horse was about the size of a
(a) Mammoth
(b) Shetland pony
(c) Fox terrier

13. Is there any evidence that radio waves affect the flight of birds?

14. A carabao is
(a) A kind of caribou
(b) The lead camel in a caravan
(c) A water buffalo

15. A rattlesnake can strike a victim
(a) The full length of its body
(b) One-third of its length
(c) Two-thirds its length

16. The record distance flown by a homing pigeon is
(a) 700 miles
(b) 7000 miles
(c) 70,000 miles

17. All of the 130 breeds of pigeons originated from a common progenitor.
True..... False.....

18. Which of the world's trees grows highest?
(a) Bigtree
(b) Australian eucalyptus
(c) Redwood

19. If somebody else's pigeon joins your flock, it is an unwritten law that you return it at once.
True..... False.....

20. The "quadrumanous tribe" is a fancy term for
(a) Monkeys
(b) Mammoths
(c) Man

YOUR NEW BOOKS

INAGUA: A NATURALIST CRUSOE • LIFE OF AKELEY • AUDUBON'S AMERICA • THE GARDEN CLINIC • CHINA'S ANIMAL FRONTIER CONSERVATION AND CITIZENSHIP • MY VANISHED AFRICA

THE WILDERNESS LIVES AGAIN

- - - - - by Mary L. Jobe Akeley

Dodd, Mead, $3.00

IN these troubled times, reading becomes our best and almost only escape; particularly when the reading takes our minds so completely from our present world complexity.

There is no better field for complete mental relaxation than a trip into nature's wonderland, back to far-off places among the charm, the beauty and the peace of primitive lands inhabited by fantastically colored birds, big and courageous wild animals and simple and unspoiled natives, whom until lately we have called wild.

In *The Wilderness Lives Again* one can roam in another fascinating and wonderful world, which but few ever realized existed, and we can be so entirely absorbed among the pages of this book that we soon forget our world of today.

Mary L. Jobe Akeley writes in very able fashion a most interesting story of Carl Akeley's life and his varied and outstanding achievements. She tells of Akeley as a personality and a genius, beloved by all those whom he contacted, and of his life as one of constant work for the accomplishment of his ideals, from which he never deviated.

This fascinating life of Akeley, interwoven with many of his thrilling experiences with African game (two almost fatal), is ably narrated, giving us a true picture of the lives and habits as well as the temperaments of the beasts we call wild.

Mrs. Akeley has incorporated much pertinent material written by Akeley's colleagues and close friends, which brings us intimate side lights on his character and thought. She also tells the story of African Hall from the time Akeley first conceived it through to the present day, when it is all but completed. This was Akeley's great dream, for which he gave his life.

The story of African Hall, which is the climax of his life and of the book, the many expeditions and eventually the building of this superb and monumental exhibit, which now stands as a memorial to him, is indeed fascinating reading to all those interested not only in the great out-of-doors, but in the life of a typical American boy, who with sincerity of purpose accomplished what he went after and had a thrilling and colorful life while doing it and left a great contribution to natural history and the arts, as well as a great and lasting monument to himself.

JAMES L. CLARK.

INTRODUCING INSECTS

- - - - - - by James G. Needham

Jacques Cattell Press, $1.50

THE aim of this little book, as outlined in the preface, is to make available to those individuals who need only a little information about insects an elementary, non-technical summary of these creatures and their lives. Two introductory sections entitled "Why Study Insects" and "How to Study Insects" prepare the reader for the fuller accounts of particular types and groups of insects in the succeeding sections. Very good line illustrations are distributed through the text to supplement and clarify the factual data presented.

The author has devoted, perhaps quite properly, the greater part of his book to those insects which are injurious to man's crops and goods or are a bane on his comfort. The approach is essentially practical. Hints as to the best method or remedy for the control or destruction of noxious insects are to be found in the discussion of nearly every group; and the principles of control are outlined in a later section. It is probably quite true that the layman is interested first in insects because of their effect upon himself or his pocketbook and that, once having gained some practical knowledge, he will turn to a broader study of the Insecta. It is to be regretted, however, that the accent has been so strongly placed on the small minority of noxious insects. Indeed, the book is an introduction not to the great bulk of beneficial or neutral insects but to those which come to the notice of the layman because of their injurious activities.

In general it can be said that the book is very simply but engagingly written. Although definitely limited in scope and intended for beginners, the discussions are adequately supplied with interesting facts succinctly stated in common language. Some of the concluding sections are intended "for those beginners who may desire through their own collecting activities to reach the threshold of entomological science."

W. J. G.

THE GARDEN CLINIC

- - - - Written and Illustrated by Laurence Blair

Macmillan, $2.00

HERE is an unusual manual for the gardener in that it tells him how to care for his plants by means of pictures supplemented by a minimum of text. An examination of the double-page spreads with captions will convince one that a good illustration can convey clearly more than pages of printed text.

The author has chosen about 100 garden favorites, including annuals, perennials, bulbs, vines, hedges, evergreens, and flowering shrubs and trees. In the pictures, amplified by the text, he gives the steps in the cultivation of the plants from the time of planting of the seeds or bulbs, or the transplanting of the tree or shrub from the nursery. Instructions about when to plant, how to plant, when to water, about mulching, pruning, recognizing plant diseases and treating them, controlling insect pests, etc., are given. In the cases of insect injury and plant diseases, diagnosis precedes treatment, as it should.

The book contains a wealth of precise and concise information. It is evident that the author speaks with authority from wide experience. The outstanding feature of the manual is the excellent explanatory drawings fully captioned. Amateur gardeners as well as those of much experience, we believe, will be delighted with Mr. Blair's *The Garden Clinic.*

CLYDE FISHER.

INAGUA

- - - - - - - by Gilbert C. Klingel

Dodd, Mead, $3.00

THIS is a tale of an American Museum expedition which at its outset was wrecked on Inagua, a little-known island in the Bahamas. The leader of the expedition, Gilbert Klingel, salvaged what materials he could and settled down in a thatched hut to unravel the complex web of life found in this out-of-the-way part of the world. Not satisfied with his original effort, Klingel returned to America to better prepare himself for further studies. On his second expedition Klingel completes the picture of life on Inagua by taking us under the sea and vividly describing the inhabitants of the surrounding coral reefs.

It has been given to few naturalists to explore an absolutely unknown coral reef and to have encounters with tiger sharks and giant mantas. Still fewer have been able to express themselves with such charm and extraordinary insight concerning the lives of the creatures encountered. Klingel's wanderings take us to spoonbill and flamingo colonies, also to the haunts of octopi and moray eels under the sea. The tale reveals the character of a naturalist who succeeded in his quest although confronted at the outset by almost superhuman difficulties.

G. K. N.

THIS AMAZING PLANET

- - - - by Roy Chapman Andrews

Putnam, $2.00

A MAN who has had 35 years association with one of the world's largest museums, who has daily contacts with its scientific staff and eminent visitors, whose personal travels have covered hundreds of thousands of miles (and, one might say, millions of years of earth history), who circumnavigated the globe three times before he ever visited Boston(!), and who reads countless letters of inquiry about natural history subjects—such a man ought to be able to emit sparks of knowledge covering the wide range of the universe and its inhabitants.

Such is the background of *This Amazing Planet* by the Director of the American Museum. The miscellaneous sketches originally saw the light as a weekly press feature; they have now been brought together in a book of what might be called the light reading of science. The order of the 80 articles is random; a reader may treat the volume as he would a magazine and begin at the middle or the back as conveniently as on the first page.

While the author would not desire to hang his scientific reputation on this book, nor wish his readers to take the text too seriously, it is surprising what a large number of recurrent questions are answered in it and what a broad scope of natural science is encompassed. The dodo, vampire, mermaid and sea serpent come in for a share of illuminating attention. Amber and ambergris, gems, dragons and mistletoe all suggest objects and ideas older than civilization, and Doctor Andrews succeeds in draping such concepts on whatever factual framework can be found for them. Other skits deal with subjects as diverse as human evolution, prehistoric surgery, fossil hunting, animal behavior, insect cycles and longevity.

This reviewer, who has a naturally malicious disposition, kept an eagle eye on the text with the hope of pouncing like a saber-toothed tiger on the author's neck. Forgetting the mixed metaphors, he can only point with alarm rather feebly: the giant man-trap clam is called *Tridacna* not because of "three fingerlike points of the shell" but because even the Roman gods and heroes would require at least three *bites* to eat one!

R. C. M.

AUDUBON'S AMERICA

Edited by Donald Culross Peattie

Houghton, Mifflin, $6.00

AUDUBON'S "Delineations of American Scenery and Manners" originally appeared in the first three volumes of his *Ornithological Biography*. In the form of 60 independent articles, they were "interspersed" with the "accounts" of birds' habits, one after each five "accounts," presumably to retain the "kind reader's" attention by giving life to the text as a whole.

Recognizing the value of these "Delineations" as contributions to the history of Audubon's times, the late Professor Francis H. Herrick, Audubon's biographer, made them accessible in book form with a pertinent introduction and preface (*Delineations of American Scenery and Character*, by John James Audubon, G. A. Baker & Co., 1926).

Evidently inspired by the same motive, Mr. Donald Culross Peattie now selects some 20 of the "Delineations," adds four Biographies and extracts from Audubon's journals, published from the original manuscript by the Club of Odd Volumes, and issues the whole in a handsome volume entitled *Audubon's America*.

As an addition to Auduboniana, Mr. Peattie's book is distinguished from Professor Herrick's by the fullness of its editorial comments. A student of the early history of the region in which Audubon as a merchant, artist and naturalist laid the foundation of his life work, he is prepared to evaluate Audubon's text for its worth as descriptive of the men and manners of his time. Mr. Peattie also knows Audubon, and if occasionally he calls attention to his lapses and chronological inconsistencies he does so with a gentle hand and a thorough understanding of the difficulties by which his subject was handicapped.

These passing biographic comments help us trace Audubon's development and his responses to both his physical and mental environment until, in the end, we form possibly a truer picture of the man than we have had heretofore.

The seventeen full-page, or double-page, colored illustrations of birds, mammals and scenery are reproduced by a process which does justice to the originals; the frontispiece of Audubon from a self-made portrait in oils is particularly attractive.

F. M. C.

CHINA'S ANIMAL FRONTIER

- - - - - - - - - - by Clifford Pope

Viking, $2.50

SHORTLY after Clifford Pope arrived in China as a member of the Central Asiatic Expeditions, he accompanied me on a trip to the forests of the Tung Ling, where the Manchu emperors are buried. This was largely to familiarize him with the methods of collecting reptiles, fish and amphibians in China.

Mr. Pope fitted into the life so naturally, and immediately evinced such a real liking for the Chinese people, that I realized that he would inevitably be successsful in his collecting work. No naturalist in China can do a completely effective job unless he has the cooperation of the natives. Clifford Pope obtained this in a remarkable degree. He at once took up the study of the difficult Chinese language and in an amazingly short time became really proficient.

For years he carried on his work without any interpreter, which is something few naturalists in China have had the ability to do. He instinctively understood the way in which the mind of the Chinese peasant operates and thus got results where a man with a lesser appreciation would have failed. While the main expedition was in the Gobi Desert, Mr. Pope carried on independent work in various provinces of China where reptilian and

"A vivid account of remarkable adventures, alone on a little-known tropical isle."
—G. Kingsley Noble, *American Museum of Natural History*

INAGUA

Which Is the Name of a Very Lonely and Forgotten Island

By Gilbert Klingel

One of the most startlingly vivid nature books of our times—the story of a young man, shipwrecked on a remote island of the outermost Bahamas, and recording his remarkable adventures with giant rays and tiger sharks, with freakish bats, flamingos, new species of humming birds, lizards, crabs, etc.

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Just published

Introducing Insects

By JAMES G. NEEDHAM
Professor at Cornell University

This little book is intended for home use by those who wish to know something about insects. It tells much about the habits of the commoner kinds of insects, and so explains the methods of dealing with them. It describes and illustrates interesting insects and tells how to rear and preserve them. It contains much about collection making, and gives simple methods that are within the reach of everyone. This outstanding authority has written in language that anyone may understand.

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amphibian life were more abundant than in the arid reaches of the desert. He did not confine himself, however, to merely collecting cold-blooded vertebrates, but obtained many rare and interesting species of mammalian life. His principal interest, however, lay with reptiles and amphibians, and his thousands of specimens represent a collection infinitely better than that obtained by any other expedition in China.

China's Animal Frontier is a charmingly written book. Mr. Pope narrates not only many interesting facts about the actual collecting of specimens, but tells how he lived and traveled and learned in China. I took up the book for a rapid reading and found myself so engrossed that I read it through almost without laying it down.

He has selected personal anecdotes which are of as great interest to anyone who does not know China intimately as to those of us who have lived in the country itself. I can recommend *China's Animal Frontier* enthusiastically.

ROY CHAPMAN ANDREWS.

MY VANISHED AFRICA

- - - - - - - - by Peter W. Rainier

Yale University Press, $2.75

IN a tent in Swaziland, nearly 50 years ago, was born a descendant of the admiral for whom Mt. Rainier was named. This boy grew up in South Africa, playing with Zulus and getting his schooling during the Boer War. Then as a young trooper in the Natal Carbineers he aided in the arrest of Dinizulu, last king of the house of Chaka. The search for diamonds lured him to Damaraland, he prospected for gold and hunted elephants in Mozambique, and during the First World War fought as a scout in German Southwest Africa. Before that war was over he had gone to mine tin on the Bauchi Plateau in Nigeria, where his wife was the first white woman to dwell.

The story ends almost too soon, early in 1919, shortly after the influenza epidemic in Nigeria and the tragic death of Winnie Rainier. Another period of even greater change was beginning in Africa, due to the automobile.

This is not a book on natural history, but rather about people. There are anecdotes about elephants, hippos, hyenas, baboons, and various kinds of beasts of burden. Native life in several countries is more extensively described, but the white characters are the most exciting of all. The book is to be recommended as a lively tale by one of those very Anglo-Saxon adventurers who played so great a part in the opening up of the Dark Continent. They seem amazingly frank, almost proud, about their irresponsible ways and drunken brawls, and do not conceal their disdain for the colonizers of other nations, except the Boers. Peter Rainier himself did his share to exploit the resources of Africa without counting the risks or profiting very greatly himself. If he regrets his vanished Africa, he should know where to lay the blame.

JAMES P. CHAPIN.

CONSERVATION AND CITIZENSHIP

- - - - - by George T. Renner and William H. Hartley

D. C. Heath, $1.60

IT has been said before that a good citizen is a good conservationist. Now we have a book for high school students which is based upon this axiom. It presents a true picture of conditions today including, without reservation, a brief description of the abominable situation of the vast underprivileged portion of this country's population.

Conservation and Citizenship contains a short but excellently written introduction by Professor Jesse H. Newlon, of Columbia University. The volume consists of nine units: What is Conservation?; The United States as a Property; Our Forests—Mine or Crop?; Our Prodigal Waste of Soil; Water—Friend or Enemy?; Our Vanishing Wildlife; Squandering Our Mineral Wealth; Our Human Resources; America Discovers Planning. This is an adequate program for any high school course in conservation and can be easily adapted to local problems. Each unit is preceded by a statement of its aims and suggested introductory activities.

The authors placed proper emphasis on the role of the renewable resources and the care with which non-renewable resources ought to be utilized. The frank treatment of human resources is commendable. Here is a phase of conservation which is generally (and often purposely) avoided. The presence of a planning unit is also rare in the usual conservation treatise. The illustrations are well chosen. It is only unfortunate that if one is interested in knowing the source of the photographs and diagrams as he reads along, he must consult a Table of Acknowledgments in the front of the book.

While this book is primarily intended for high school use, it is by no means written in the usual text-book style, and it will be of equal interest to Mr. Average Citizen who has long been out of the classroom. The authors are practical conservationists who have had experience outside the "cloistered halls" of educational institutions. They know that the best way to foster conservation is by attacking the problem from the most advantageous position—the school. The youth of today are tomorrow's citizens and leaders. We must educate our younger generations in the proper use of our national resources before it is too late. One important attitude must be that the true patriot not only preaches but *practices* conservation.

JULIUS KAIKOW.

Answers to Questions on page 249

1. (b) The passenger pigeon does not now exist. Though its vast flocks once darkened our skies, it was never used as a message carrier. See page 207
2. (b) In six years. See page 230
3. True. An amount of rattlesnake venom that would kill a man can normally be swallowed without serious result. See page 238
4. False. Motor transport across the Sahara promises to affect in no small way the future of the colonial territories in Africa. See page 208
5. (b) The pigeon known as the barb cannot raise its young because its bill is too short in both adult and young to accomplish feeding. A foster parent is necessary. See page 207
6. (b) Stand stock still. By remaining still there is less chance of being struck, since the rattlesnake is equipped by instinct to strike at a moving object. See page 234
7. False. Rice is the leading agricultural product of the Philippines, but insufficient quantities are raised for home consumption and much has to be imported. See page 228
8. The parents have been observed to keep the first egg just warm enough to sustain life until the second one arrives. See page 207
9. True. See page 218. There are mountains far in the interior of the Sahara which are reported to be partly covered with snow during several weeks of the year.
10. The pigeon. The activities of 350,000 pigeon fanciers in Belgium formerly provided substantial revenue for the government. See page 206
11. False. The Negritos of the Philippines are truly pygmies, with average height equivalent to a thirteen-year-old American boy. See page 231
12. (c) Fox terrier. See page 199
13. Some. Pigeons are reported to have become bewildered in flight near the towers of a broadcasting station, until there was a momentary break in the program. See page 242
14. (c) A water buffalo. See page 233
15. (c) Two-thirds its length. See page 234
16. (b) The record distance is over 7000 miles. See page 205
17. True. All modern breeds of pigeons originated from the blue rock dove of Turkestan (*Livia livia*), which the ordinary street pigeon of today resembles most closely. See page 241
18. (c) Redwood. Earlier reports that the Australian eucalyptus is the world's tallest tree are considered mistaken. See page 247
19. False. Tradition permits you to hold another's pigeon for ransom, and if the owner rejects your terms you are free to keep it. See page 207
20. (a) Monkeys. "Quadrumanous" comes from the Latin *quadru manus*, meaning four-handed. See page 196

ERNEST THOMPSON SETON'S TRAIL AND CAMP-FIRE STORIES

- - - - - Edited by Julia M. Seton

D. Appleton-Century, $1.00

AFTER reading *Animal Heroes* by Ernest Thompson Seton, John Burroughs wrote in his Journal, "He [Seton] easily throws all other animal story writers in the shade." And many others hold the same opinion. Not only is Seton a writer of stories, but he is a great teller of stories—the best that this reviewer has ever heard.

The stories here brought together, 20 in number, Seton has told many, many times around the camp-fire and in the woodcraft council-ring. They include "Little Burnt-All-Over," "The Peace Daughters of King Capilano," "The Three Sioux Scouts"—to mention just three. They are all in the form in which Seton told them. The introduction to the volume is an excellent, practical discussion of story-telling.

CLYDE FISHER.

OUR READERS SPEAK

Sirs:

.... We have a good many magazines. I sometimes wonder why we have them. I never wonder why we have the magazine published by The American Museum. I always read it from cover to cover right away, and then look it over again. The make-up of the magazine is splendid . . . .

F.M.S.

Boston, Mass.

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are printed from photo-engraved plates made by STERLING ENGRAVING COMPANY, 304 E. 45th Street, New York, N. Y.

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Above illustration from Bird Group of Hudson Bay Region in the American Museum of Natural History

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LETTERS

SIRS:

From far-away Australia may I have the pleasure of congratulating you on your excellent article on shells by William K. Gregory in NATURAL HISTORY Magazine for November, 1939. My copy was lent to me by the New South Wales Naturalist Society.

I have read and reread it many times. . . .

J. W. HAWLEY.

Sydney, Australia.

* * *

SIRS:

I have just read your interesting article about shells in the October issue of NATURAL HISTORY, and wish to ask a question.

What species of cowry is the small, dark-spotted fellow shown between the argus and the *tigris* in the picture on page 170?

During the past two years I have been trying to secure a fairly representative collection of cowries . . . [and] am interested in getting pairs of about 40 missing species within a reasonably short time.

WILLIAM L. HAMPSHIRE.

Baltimore, Md.

The cowry referred to is one which Doctor Gregory, the author of the article, bought at Suva, Fiji Islands. The name given it there was *Cypraea lynx* Linn. It can probably safely be classed with this variable species, although it is not typical with its faint cross-zone over the back and the spots on the left side separated by strings with droplets of color.—ED.

* * *

SIRS:

I read Doctor Gregory's article on shell hunting in the November, 1939, NATURAL HISTORY. It interested me very much and I wondered if you would be kind enough to give me a bit of information regarding the enclosed shells. . . . I live in my grandfather's Colonial home . . . and am trying to restore it as nearly as possible as it was in the past. In the formal garden there used to be these little shells. . . .

(MISS) L. H. BILLS.

Bolivar, Tennessee.

Doctor Gregory informs us that the samples sent agree with the pictures and definitions of *Rangia (Gnathodon) cuneata,* a species of clam which was apparently taken for the first time in 1870 in Lake Ponchartrain, New Orleans, but more recently has been collected near Jacksonville, Florida, and in Georgia.—ED.

* * *

SIRS:

I owe you—and so does the world—deepest thanks for William K. Gregory's thrilling and beautifully illustrated shell article. . . .

MRS. FISKE WARREN.

Pride's Crossing, Mass.

SIRS:

I have just read your very interesting article in NATURAL HISTORY on designs in shells. . . . It opened my eyes to the possibilities of obtaining inspiration from shell shapes and patterns.

DOROTHY A. JONES,
Librarian.

Philadelphia Academy of Fine Arts,
Philadelphia, Pa.

* * *

SIRS:

I am much interested in your most helpful article on shells in the October number of NATURAL HISTORY. . . .

F. S. WEBBER.

Holyoke, Mass.

* * *

SIRS:

I have lately read some articles on conchology by William K. Gregory in NATURAL HISTORY and would like to ask for some information.

I have a collection of shells and am turning them over to a young relative who is very much interested in this subject. Not long ago I saw a short review of a new, well-illustrated work on shells. A search of the back numbers of NATURAL HISTORY failed to show it. Perhaps you could give me information as to title and where printed. If not, could you recommend some good general work on the subject?

W. E. UNGLISH.

Gilroy, Calif.

The book sought is very probably *World Wide Sea Shells* by Maxwell Smith, published by the Tropical Photographic Laboratory, Lantana, Florida, 1940; price $4.50. This book illustrates more than 1600 species and is a most useful work.

A fine general work with many illustrations is *The Shell Book,* by Julia Ellen Rogers, Doubleday, Doran & Company, Garden City, New York, 1937; price $5.00.

A popular book with many interesting facts about shells is *Strange Sea Shells and Their Stories,* by A. Hyatt Verrill, Colonial Press, Inc., Clinton, Mass., 1939. See also review of *Marine Shells of Southwest Florida,* by Louise M. Perry, on page 308 of this issue of NATURAL HISTORY.—ED.

* * *

SIRS:

The cover of your November number is one of the loveliest pictures I ever saw. Had you thought of having extra copies of that picture struck off for framing? . . . I myself want three copies, and if necessary shall buy the magazine to obtain the cover, although I have already read it through. . . .

I can pick them up when I go down to New York next week. . . . But I want

Continued on page 312

For the hands you wish most to honor this Christmas, give Longines, the world's most honored watch. Longines watches combine all of the qualities one demands in a fine watch—reputation, accuracy, long life, elegance. Longines watches have won 10 world's fair grand prizes, 28 gold medals.

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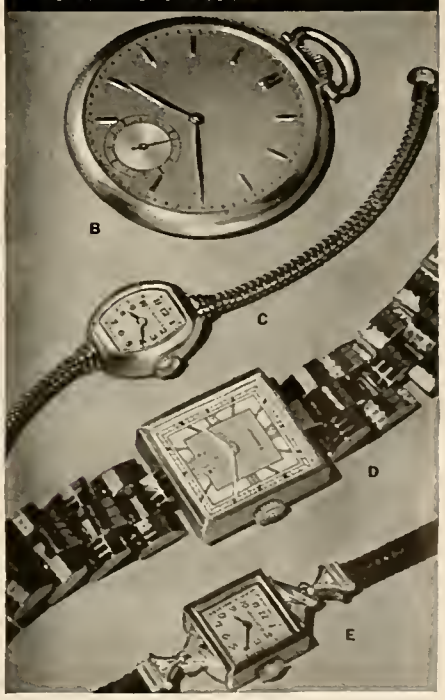

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FINNY PHOTOGRAPHS

By CHARLES H. COLES
Chief Photographer, American Museum of Natural History

FEW efforts in indoor photography can offer the sport and the element of chance that taking pictures of fish presents. The uncertainty of gauging the psychological reactions of your pet guppies or goldfish makes it almost impossible to tell what form your picture will finally take. A really successful picture combining good definition, artistic composition and a feeling of realism is something not easily attained.

With a large amount of luck and quite a bit of skill, it may be possible to make your photographs without any preparation other than loading your camera and moving the fish bowl to a convenient location. A few advance arrangements will, however, add considerably to your chances of success.

The tank

First and foremost in importance for fish photography is the proper tank. A rectangular tank is necessary so that a flat glass surface is presented to the lens of the camera. This arrangement prevents optical distortion from marring the form or sharpness of your subjects. The tank should be rather small, not over a foot in length, and thoroughly cleaned.

In the tank a sheet of glass as long as the inside dimension and as high as the tank is set up on its long edge rather close to the front glass. The space between the front plate and the glass sheet is reserved for the fish. Into the rear compartment undersea plants are introduced to set the stage and provide a background to lend reality to the undersea pictures, and the glass sheet prevents the fish from hiding behind the plants. In some cases of extreme close-up work, the sheet is actually used to crowd the fish against the front glass and prevent its turning or moving out of the plane of focus. A full side view is thus assured for an accurate record of the shape of the fish. Pebbles are dropped into the bottom of the tank on both sides of the divider sheet to hide the lower edge.

Lighting the aquarium

The most readily available light source with which to do the photography is daylight. The greatest difficulty is to direct it so as to obtain the desired results.

If the sun is out, set the aquarium so that the sun's rays enter from above and from the front of the tank. This direction assures that the front of the fish will be illuminated. Beware of reflections in the front glass of the aquarium. By reflection the camera and the photographer may easily be the most conspicuous objects in the picture. The camera should be draped with black cloth to prevent its bright metal parts from glaring in the reflections. By taking the picture at a slight angle to the glass, reflections of the camera may be avoided, but other reflections may be introduced. By placing the head just in front of the camera lens and looking at the aquarium carefully, annoying reflections can be quickly seen and steps taken to remove them.

A large white card or cloth should be

(Continued on page 310)

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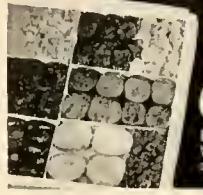

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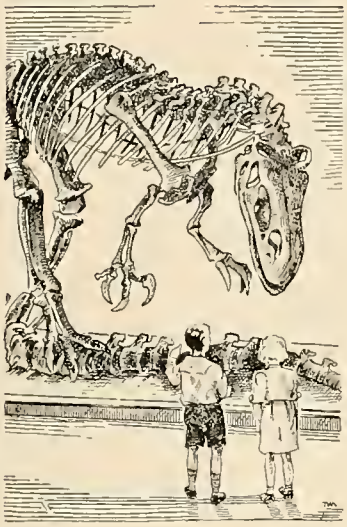

THE Lamp of Scientific Truth has been blown out in many nations of the world, in many others it is blanketed to a feeble flicker. There is an intellectual black-out everywhere on the globe save here in the Americas where scientific truth is not biased by political expediency or propagandized in support of social theories.

Only knowledge that is true and honest and abundant can make men free; and only the spread of that knowledge from generation to generation can keep them free.

The influence of this Museum is tremendous, as the statistics show:

2,000,000	annual visitors, including Planetarium
25,000,000	contacts by Department of Education
624,000,000	hour listeners to radio programs
1,000,000	learners taught by Education Staff
27,000	listeners to daily music programs
200,000	miles a year traveled by Museum trucks making 40,000 deliveries to schools, hospitals, prisons, colleges and universities.
480,000	visitors at Bear Mountain Trailside Museums
35,000	orders for loan materials outside of New York
27,000	subscribers to magazine NATURAL HISTORY.

What good does this do—is it worth while? This is an important question, but there is one far more important. In times like these when we should bend every effort, public and private, towards the preservation and perpetuation of our way of life, is this a proper activity? If it is, then the critical times demand redoubled effort and extended service.

The Museum, we know, is an unparalleled center for recreation and amusement. It is, moreover, a tremendous stimulant to outdoor living and sane development. From our experience with refugees we know that it is for many a medium of escape from distress or bewilderment.

But the real work of the Museum is to help people become more aware of themselves, and of their surroundings, to help them to think in terms of realities and not theories, to help them to deal with their problems (in real ways), and to supply the necessary materials for both thought and action. The character of the mental and physical activity of people is the determiner of the quality of their citizenship. So, to many thousands of people the Museum supplies almost the only contact they have with the materials about which they talk. These materials thus become the center of their learning and the focus of their activity. Through these materials in the natural sciences they are enabled to relate themselves and their living to the life around them.

To hospital patients, prisoners, the blind and other shut-ins, the Museum materials offer release from the long hours of confinement, and makes adjustment to living easier and better. To the multitude of persons whose main interest lies in themselves and in their problems, these materials offer an interpretation of life. The housewife, home decorator, art student, carpenter, furrier, shopkeeper, sales girl, indeed every worker can find a greater understanding of his place and his work. All can learn new values and self-respect.

These things are the stuff with which the freedom of our way of life is woven. We want the greatest of individual initiative and action, compatible with the greatest social good. An agency that supplies this need is important at any time, but most greatly important when stress from within and propaganda from without tend to strain the fabric. There is no better citizenship than this Museum provides, and there is no better agency for the support of individual freedom.

Charles Russell

The American Museum of Natural History

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The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President — ROY CHAPMAN ANDREWS, Sc.D., Director

VOLUME XLVI—No. 5 ★ ★ ★ ★ ☆ ★ **DECEMBER, 1940**

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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.

ASSOCIATE: D. R. Barton.

ART AND PRODUCTION: 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 DEPARTMENT: Sherman P. Voorhees, Manager.
REPRESENTATIVES:
Warwick S. Carpenter, Santa Barbara, Calif.
Wells Constantine, New York, N. Y.

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The American Museum of Natural History wishes to express gratitude for the assistance in the promotion of the interests of NATURAL HISTORY that has been rendered by the Work Projects Administration.

NATURAL HISTORY is published monthly (except July and August) at New York, N. Y., by The American Museum of Natural History, Seventy-ninth 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.

UNCHALLENGED CHAMPION

By E. THOMAS GILLIARD

As exciting a story of adventure as modern exploration can tell led up to the discovery of this eighth wonder of the world and to its pronouncement, here for the first time in the English language, as the highest waterfall in the world

WHEN Jimmy Angel, American soldier of fortune, aviator and prospector, flew out of the jungle wilds of Venezuela on a March evening in 1937, he divulged to his associates a series of tales unparalleled in the annals of twentieth century exploration. He had just returned from a "Lost World."

He spoke of a vast new range of mountains far to the south in the unknown Guiana Highlands, of a population of aboriginal natives, of rivers rich in gold, of a plateau in the sky like a huge walled fortress "about 9000 feet high and from a quarter to a half a thousand square miles in extent." Most amazing of all, while planing along the cliffs of this Lost World fortress, he had seen a huge waterfall "one mile high."

Courtesy of the Ministerio de Fomento, Venezuela

(Left) **TWENTY TIMES as high as Niagara and fully 1000 feet higher than its nearest competitor: Angel Falls, named after the venturesome aviator and prospector whose fearless forays into one of the least known areas of the world led to the scientific exploration of the "Lost World" of Auyan-tepui. Here the falls are shown at the end of the dry season, when their volume is smallest**

(Below) **THE BRINK of Angel Falls, photographed likewise from the air, but at a time of greater flow**

Heny photo

Thus more than three years ago Jimmy Angel announced to doubting Thomas' the discovery of the world's greatest waterfall, a fall fully 1000 feet higher than any other recorded in the world and 20 times as high as Niagara. Perhaps in the light of statistics and rumors of Jimmy's boundless imagination, refusal to believe his story was pardonable. Be that as it may, it was doubted by many and attributed to motives of promotion or just plain hallucinations.

To get at the beginning of Jimmy Angel's story, I might tell the tale as I got it one evening from a Texas oil driller in Ciudad Bolívar. Slightly dazed by the excessive heat and the chorus of insects buzzing over our table, I heard the story unfold. Except for obvious allowances it probably contains little fiction.

Seven years before in a café in Panama City a grizzled old prospector had limped up to the bar and demanded a brandy. At his elbow, tall, blond and scar-faced, stood a man from out of nowhere. This was Jimmy Angel, who would fly anything with wings and a motor—provided someone was willing to pay for the job, preferably in advance. He earned his aerial spurs dogfighting over the trenches of World War I and has been stunting and barnstorming ever since. Between the test-pilot and the stubble-chinned prospector there arose an easy camaraderie, and the prospector unwound a startling story of a hidden El Dorado. Before the night was over, the two struck up a deal: Jimmy Angel would fly Williamson, the prospector, in if he would put up $5000 for the use of the plane. Three days later the two men drove to a little hangar, and there our Don Quixote and his Sancho Panza wheeled out their *Rosinante*. Somehow, Jimmy coaxed it off the ground, and thus began their adventure.

A gold mine in the sky. Bob Williamson had painted a vivid picture of a mountaintop blanketed with yellow nuggets, but he steadfastly refused to divulge the exact location.

Cruising along the Caribbean, they rounded the snow-capped peaks of Santa Marta, refueled at Ciu-

dad Bolívar, and winged into the uncharted interior. On they flew, the endless jungle beneath them, its yawning chasms and billowy treetops reaching out like the predatory Venus's-flytrap, ready to seize and swallow the insignificant buzzing pest. They flew a zigzag course, following Williamson's hunches; and Jimmy was beginning to wonder how the wild gold-chase would end when over the horizon loomed a mountain shaped like a huge walled fort. The precipitous slopes shot up so abruptly that it appeared absolutely unscalable. Williamson gestured excitedly toward the summit. Jimmy's heart dropped. Nervously he circled over this Lost World. The plateau of Mt. Auyan-tepui was more than 20 miles long and half that in width, but it didn't seem to offer a single landing place.

Generally Angel didn't mind gambling with destiny, but this time the dice seemed loaded. Williamson, however, would hear nothing of turning back without a plane-load of nuggets. So, tightening his safety strap, Angel glided in. The machine touched and bounced along. For a moment the wheels caught, and the nose tilted forward, but the crate rolled to a jerky halt.

Forgetting his airsickness, Williamson bounded out before the propeller had stopped spinning. He staggered down to the banks of a nearby stream, his fingers twitching greedily as he ran.

When Jimmy started the take-off, the old prospector was oblivious to all except the little tinted rocks he caressed in his calloused palms. Back in Panama he cashed $27,000 worth of gold.

The frenzy of the aerial treasure quest and the new life it opened proved too much for the weary old man. Two months later he died with a small fortune under his pillow. Buried with him was the knowledge, if he possessed it, of the mountain's exact location.

Where had he been?

No such mountain was known to geographers, the region was a blank on the maps, and the plane had followed such a wandering course that Jimmy Angel doubted he could fly back to the golden hoard. However, human nature was challenged.

"That's why Jimmy has risked his life these many years in that hellhole," the driller told me. "He's hipped on finding that gold again."

Furthermore, if any man could prove that deep in that wilderness a waterfall fell sheer for 20 times the height of Niagara, he would establish the eighth wonder of the world.

There were many doubters. Had he really flown south over the trackless jungle? Would a passenger back his statements? They knew that no navigable river flowed out of the Guiana Highlands, and as Gustavo Heny, a sportsman-woodsman, explorer of Caracas, said, "If you can't get in, you can't get out, and it's poison to risk it." A man can cope with fevers, poisonous reptiles and dense swamps, but he travels on his stomach. In this region he must carry 85% of his food in his pack and he will eat all he can carry in one month. This means that the most determined party must turn back after sixteen days. Since a trail could scarcely be cut to the edge of the Guiana Highlands in less than two months, even by frantic efforts, the wisdom of Gustavo Heny's remark is amply illustrated.

Because he needed a stake, Angel hammered away at any skeptic with a willing ear and a bank account. He attended the clubs and tea parties and quickly became a drawing room hero of sorts.

He said that the jungle reached southward only about 100 miles beyond the Orinoco before it became broken by "hundreds of square miles of fine upland grazing country with savannas as flat as Newark Airport," where between the giant ant castles he had flagged half a dozen private airports. He said that he had cached emergency supplies of gasoline in soldered five-gallon tins at several of these ports.

Scientific interest

The fact that a great Lost World really existed, falls or no falls, was sufficient to put the zoological world on its toes. Scientists in all branches who were acquainted with the strange flora and fauna of the two other Lost Worlds joined in acclaiming Mr. James Angel's discoveries.

The first Lost World, Roraima, had been discovered at what is now the junction between Brazil, Venezuela and British Guiana. Robert Schomburgk, a famous German engineer and mapper, discovered it in 1838 and revisited it with his brother Richard, a zoological collector, in 1842. Richard noted that the cliffs separated many distinct birds and plants on the mountaintop and sides from those round about. And Cabanis, an eminent European zoologist, found that many of the forms were new to the scientific world.

Later two other expeditions, under Henry Whitely and F. V. McConnell, managed the difficult river journey and the long, dangerous trail to confirm that Mt. Roraima was a mountain island rising in a sea of tropical jungle, an island sanctum where hundreds of plants and animals existing nowhere else on earth, lived their own Lost World. It was precisely this situation which Conan Doyle dramatized in his imaginative novel *The Lost World*. Many will remember the Hollywood thriller based on this story, with its additional blood and thunder, its apes, its beautiful mechanical dinosaurs and a petite blond in an African leopard skin.

Unlike Roraima, the second Lost World, Mt. Duida, near the headwaters of the Orinoco River, remained unapproachable until 1912, when the American Museum, in order to determine whether the life it supported was equally strange, dispatched two professional field men, Leo E. Miller and F. X. Igsleder. After long and grueling travel through fever infested lowlands, they reached the slopes of Mt. Duida by way of the headwaters of the Cunucunuma River. But shortly after collecting had begun, Igsleder fell desperately ill with a complication of beriberi and malaria, and in order to save his life, Miller was forced to take him down river to San Fernando on the upper Orinoco, and thence to Trinidad. They never went back.

Dr. Frank M. Chapman examined the few birds which they had managed to collect and, like Cabanis,

was amazed at their unusualness. His interests in the Guiana Highlands, originally inspired by the Roraima collections, took on new fire. Pulling to its full length the South American roller map which hangs in his office, he examined the blank area spreading between Roraima on the east and Duida, 400 miles to the southwest—a huge area which, with the exception of Matto Grosso, was probably the least known spot on the face of the globe. Contemplating the wealth of birds which dwelled there, the mountains, the lakes, and rivers, the animals, perhaps even the races of unknown Indians, he resolved that he would undertake to crack their mystery with a series of expeditions.

The outcome was an expedition organized by Doctor Chapman and led by Dr. George H. H. Tate and T. Donald Carter, both of the American Museum, who succeeded in making an excellent zoological survey of the Roraima region. In 1928 another expedition, again under the leadership of Tate, saw duty in the dangerous Duida area. The great plateau was reached for the first time and, as with Roraima, great numbers of unknown animals and plants were found. Strangely, however, while some of the animals and plants bore a strong likeness to those of Mt. Roraima, perhaps one-fifth resembled those from the high Andes more than 1000 miles to the west. Duida and Roraima were both composed of ancient Cambrian sandstone which probably had been exposed above the marauding seas longer than any other portion of the New World. Some hazarded the supposition that formerly all the highlands were joined in one great plateau, and that the little Lost Worlds of Duida and Roraima were but remnants of the vast animal and plant population which eons ago thrived on the whole plateau.

In October, 1937, at the instigation and with the support of William H. Phelps, an eminent American businessman and scientist residing in Caracas, an American Museum expedition sailed from New York. It had as its leader the experienced George H. H. Tate, just returned from a two-year trip with the Archbold Expedition in the interior of New Guinea, William F. Coultas, former leader of the Whitney South Sea expedition, James A. Dillon, mammalogist, William H. Phelps and his son, William H., Jr., and the author as ornithologist. Captain Felix Cardona, a prominent Spanish sea captain, was engaged as trail finder and radioman. By great good fortune Jimmy Angel was persuaded to fly the expedition in. But much was to happen to prevent this, including an accident which almost cost Jimmy his life.

Angel had induced "Shorty" Martin, a well-known oil geologist, to accompany him on a reconnaissance flight. Martin had agreed with a shrug —"only to stop this constant argument, to see who's kidding who." And their flight corroborated the existence of the gigantic waterfall. Martin brought back photographs and hastily drawn maps of the "walled fortress." He spoke of Indians whose only association with white men was with Angel. He had sampled one of Jimmy's landing fields, had seen the tins of gasoline, the motor repair scaffold, and thatched hut where Angel bunked. Finally, and most emphatically, he asserted that the falls were "all of 4000 feet high" and added, with a sickening look, that they had checked the altitude as well as possible "while Jimmy flew up and down in the spray."

Gold was the keynote of their interest. Martin knew that the little Uruyen River, which sprang from the innards of the mountains, showed rich "color." Jimmy said he was sure this was the mountain he'd landed on with the old prospector. Others, too, came flocking to Angel—oil men, geologists, gentlemen-sportsmen of Caracas, and even an El Paso night-club owner. Nearly $100,000 is rumored to have been invested in the search so far.

Fired with renewed support, the flyer went to work. On a reasonably clear shelf 3000 feet up on the side of the mountain, he cached gasoline and a two-way radio at a base camp from which an attack on the lofty plateau could be launched.

For the final drive to the top, he enlisted the aid of Gustavo Heny, an expert woodsman, and Captain Felix Cardona, one of South America's most colorful characters and perhaps the only white man in Venezuela who can outwalk an Indian.

After surveying Mt. Auyan-tepui from the ground and the air, the three gold seekers abandoned the plan to land on the summit; but Cardona discerned a narrow chimney crack in the sheer cliffs through which he thought he might possibly attain the top. This intrepid explorer and Heny, spurred on by visions of quick wealth, attempted the climb, wrestling for days with precipitous rocks and tortuous ledges. Finally they pulled themselves over the last barrier and stood on the summit—the first humans ever to scale this mighty monarch of the Guiana Highlands.

Discouragement

Their joy at reaching the plateau was soon tempered by disappointment. There were no million-dollar nuggets lying around. And three wall-like cliffs barred progress to the section where Jimmy Angel had thought the gold would be. Cardona and Heny managed to pass the first two, but the third great canyon, into which in all its towering glory tumbled the giant waterfall, stopped them short.

Beyond it they sighted what looked like a possible landing field. Angel studied the spot from the air and didn't like the looks of it, but after several survey flights reluctantly decided to chance it.

Before taking off in the morning, the partners reached a verbal agreement. Jimmy Angel pledged his ability to land the plane without injury to its passengers but did not guarantee that he could take off. Gustavo Heny, somewhat dubious, said that if they cracked up he could lead them out of the Lost World. Cardona was to remain at the base camp to organize a rescue expedition if necessary. Short-wave radio would keep him in touch with the plane.

Just as the pilot was warming up his motor, a comely figure ran from the tent and placed herself in front of the propeller, screaming that she wouldn't let Jimmy go without her!

It was Jimmy Angel's American wife who, having lived the hectic life of a stunt flier's wife, had no desire to become a stunt flier's widow. She insisted on

Composite photo by Tate

Cordona photo

(Above) THE LOST WORLD of Auyan-tepui, in Venezuela, a wonderland from whose 8000-foot rim plunges the recently discovered waterfall that dwarfs all others in height. The expedition sent by the American Museum, under the scientific leadership of Dr. G. H. H. Tate, sought to study the unusual plant and animal life that might be expected to survive on such an isolated tableland

HUNDREDS of square miles of unexplored territory lie between civilization and Mt. Auyan-tepui, to which Jimmy Angel blazed the air trail. At left, Iacha Falls passes underneath in the neighborhood of the mountain

(Below) JIMMY ANGEL and his wife in a hut on his wilderness airfield below the lofty cliffs of the mountain. Not unlikely stories of gold on the summit first led the flier to this remote section of South America

Simpson photo

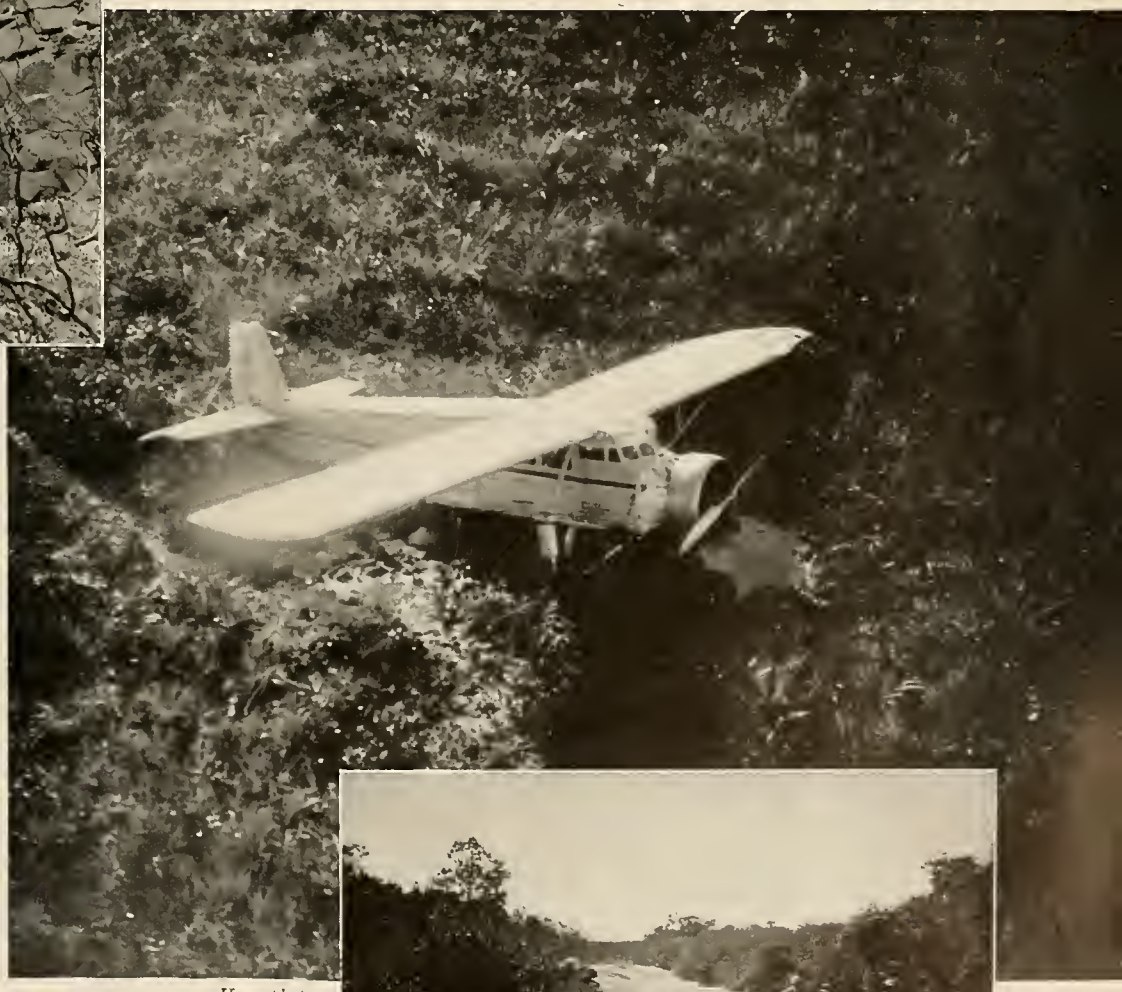
(Below) Natural landing fields in a region supposed by many to be impenetrable jungle enabled planes to fly to a region that had never been reached on foot

Heny photo

(Left) Vertical cliffs guarding the top of Mt. Auyan-tepui dwarf the human figure visible at lower right. It was obstacles like these that retarded the climb of Angel's two companions, Gustavo Heny and Captain Felix Cardona, on a gold prospecting expedition. Once on top, deep canyons prevented them from reaching the section of the plateau they wanted to explore, and they resolved to risk landing on its irregular surface

Simpson photo

Heny photo



(Right) MISHAP befell the party on top, which included Mrs. Angel, when their plane in landing settled into soft earth and gasoline began to drip from a sprung seam. Separated from the foot of the mountain by two weeks of difficult trail-breaking, their survival can be attributed to rare skill and persistence. The plane is still on top

(Lower right) The Angel party on the way out. This is one of numerous rivers on top of the mountain whose waters probably combine to make the great plunge over Angel Falls

Heny photo, right

joining the gold hunt as camp cook, refusing to budge from the propeller's path.

Angel tried to coax her away but she stood her ground. His eyes met his companion's. Heny shrugged his shoulders. "All right," Jimmy called. "Pile in." The plane bearing two men and the woman slid down the short runway, then leaped toward the sky. Cardona, the sun beating down on his emotionless countenance, waved them goodby.

Mrs. Angel had hoped her presence would make Jimmy more cautious. It did. On top of the plateau the plane coasted to what was a perfect three-point landing—until a bump of rock caught its undercarriage. The tail tilted up, then flopped down into a bog. The plane settled heavily into the soft humus, and precious gasoline began to drip from the wrenched seam. The three occupants leaped out. Jimmy scanned the tableland regretfully. "This doesn't look like the place I landed with Williamson," he murmured.

Heny scooped up a handful of rocks. "Doesn't look like gold," he announced, dropping the stones. The plane's wheels had all but disappeared in the soft earth. "Can you get her out?" he asked. Angel shook his head. "Then let's see if we can find some gold and a way out of here."

With the radio, which luckily still worked, they contacted Cardona and told him the plane could not take off but not to worry about them for approximately ten days.

Even in their serious predicament they searched for gold, but without results. For fourteen days Heny explored the face of the mountain for a trail down, and each day managed to pierce a mile or so.

Rescue plans

Meanwhile several rescue expeditions were being organized. Mr. Phelps and "Shorty" Martin succeeded in chartering a Venezuelan Government Aero-Postal airplane piloted by one of Jimmy's old friends, Lopez Henriquez. Eight days later the three men flew the big Lockheed Electra from Ciudad Bolívar to the mountain. They cruised over part of it and then flew over the camp and saw the tiny brown tent in which Cardona sat at the radio, talking to them. Mr. Phelps, having seen the mountain, was convinced that rescue could only be accomplished by means of an autogiro. He set out for Caracas intending to cable for one, but fortunately this plan could be halted in time. For the lost fliers finally crawled exhausted into the base camp. Entering the tent, they found Cardona, with earphones clamped over his ears, calmly directing the rescue plans. After flashing their safety over the air, Cardona's first question was: «*¿Donde está el oro?*» (Where is the gold?) Empty hands were his answer. "Do you think this is the right mountain?"

"I'm sure of it," Jimmy re-affirmed.

All of which brings us to our own expedition. On the morning of December 1st, 1937, as we scurried here and there among the piles of food, equipment, and trade goods scattered around the great airplane at Ciudad Bolívar, I detected a gleam of excitement. Weather permitting, four trips were to be made. Tate, Coultas, Cardona and four peons would go on the first; Dillon and Billy Phelps on the second; myself on the third; and Mr. Phelps on the last. Just in time I rescued my duffle from being pushed into the nose of the ship on an earlier flight—bundles which contained everything on which I would have to depend in the event of a forced landing: bandages, a shotgun with 100 rounds of ammunition, a mosquito bar, quinine, blankets, extra stockings, extra boots, a machete.

I was sitting on the shaded porch of the Gulf Oil headquarters sipping an iced drink, the last touch of civilization I was to have for almost four months, when the big Lockheed roared back from its second trip. Soon another cabin-load of equipment was in the plane, and, astride it, I was flying over Venezuela. About an hour later, after crossing the Orinoco and flying along the wild Caroni River basin, we passed under a snowy ceiling of clouds. Just before gliding down through a hole, I saw far off to the south a black island, Mt. Auyan-tepui protruding ominously through the mist.

Under a cloud blanket our plane followed a strange and dangerous course. The ceiling lay at about 900 feet; below was an endless green maze of tropical jungle, intermittently broken with a corkscrew river which wandered aimlessly over the country. This river, the Caroni, would offer our only escape from the region in case of accident. Sight of it recalled the ill-fated Eugène André expedition which was wrecked in the middle of the dangerous Arichi Rapids of the nearby Caura River while collecting for the Tring Museum, England. There had been fourteen men in the party, and all they could salvage was food calculated to last eight days and a small boat which held only eight men. Twenty-six days later, much nearer dead than alive, André and seven men emerged at La Prisión; the other six had died.

At length I began to see many stone pinnacles jutting up into the clouds like giant supporting columns. We flew for about an hour in an extremely bumpy layer, passing from room to room in this amazing series of giant caverns, until at last we approached a great forested wall. Our pilot skirted this, and after flying into what appeared to be a huge box canyon, he banked the plane and cut the motor.

Below I observed that there were a number of large, yellowish fields. The seemingly endless forest had ceased except for scattered clumps. Directly ahead were four little white flags pointing the way to our airfield, and to the right stood a palm-thatched hut and a group of strange looking individuals. Our plane nosed down toward the lowest landing field on the side of Auyan-tepui—the Lost World.

A wilderness Woolworth's

In short order I became acquainted with the Arecuna Indians who clustered about the plane. In the thatched house I viewed the amazing barter shop which Bill Phelps had already set up. All manner of Woolworth's articles were dangling from a long clothesline, on which the poor Indians cast many a wishful look.

It seemed that with all of the potential labor standing about we might easily start at once for our

proposed base camp. However, we discovered to our dismay that Alejo, their chief, who was on his way, would have to pass on any such venture. Furthermore, the Indians could never be made to climb the mountain, for it was in some manner regarded as a god. A *kanaima,* or evil one, would inflict injury upon any Arecuna who ventured to scale the lofty plateau.

Lopez Henriquez was tinkering with his plane when a tall, handsome, middle-aged Indian in ragged trousers emerged from the jungle, swinging a glittering machete—the chief. He stepped regally across the clearing, trailed by a score of men and women. The almost naked braves each clutched a bow and arrow or a blowgun. At each woman's neck was a squealing brown baby.

The chief's retinue approached in single file and stood stock-still. Cardona advanced to greet him. With a commanding gesture, majestic despite his tattered trousers, Alejo summoned his three advisers and followed the Captain to the tent where Tate, Billy Phelps, and Bill Coultas awaited the conference.

The silver bird wins the chief

Our best bartering would have failed, I believe, had not the old chief shown an insatiable desire to fly in the big bird. For he had several times trekked out to civilization and was prepared to insist that we pay in silver for everything. But in the end the stern chief strolled out to the silver bird, stroked its sides, and without a backward glance at his many wives, jumped into the cabin.

Lopez, the pilot, didn't like the idea. He grimly pocketed a monkey wrench as he clambered into the plane. The chief, establishing personal contact with a thunderbird for the first time, froze rigidly in his seat, staring straight ahead. He remained as immobile as a cigar-store Indian, while his tribesmen peered in the window. The plane lifted off the ground and flew out of sight.

Alejo left in command his eldest son, Jesús (pronounced Hay-soos), who began shouting orders to his tribesmen. The Indians shuffled up to shoulder their loads, totaling almost two tons. Cardona led the way up the mountain. Behind him trailed the 40 Arecunas, presenting a dramatic picture silhouetted against the sky.

When we reached the 3600-foot camp, from which we would attempt the assault on the summit, Tate was already putting its long palm-thatched shed in order, and Cardona was busy in the radio tent trying to recommission the short-wave set. This station, known as "YVGAH in the Guiana Highlands, calling Valery, Ciudad, Bolívar," had not been touched since Captain Cardona had contacted the outside world with it at the time of Angel's disaster.

Scientific work at once began at this level, and we found two nicely distinguished types of plant and animal life. To the north, about 100 yards from camp, a high, thick bank of tropical rain forest, growing in places to a height of 150 feet, contained many strange birds and mammals—deer, peccaries, giant anteaters, howling monkeys, tapirs, etc., and about 250 different kinds of birds. A number of these had never before been seen by man, and 26 species had not previously been known to live in Venezuela. Bellbirds, Cock of the Rock, toucans, parrots, macaws, and a host of small ground birds were found. To the south, beyond the Angel airfield, a stony slope with spaced-out trees and small patches of savanna proved to be the ideal habitation for all sorts of birds adapted to semiarid conditions. It was watered by a little stream from higher on the slopes of the giant mountain, and was scarred with tapir trails.

For several days an intensive collecting program went on unabated, but always we wondered when our leader would decide to attack the mountain. All went well, and amazingly enough Doctor Tate even pursuaded several of the Indians to carry loads up to the plateau. But a sad accident in far-off Caracas was destined to complicate matters seriously.

Felix Cardona, after tedious days of tinkering, had finally fixed the radio—the little magic machine that stood as a gateway to our safety, an avenue through which the staples of life, if necessary the marvels of surgery, could be summoned. The Captain got a rousing cheer when he walked out of the radio tent, sweat dripping from his face, to announce that he had contacted Ciudad Bolívar. But he didn't smile. The first news he received was of a fatal accident to his son.

Cardona planned to leave us the following morning. He was the only man in our company who knew the difficult trail to the summit.

In the face of this turn of events there was no alternative but for Tate to undertake the ascent, unassisted. It was, therefore, decided that he should leave as scheduled with six natives. If he succeeded in finding an entrance through the Sanjón, the great chimney canyon through which Cardona and Heny had struggled to the top, he would establish a little camp near the rim, sending four men back with a letter of instructions. If, however, no Indians appeared, Mr. Phelps was to use his own judgment. Early the following morning Tate departed with his six men, carrying food and hundreds of feet of rope.

Cardona, however, ran into difficulties. No airplane could be found to take him out. With Tate gone, and with Cardona either in the sanctitude of his tent or glued to the earphones, the rest of us settled down to cutting hunting trails, to collecting and to watching the steep mountain slopes for signals, both day and night.

No signal

For four days we waited for Tate's Indians to return. Frequently during the day one of us watched through binoculars, but never so much as a flash of light or a wisp of smoke was seen. As the interval lengthened, Mr. Phelps became increasingly worried and decided that Captain Cardona should lead a supporting party. Cardona and four Indians undertook the climb and, much to my pleasure, I received orders to go along.

I set out early the following morning, little dreaming that with the exception of a small dish of rice, I wouldn't eat again for two and a half days. I had whipped together all the little things I thought I would need: gun, 100 rounds of the smallest, lightest bird shells, binoculars, a yellow flag for sending

Gilliard photo

SOON AFTER THE ESCAPE of Angel's party from the plane marooned atop Auyan-tepui, the American Museum expedition flew to the base of the mountain, prepared to scale it. Seated in the dining hut at left are shown William H. Phelps, of Caracas, who supported the expedition, Dr. G. H. H. Tate, its scientific director, William H. Phelps, Jr., and James A. Dillon, mammalogist

THE JAGGED MOUNTAINS north of Camarata (in the distance below) were one of the features which made the flight to the Lost World difficult. Seven round trips had to be made

Tate photos

(Left) Base camp adjacent to the improvised landing field under the very brow of the mountain. Radio communication was maintained here with civilization

Dillon photo

(Right) Tropical verdure dotted the landscape at this camp 1500 feet above sea level and provided materials for hut building. Tents supplanted huts on the cooler summit

(Right) INDIANS with blowguns were a common sight. Though quite used to the usual dangers of their country, the natives refused at first to help scale the mountain. An evil spirit, they believed, would inflict injury on anyone who attempted this

(Below) THE PLANE which carried the expedition and its provisions; William H. Phelps in the door

Gilliard photos

(Right) FIELD LABORATORY: Dillon, Bill Phelps, and Tate at the table where Auyan-tepui's interesting and specialized animal life was examined and prepared for shipment to the American Museum

(Below) ARECUNA women carrying babies and loads. The tribe finally agreed to accompany the explorers up the mountain when their chief was offered his first ride in the great silver "thunderbird"

Dillon photo

Hundreds of feet of rope were carried on the first ascent, to be used on stretches like that shown at left. Evil spirits believed to inhabit the mountain were not encountered, unless one took possession of the peon Genaro when later he ran screaming into the brush. But difficult rock work they met aplenty

Dillon photo

(Right) The thirsty climber was never far from a drinking fountain, for the funnel-like bromeliads, when tipped up, readily poured their accumulated water down his throat

Gilliard photos

(Left) SOUTH POINT, from just below the top wall, looking toward the base camp, which could be seen through binoculars on the plain far below. Flags were relied on (though not at this point) for signaling

(Above) THE loyal son of the chief, who was placed in charge of the Indians assisting the expedition and proved a most valuable and diligent ally when food problems became acute

(Above) The rare tree related to the tea group, scientifically named *Bonnetia roraimae*, which previously had been known only from the sister Lost World of Roraima

(Above) Rocks you can see through: curious stratifications of dune and silt material in which the softer layers have been eroded out. This is typical of Auyan-tepui

AN abandoned camp of the Angel party *(at right)* spurred the search for the plane, whose cabin might serve as a dry field laboratory. Ultimately the glint of its silver wings was spied some seven miles away. But intervening canyons like the one shown below prevented the expedition from ever reaching it. Against serious difficulties the scientific work was pushed forward, and during five weeks a great number of plant and animal specimens were collected to enrich the Museum's fund of rare types

Gilliard photos

(Right) For subsequent visitors: a cairn built by G. H. H. Tate and William H. Phelps, Jr., just prior to abandoning the mountaintop. Few have ever reached this remote plateau of the world's highest waterfall. Beyond it are visible many other wholly unexplored tablelands

code from the drab rock background, Voigtlander and Leica cameras with as much film as I dared carry, an extra woolen shirt, scalpels, arsenic, cotton, two blankets, a roll of gauze and a bottle of iodine. The gun and cameras had shoulder straps, the rest was lumped into the pack I carried.

Cardona, my new leader, plodded ahead; I followed the four heavily-laden Indians. My first leader had been Tate, my second Mr. Phelps, and now I was under the command of a man who could not understand a word of my native tongue, nor I his.

The heavy mist was replaced by rain before we were half over the jungle trail toward the edge of the 3600-foot shelf. The rich forest through which we passed continued for about three miles. Shortly after the first signs of the steep talus were reached, Tate's trail led us onto a vast, burned incline. Gaunt, denuded forests of seared trunks attested to the severity of a fire which had ravaged this area ten or fifteen years before, and the going was exceedingly difficult. After four hours of continuous climbing, partly with the aid of ropes rigged by Tate, we reached the crest of the 4900-foot terrace. Soon after, we met and passed the four mud-spattered Indians who had accompanied Tate. This meant that he had gained the summit and was encamped there.

Mud and orchids

After an unpalatable rice stew we turned in, anticipating the thrills that were to follow. It was pouring in torrents when I awoke at dawn. Much to my disgust Cardona gave orders that we start immediately without breakfast. For the first hour we climbed step after step in the bed of a gushing stream and then, leaving this, we headed into the burned remnants of a type of forest new to me. At times the mass of charred limbs through which we crawled, resembled a giant rhododendron entanglement. Elsewhere the peaty soil supported numerous bushes and beautiful ground orchids, both red and yellow, as well as spiny bromeliads about two feet in height resembling tall, slender cabbages open at the top. They were filled with rain water and, following Cardona's example, I drank from them. The process was rather disturbing until I learned to sift out the drowned insects with my teeth. The great cliffs were clad in mist, even the giant Sanjón crack through which we must pass.

About midafternoon we reached the first wall at an altitude of 6500 feet, a sheer cliff which towered straight up for about one and a half times the height of the Empire State Building. Following to the left, we entered a foggy cleft, walled on both sides. The trail through this narrow, steep canyon is unforgettable. It was so copiously littered with all of the boulders which in the last eon or so had toppled into it, that I felt like a chipmunk in the bottom of a stone quarry. To top this off there were literally hundreds of waterfalls pouring into the abyss. At many points Tate had laboriously rigged ladders and ropes. My clothes were saturated with water and my boots oozing; even the cigarettes and matches under my "Duck Back" hat had been drenched by a cascade of water.

The crew of Indians with their heavy burdens were having a desperate time. Cardona and I were forced to wait for them time and again. Once, pointing skywards, I made Cardona understand that I wanted to know how many hours it would be before we reached Tate. His answer was that we would be with Tate «*en una hora.*» At the end of an hour we were still deep in the canyon, and shortly thereafter the fog thickened and we lost the trail completely. Dusk set in just as we found it, but the Indians had no intention of continuing.

Going back I found the four boys, drenched and freezing under a small overhang. Cardona was nowhere in sight. Breaking open my pack, I found some dry matches, and miraculously we started a small sputtering fire at the entrance of the cave. All of our blankets were soaked, and we were so famished and cold that sleep was impossible. All of that night we lay on the rocks in a human tangle.

When dawn broke, Captain Cardona, returning from wherever he had slept, directed in no uncertain terms that we begin still another day without so much as a mouthful of rice. The sun came out brightly and we obeyed, assuming naturally that Tate's camp was near at hand. Somehow we gained an altitude of 8000 feet and by way of a spectacular cat's path leading along the face of the cliff, suddenly found ourselves overlooking a vast, barren tableland. It was so frightfully cut by canyons that it appeared absolutely impossible to negotiate. At sight of this the Indians suddenly threw down their loads, flatly refusing to budge without food.

To use a familiar axiom, "I didn't know what the score was," but I knew that somewhere out in the god-forsaken stretch of land a nice fire was burning and victuals were cooking. I loaded the old shotgun and headed defiantly past the group. For two hours I picked my way over a barely discernible trail. Finally at 10 a.m. I reached the top of a large loma. Down below, about two miles distant, I spied a little green tent hemmed in among the rocks. I fired one shell and, watching through my binoculars, saw a figure run out of the tent. It was Tate. With the Morse flag attached to the barrel of my gun, I sent him two words: "Mutiny"—"Starved." The poor man probably thought that the base camp had been ambushed and eaten, but at any rate I got results.

Perhaps an hour later in one of those incredible places, where the trail tunneled along anywhere from five to 20 feet above the ground in the upper limbs of an ancient pygmy forest, Tate and I practically bumped heads. Tate's eyes flashed as he listened to my tale, but before undertaking to find Cardona and the Indians he shouldered my pack and led me to food and bed.

The Indians were eating rice when Tate found them with Cardona. After the meal they left for the base camp with a written note from Tate to Phelps. At last we were on the summit of the Lost World. The whole area looked like "the land which God gave to Cain." The canyons, fissures, walls, and entanglements of foliage greatly impeded progress anywhere.

During the next five weeks 32 species of subtropical birds, a great many mammals, and many plants were collected. Most of the boggy humus area was overgrown with a forest of a *Bonnetia roraimae* averaging about fifteen feet in height. This tree, related to the tea group, had previously been known only at the plateau of Mt. Roraima. Here and there throughout this forest were little swamps in which pitcher plants, xyrids, and pipeworts were found.

Now, it had been our fond hope that, once on top of the mountain, we could find Angel's disabled plane. We knew that it probably contained supplies, and that its roomy cabin was waterproof. There I visualized myself skinning birds comfortably amidst the fascinating instruments. But search as

we would, we could not find it. Time after time we ran across parts of the trail Gustavo Heny had used in his escape from the wrecked airplane, and our esteem for his woodsmanship grew; but still we could not find our way to the plane.

One morning while collecting in the vicinity of the highest part of Auyan-tepui, I followed a flock of paroquets *(Nannopsittaca panychlora)* with my eight-power glasses until they disappeared over the plateau beyond the third wall. This had happened before, and it occurred to me that the vegetation of that area must be much more abundant. Then, as I looked at the far-off plateau, some seven miles distant, a tiny point of light suddenly caught my eye. Through the glasses I made out the lines of a silvery body. We had found the plane.

Tate was incredulous when I told him. Going back with him I pridefully pointed out the general spot and then threw my glasses into range. The airplane was gone! I scrutinized the far-off plateau for some time and finally thought I could make out the field in which I had seen it. The morning sun had changed position just enough to divert the reflection, and had I not looked just when I did, I should never have seen it.

The plane was much closer than we expected, and its discovery gave us all new enthusiasm. In a day or two we had packed up summit camp No. 1, all but the tent, an emergency supply of food, and a primus stove, and had proceeded north to establish the summit camp No. 2.

Food was a pressing problem, and it was not until the third batch of it had arrived that we began to have faith in the possibility of ever reaching the great plateau beyond. Mr. Phelps at the base camp had succeeded in bribing four stout Indians to make two trips up the mountain. The two peons who had arrived with Tate grumbled at the "horrible" cold and rain and almost incessant mist, and one day packed up and left. A few days after arriving on top, Cardona started the long trek back to civilization on foot, with five peons.

We weren't doing so well. We were only at the beginning of a very tough job. But the sixth peon, Genaro, a big strapping Venezuelan with a constant smile, was with us, and he, Tate, Bill and myself transported the food, shelter, and housing.

The giant boulders, crevasses, canyons and the no-man's-land of thickets, which during the next 25 days succeeded in blocking our frantic efforts to find a pass over the colossal third wall, proved to be the habitat of many new and fascinating birds. We had been in this camp four days when Genaro suddenly broke out in a fit. He screamed incoherently and ran off to the river. We did our best to console him, because we liked the fellow and we were in desperate need of his assistance. Nothing did any good, however, and some time later he wandered away.

Food shortage

Things looked very bad. All of the Indians below except Jesús, the chief's son, refused to climb the mountain. None of the peons remained, and we were in the middle of the plateau, our goal practically at hand and as yet untapped. When I made the gross error of cooking an anteater and a few pancakes, the boss installed me as cook and manager of the commissary. Taking stock, I figured that we had enough food to last five days. Instead of five days, I starved the boys for 22 days.

The Indian, Jesús, was a blessing. About every six days his lonely call would drift into camp, announcing that once again the boy who had promised the chief to assist us, was approaching with a five-gallon tin of food and equipment. Bill Phelps took on a huge load of bird and mammal skins and departed with Jesús. Coultas, staggering under a heavy load, returned with him, stayed a short while, and then started the three-day trek out with more of the invaluable zoological specimens. Mr. Phelps and Dillon were the next to undertake gallantly the backbreaking job of carrying sustenance to us and of hauling the priceless scientific booty back to the base camp.

As the days flew by we gradually gave up the idea of reaching the plateau beyond. This was a bitter pill to swallow for we were within two miles of the airplane and the greatest waterfall on earth spouted about a mile and a half away. Gold, waterfall, a luxuriant plateau of unimaginable treasure, the wrecked airplane—all were lost to us beyond that walled horizon.

Seven days without sugar, two days without meat, no vegetables for ten days, no cigarettes for a week, and no more to come. The men looked to me to produce another cache of sugar or meat, but the inevitable had come.

We packed our birds, mammals, plants, insects and photographs. Carrying these and the most valuable equipment, such as guns and cameras, we departed with hardly a backward glance at the fine tents left standing in a scene of unimaginable desolation. I wondered if man would ever see them again.

General Eleazar Lopez-Contreras, President of Venezuela, who had taken a keen interest in our expedition and who had granted many invaluable facilities, was immensely enthusiastic over the results. Not long after our return he commissioned a group of geologists, archaeologists, and engineers to make a survey of the areas surrounding Mt. Auyan-tepui. Dr. George Gaylord Simpson of the American Museum of Natural History, a prominent paleontologist, accompanied the party. Angel, who had obtained another plane, was again engaged as pilot.

In December, 1939, a large volume entitled *Revista de Fomento* was issued by the Venezuelan Government. This work contains the findings of this party and is packed with information, photographs and maps regarding their explorations and surveys. Appearing therein is the full-page illustration of *Salto Angel* (Angel Falls), showing them from top to bottom. This was taken from Angel's plane by the geologists and topographers who, to quote Doctor Simpson "could hardly believe their eyes."

These conservative scientists have recorded in the geological report that Angel Falls are in excess of 3300 feet. Doctor Simpson suggests that even this figure may be too conservative. He saw the falls on March 8th, 1939, at the end of the dry season in their lowest ebb and he tells me that "the altimeter in Jimmy's plane showed the canyon to be about 6500 feet deep and the falls jumped most of that distance." He believes that they may be 5000 feet high—nearly one mile!

The appropriate honor bestowed in naming the falls after Jimmy Angel makes them a monument to the courage and persistence of this explorer-aviator and soldier of fortune.

The full story of this exploration leaves in all of us a profound sense of the high adventure that yet remains in a world that is often thought to hold nothing new. This eighth wonder of the world may some day be on a list of "Cook's Tours," but as yet it has not been approached on foot.

WORLD'S HIGHEST

Angel Falls established as the earth's loftiest and compared for falls throughout the world

THROUGHOUT history waterfalls have inspired man with their beauty and mystery. Yet the one which towers head and shoulders above all others has only recently been discovered and has been seen by few white persons. While Niagara, like many other well-known falls, owes its grandeur largely to volume, and sheer height can never overshadow sentimental appeal. Angel Falls is fully as high as 20 Niagaras, possibly 30. It towers above all other recorded waterfalls by a distance equal to the height of the Chrysler Building. Many reported falls have had to be omitted from this chart for lack of accurate information, for man has often preferred to gaze in rapture rather than measure a spectacle whose majesty cannot be translated into mere figures. Note also that some of the famous falls, like Yosemite, are not one drop, but several. Angel Falls plunges unbroken for no less than 3300 feet, by some estimates close to a mile.

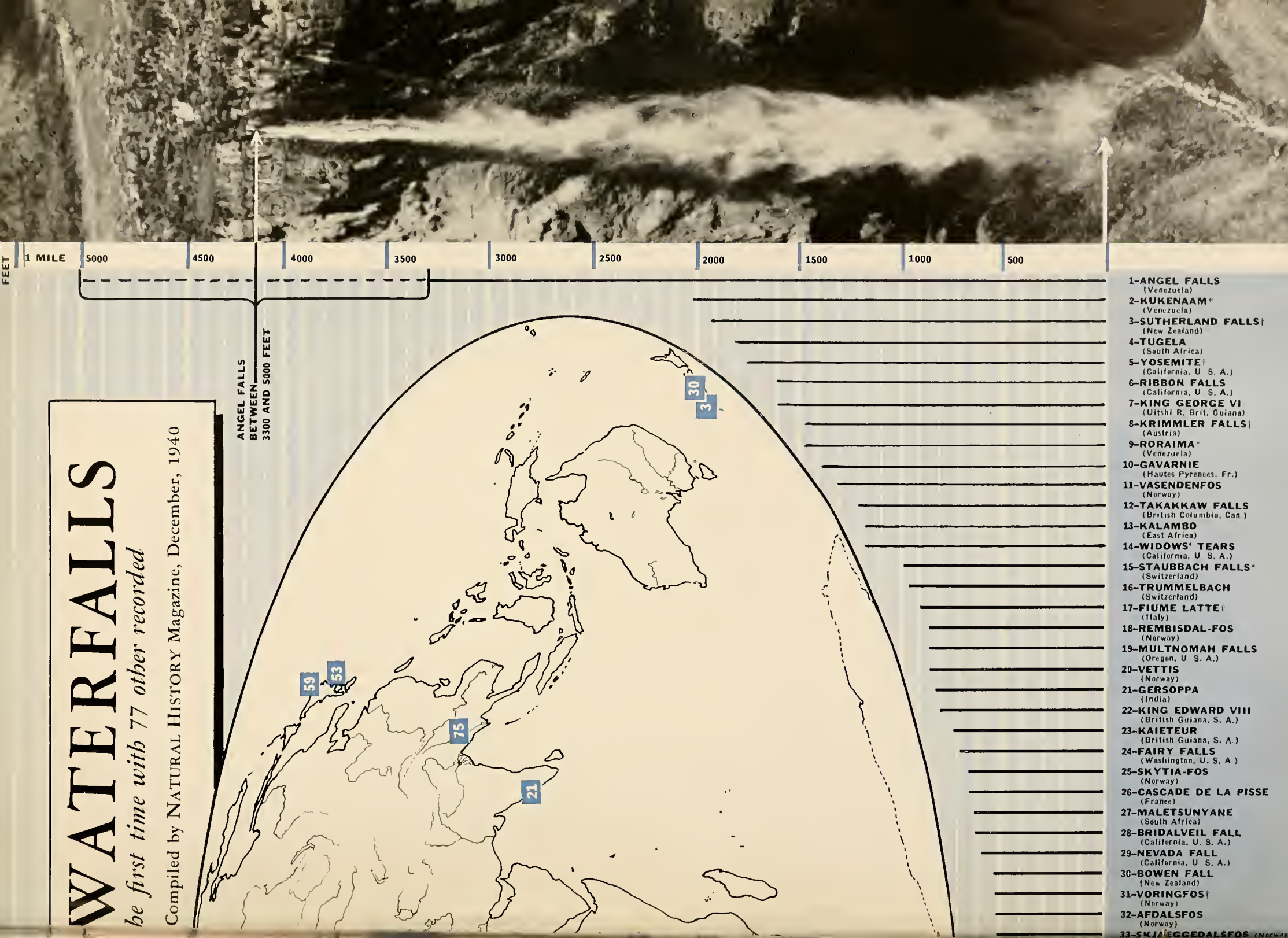
1–ANGEL FALLS* (Venezuela)
2–TUGELA (Natal, Africa)
3–YOSEMITE (California, U. S. A.)
4–MARIA (Venezuela)
5–ROBERTSON (Alaska, U. S. A.)
6–BRIDALVEIL (California, U. S. A.)
7–KAIETEUR (British Guiana)
8–ELSA (Rhodesia, S. Af.)
9–ARIPO (British Guiana)
10–TAUGLBOEN (Norway)
11–ROSENLAUI (Switzerland)
12–ALBERTA (Alberta, Canada)
13–ZAMBEZI (Rhodesia, S. Af.)
14–ROSS (Washington, U. S. A.)
15–GAVARNIE (France)
16–GRIESBACH (Austria)
17–GIESSBACH (Switzerland)
18–TRIBERG (Germany)
19–ELK (Alberta, Canada)
20–TRUMMELBACH (Switzerland)
21–MARMORE (Rhodesia, S. Af.)
22–MAPAJO (Venezuela)
23–PARAGUA (Venezuela)
24–SHOSHONE (Idaho, U. S. A.)
25–GIESSBACH (Switzerland)
26–ROCHEMELON (France)
27–MAGOEBA (Rhodesia, S. Af.)
28–SNOQUALMIE (Washington, U. S. A.)
29–SNOQUALMIE (Washington, U. S. A.)
30–TUGELA (Natal, Africa)
31–GIESSBACH (Switzerland)
32–TRUMMELBACH (Switzerland)
33–ROSENLAUI (Switzerland)
34–GASTEIN (Austria)
35–GASTEIN FALLS† (Austria)
36–TOSA FALLS† (Italy)
37–KING GEORGE CATARACT (Cape Province, S. Af.)
38–TEQUENDAMA FALLS (Colombia, S. A.)
39–HERVAL CASCADES (Brazil)
40–ILLILOUETTE FALLS (California, U. S. A.)
41–HOWICK FALLS (South Africa)
42–GRANITE FALLS (Washington, U. S. A.)
43–VICTORIA FALLS (Rhodesia, S. Af.)
44–SCHLEIERFALL (Hallstadt, Austria)
45–WALDBACHFALL† (Austria)
46–CASCADE D'OURSIERE (France)
47–VERNAL FALLS (California, U. S. A.)
48–GRAND FALLS (Labrador)
49–VIRGINIA FALLS (Northwest Ter., Canada)
50–YELLOWSTONE (LOWER) (Wyoming, U. S. A.)
51–SLUISKIN (Washington, U. S. A.)
52–REICHENBACH (Switzerland)
53–ICHI-NO-TAKI (Japan)
54–SNOQUALMIE FALLS (Washington, U. S. A.)
55–MONTMORENCY FALLS (Quebec, Canada)
56–PAULO AFFONSO FALLS† (Brazil, S. A.)
57–SAUT DE LA PUCELLE (France)
58–SCHLEIERFALL (Gastein, Austria)
59–SPLENDOR OF THE SUN* (Japan)
60–HANDECK FALL† (Switzerland)
61–PISSEVACHE (Switzerland)
62–TAUGHANNOCK FALLS (New York, U. S. A.)
63–IGUASSU FALLS (Brazil Argentina, S. A.)
64–COMET FALLS (Washington, U. S. A.)
65–SHOSHONE FALLS (Idaho, U. S. A.)
66–TWIN FALLS (Idaho, U. S. A.)
67–NARADA FALLS (Washington, U. S. A.)
68–NIAGARA (New York-Ontario, N. A.)
69–CASCADE DE COUZ (France)
70–SHAWINIGAN FALLS (Quebec, Canada)
71–HANDOL (Sweden)
72–PISTYLL-Y-CAIN (Wales)
73–LABRO-FOS (Norway)
74–TOWER FALLS (Wyoming, U. S. A.)
75–MYITNGE FALLS (Burma)
76–SCALE FORCE (England)
77–MURCHISON FALLS (Africa)
78–YELLOWSTONE (UPPER) (Wyoming, U. S. A.)

* Diminishes or disappears entirely in dry season.
† More than one leap.

WATERFALLS

be first time with 77 other recorded

Compiled by NATURAL HISTORY Magazine, December, 1940



ANIMALS IN AN AIR RAID—*Caught in the devastation of total war, wildlife not only proves its courage but teaches man the difference between confusion and fear*

By ERIC HARDY

THE crack-crack of antiaircraft fire had just died down after four hours of wave after wave of enemy bombers droning over the town. I stood in a block of sandbags and listened. It was deathly silent, so silent that one could have heard a bomb drop, to use a popular expression, and then I looked up suddenly as I heard the whistle of wild ducks winging their way across the sky. Somewhere, unseen in the darkness above, a flight of mallards made its way down to the river. I pulled out my watch—40 minutes to dawn! These ducks had almost kept to schedule in their flight down river. During all that infernal noise, as barrage after barrage was sent up by the town's defenders to stop the rumbling bursts of 500- and 1000-pound bombs, the ducks must have crouched by some sheltered pool or river creek, too scared to fly, and they had probably lost a night's feed.

This war is having a strange effect upon wildlife. The unexpected turn of events has brought the devastation of total war into their countryside as well as ours. I am not going to attempt to read the mind of a fox, or owl, wild duck or wild deer: I just want to tell you what I have seen, or heard, or found as a naturalist living and working in the "Battle for Britain."

Confusion has been brought to wild things. In Tom Turner's end of the town they never see wild wood pigeons in normal times. This town is not like London, where the wood pigeons will almost eat out of your hands like the pet pigeons of Trafalgar Square. For ten miles or more around the country here every wood pigeon springs up from the cornfield and clatters away on noisy pinions at the very first sight of anyone in the field or the lane alongside. They mistake your harmless walking stick for a gun, because every farmer shoots pigeons on sight. But Tom Turner came with the tale of a woodie that was roosting in his garden hawthorns, and declared it was the first he had found there in fifteen years. It came during an air raid when the whole heavens seemed to be cracking up, when incendiary bombs set a small wood on fire at a country estate. All the wood pigeons roosting in the treetops there clattered out and were soon dispersed over the countryside.

The birds seem to be in the same state of confusion experienced during a fog or a thunderstorm. They are terrified. They don't know where to go for shelter, so they dive down to the first spot they find and stay there until all is clear. Then, like the rest of us, they take on new courage, make for their old haunts, their old trails and flight lines. In an hour or two after a big raid which may have brought 20 square miles or more of countryside into action with great flashes of fire from roaring guns, there is a tremendous movement of winged folk through the skies.

The searchlights too add to the confusion of the migrating birds. I noticed this in the first months of the war when night after night the searchlight units were practicing in those regions not yet visited by enemy aircraft. Modern searchlights are so powerful, illuminating to the limits of the horizon, that even on the darkest night a battery of searchlights adds a moonlight glow to the countryside or to the town. We have known for years that the bright light of a lighthouse lantern or a lightship in an estuary lures the migrating birds off their course. Hundreds have crashed to death against the glass of the blinding lantern. Something very similar happened with the searchlights. In normal times our cities are such a blaze of light that migrating birds are attracted overhead much as they are attracted to lighthouse lanterns; often we have heard their calls as they passed over in the night—a redwing's faint lisp, a starling's or thrush's "seep." In wartime the towns are blacked-out of all illumination visible from above, and one misses many of the usual migrant calls. But a long spell of searchlight activity will lure the flocks that are passing over open country. They cannot crash into any lighthouses beneath these great beams. Nevertheless many of the birds are lured to their doom, for over the towns and cities of half of Europe float great silvery-gray balloons attached to long, steel cables; and many a migrating bird breaks a wing or shoulder against the unseen cable hanging in the sky to wreck the metal machines that fly by night.

I have picked up a ruff killed on its way from the Arctic, a woodcock that had come over the North Sea from Norway, a wheatear on its way from the local rabbit warren on the sand hills to the warmer winters of North Africa. The wild geese fly too high to strike the balloon cables.

There is evidence of confusion in one's ordinary daytime walks. For example, Black Wood, on the top of the hill above my home, has been visited by Rex (my collie sheep dog) and I on most mornings for the past fifteen years. It's the last place where one would expect to flush wild ducks, for the nearest water is on the other side of the big hill. The wood itself is as dry as tinder, thick with old bracken and

choked with an almost impenetrable jungle of young birch trees. Well, we'd never seen or heard about duck in Black Wood until one morning recently when Rex flushed a pair of mallards from the very middle of the wood, where a week before I had sent a fine jack hare racing away. These creatures had sought shelter during the night because of their fear of the open in their normal haunts.

But fear has not been so evident as we anticipated. When the sirens wail out their horrible warning, when the antiaircraft guns crack out at the first planes in sight, and the defending Spitfires roar up and over the sky, the carters in the streets unhitch their horses from the shafts and fasten their halters to the bottom of the back wheel as the safest precaution. In a big thunderstorm a horse might be scared enough to bolt at a clap of thunder; but there's so much noise going on in a big raid—almost ear-splitting noise that makes the ground tremble for miles from those 4.5 antiaircraft guns or those 1000-pound bombs—that confusion but little fear takes hold of the well-trained animals. Given a nose bag, the average horse is quite content to stand through a raid showing no more fear than an occasional toss of the head at each new sound.

When the war started those of us who had a lot to do with national Air Raids Precautions advised animal owners to give their dogs and other animals bromide tablets before a raid in order to steady their nerves. Some people still give their dogs these nerve tonics, but we have found that they are needed only by those badly trained, excitable house dogs. My own dog has been through many long raids and has never had any drugs, ear-pads or anything else. He has been trained for it all. He is a collie sheep dog, one of those lovely black and white, silky-coated creatures of intelligence from the northern hills which have gained world-wide fame for their part in the sheep dog trials. As our worst raids come in the night, I see that Rex gets his one meal in the evening before dusk. This leaves him rather heavy and sleepy for the night. When the sirens start up from their low whisper to their veritable howl, he joins in the warning with his barking—this was his own contribution, for we never taught him to do it. He discovered that the sirens meant something important and that we were eager not to overlook them; that they were something wrong like an intruder in the garden or a trespasser within the gate, so he barked as on all such occasions. When the family appeared at the back of the house, he preceded them down the garden and into the shelter, taking up his appointed place on a mat in one corner. There he lay calmly and peacefully without a murmur, until the sirens again screamed out the single, high-pitched, continuous note that means "raiders past." He then gets up from his corner, runs up the stairs, and is first out of the shelter, going straight to his kennel.

Now we have often slept all night in that little shelter, and for three of us and a dog, plus a large wooden stairway, a small table of emergencies and food, a bench, a portmanteau of change clothes and private papers (in case the house is wrecked), plus a number of rugs and pillows, a floor space six feet by four feet is not much. Yet Rex seems to understand: if there are six or ten hours of warning to keep us there till morning he occupies just his length and not an inch more; nor does he move out of his place all night through. Of course every dog is not like Rex, but it just shows you that a lot of the war's effects upon animals is mental.

Another example of the lack of fear occurred in a particularly noisy raid. I found one of our local tawny owls, which nests in a convent wood above my house, flying round my neighbors' gardens, calling a curious, rasping note made only on occasions of confusion and perplexity. His normal nightly occupation is to hunt up and down a long hawthorn hedge that follows the bottoms of our gardens, searching for field mice and sparrows. On one moonlight night he collided with my window, which he possibly mistook for a pool of water in which he could have one of his much enjoyed baths. But during the firing of this raid, he could not understand the reason why people suddenly ran down their garden paths when they should have been in bed, and like rabbits they all disappeared from view down their burrows and did not reappear. Flash after flash of light illuminated the sky, and man-made sunrays swept back and forth against the night. It was all strange and confusing to that owl, for he could not possibly understand the danger of those bangs when there was no gamekeeper walking around with a big gun under his arm to make them.*

Death, as well as confusion, amongst the animals is the result of air raids, and it comes in strange ways. The first bomb craters I saw in this war were three in a line on Hundred Acre Farm bordering the main road, which the raider had tried to hit and missed. They were about fifteen yards in diameter but only a few yards deep. The first thing I found upon inspecting them was a decapitated hare lying beside one of the craters. Its head was nowhere to be seen. The bombs that are dropped casually or jettisoned by fleeing bombers often fall in lonely farm fields, and on such occasions a good number of farm animals have been killed while grazing, and rabbits have been blown out of their burrows, warren and all. You see, to any animals feeding or hunting down a hedgerow, the increasingly loud whistle of a bomb coming down seems like the whistling wings of a swooping falcon about to pounce on its prey, and most creatures prick up their ears and raise their heads to see the cause of it. More than half the dead creatures we have picked up near the bomb craters in the fields have had their heads blown off. But they are only the creatures near to the crater. A few yards away, their small forms are so low on the ground that they escape the splinters just as do our Air Raid Wardens and soldiers who fall flat upon hearing the whistle of a falling bomb.

As can be expected, the antiaircraft guns that send up a box barrage into the sky, often turning away a wave of bombers, must bring down a few birds that are flying there. But the number of avian casualties is surprisingly small. During an air raid near Edinburgh, the antiaircraft brought down a shag or green cormorant, which was found to be wearing a metal leg-band, which had been affixed to the nestling the

* As I read over this article in my shelter during an air raid, I notice at a temporary lull in a heavy spell of antiaircraft guns and bombs that the hooting of a cock tawny owl is quite audible from our hedge. Is he venting his wrath at the raiders?

(Continued on page 293)

WEST COAST

By FRANCESCA LAMONTE
Associate Curator, Department of Fishes, The American Museum of Natural History

(Below) FLANKED by graceful, wide-spreading outriggers, Michael Lerner's fishing launch rides a rough sea off Tocopilla, Chile. Mr. and Mrs. Lerner added eleven swordfish and 29 striped marlins to their already enviable haul of game fish. Scientists gleaned more information on swordfish habits, moved closer to solving an outstanding mystery—where does the Western Hemisphere swordfish breed?

David D. Duncan photos

(Right) STRIPED MARLIN FIGHTING. This most energetic game fish sometimes leaps clear out of the water. Rod and reel anglers have not hit the top in records, for specimens weighing 1000 pounds are known to swim the sea

The fourth Lerner swordfishing Expedition breaks the heavy seas off South America's desert shores to enlarge our knowledge of these mighty game fish and penetrate the mystery of their breeding grounds

THE barren hills of the Coastal Cordilleras slope sheer to a narrow strip of shore. Behind them stretch hundreds of miles of sand desert—the pampas of northern Chile—backed by the snow-covered peaks of the high Andes. In front is the Pacific Ocean.

Just three days through the air from the heat of a Miami June, and we are in the chill of a West Coast winter. Two fishing boats stand in the harbor of Tocopilla waiting for our expedition. All around them the water is alive with anchovies, and the neighboring boats are obscured by flocks of birds swooping down to feed on the small blue-and-silver fishes. Sea lions clamber awkwardly down the guano-covered rocks, flop into the water, then dart sleekly toward their prey. All the barges are edged with pelicans digesting their latest meal.

The mountains shift from color to color in the thin morning sun. The town of gray sheds at their base sends out to the waiting freighters an immense fortune in minerals, to enrich the soil of other lands and to make the weapons from which no living thing is safe any more.

This is a coast of strange contrasts, where desert sands, barren of vegetation, hold an incredibly rich store of minerals; where rough waters, beating against the driest coast in the world, conceal an angler's paradise.

The climate is ruthless. It is almost devoid of rain, but subject to devastating floods. Rains are so infrequent that they bring terrible destruction. Houses emerge with crumbling walls and ceilings. Servants do not appear for work because their homes have fallen in or been swept down the mountainside. The roads to the mines are washed out. Tidal waves in one night destroy prosperous ports, leaving only ruined walls.

This is a land dependent upon the vagaries of marketing its mineral wealth; a land where a change in the processing of nitrates leaves a once gay and busy city with half-paved streets of empty mansions.

Our expedition reached Tocopilla in time to collect W. E. S. Tuker's affidavit for the latest record rod and line swordfish—an 860 pounder. Down at the dock we saw two brought in that day—841 and 507 pounds. It is hard to believe that these enormous bronzed creatures with their powerful muscles and flat, heavy swords, began life only one or two years ago as eggs the size of a pinhead.

The very young swordfish, just hatched from such an egg, is transparent, covered with glassy spikes, and equipped with two fragile, blade-like, toothed jaws. Before this animal achieves its adult appearance, it goes through various gradual changes: the lower jaw shortens; the teeth disappear; the skin becomes smooth.

Realizing the minute size of the eggs and young, we do not wonder that we still have not discovered the breeding grounds of our own and the South American runs. Only the self-contained Sicilian run, which spends its entire life around the Strait of Messina, serves as a guide for our search. There, in April, adult swordfish begin to swim inshore in pairs to spawn. In the big, stationary tunny nets, eggs, larval fish, and spawning adults have been collected. Scientists have even hatched the eggs and brought the fish to thirteen days of life in a laboratory. So at least we know exactly what one object of our search looks like, which is not always the case when young of a fish vary from the adult as much as many of them do.

David D. Duncan photo

(Right) THE EXPEDITION on "safari" across the desert en route to Tocopilla. Though barren, these desert sands contain Chile's nitrate wealth, which is used for explosives and to enrich the soil of other lands

(Left) NATIVES "PANNING" on the barren shore off Tocopilla, Chile. In this country everything depends on nitrates. A change in the process of manufacture may leave a once gay city with half-paved streets and empty mansions

Lerner Expedition photo

We wish we knew this much about the marlins. These offer an even more complicated study, for there is only one swordfish all over the world, but there are several different marlins—white, blue, black, striped.

If man wants to utilize swordfish or marlins for gain, either monetary or scientific, it is obvious that he has to follow them to their own haunts and in their own seasons. First of all, of course, he has to find those haunts, for fish have mysterious ways that only patient study can reveal. Such study began long ago before railroads, modern steamers, and airplanes made it quick and easy to get to the ends of the earth. Aristotle and Pliny knew the swordfish tribe, as did others long before them. But knowledge was fragmentary and so confused that it is difficult to know just which fish some of the older writers meant when they used the word "swordfish."

Today, it is clear that there is only one true swordfish, with many distant relatives. And these relatives are the same surprise that anyone's relatives are apt to be.

The marlins, sailfish, and swordfish have the family head, and might be said to have the family nose, although the sailfish and the marlin are equipped with a narrow, cylindrical weapon, while that of the swordfish is broad and flat. A search into the genealogy, however, reveals how distant the relationship really is. For a great many years this genealogy was in a state closely resembling the mind of the Old Man of Khartoum

> Who kept two black sheep in his room
> "They remind me," he said
> "Of two friends, who are dead;
> But I cannot remember of whom."

In this case, search revealed that the ancestor of the swordfish was a fish called *Blochius*, which swam about some 45 million years ago; while *Palaeorhynchus*, who came along a few million years later, bore characteristics of an ancestral sailfish or marlin; thus the two families have been separate for many million years.

More modest, and, like many modest relatives, more numerous, is the mackerel, the most primitive of the large group in which all these fish belong. Other relatives are the tuna, cutlass fish and wahoo. Genealogy of fish is not merely a question of outward appearance or names. It is a basic study involving every smallest bone of the skeleton and every smallest measurement and body proportion.

In the past it has been so difficult to obtain whole specimens of the very large fish, that the swordfish and marlin studied by the older scientists were each known by name—"the Loire specimen," "the Grant specimen."

We have been more fortunate than our elders, in being able to make expeditions to the big swordfishing and marlin grounds of the world and study freshly caught specimens.

By our firsthand study of the adults, we are gradually nearing the breeding grounds by discovering just where the adults are at certain stages of their life —when they are sexually inactive, have recently spawned, or are ripe for spawning.

For a very long season of the year, the waters near Tocopilla are full of large, commercially important fish, especially the swordfish. But owners of the few small fishing boats native to the harbor are hampered by heavy seas and light purses, and for the most part confine their activities to the anchovies near shore.

Nor is a commercial catch always suited to our needs, for it is customarily brought in at least partially "dressed," that is, gutted, with head, fins and tail gone. And we need whole fish for our measurements.

It is a popular belief that length and weight are indicative of the age of a fish, but it is not true. Each part of the organism has its own rate of development, and the relation of various parts to each other and to the whole indicates the typical changes we may expect at certain periods of growth. Data we have collected on the blue marlin, for instance, show that many of the organs and parts of the body grow relatively faster or slower than the body length. Added to this is the relation of the body proportions to the principles of streamlining which are necessary for the fish to move about adequately in its liquid environment. Our mysterious 47 measurements are designed to cover these factors and to tell us ultimately something about the growth stages of these fish.

Here in Tocopilla, our Museum expedition was once more completely dependent for laboratory specimens on the angling skill of Michael and Helen Lerner. This dependence was well justified by their catch of eleven swordfish and 29 striped marlin during our few weeks there.

Our two fishing launches left every morning at daybreak. An ocean too rough for risking our outriggers near the mole forced us to wait for a swell that would bring the rowboat to us, and we jumped. Once transferred to our launches, we were soon in open ocean looking for the flash of dark fin above the water.

Soon the anglers were out of sight of land. The rest of the party on shore, tuning the radio in for distant San Francisco, London, or Moscow, would suddenly hear our own boats talking with each other, the voice of Captain Hatch signaling, "*Santa Luisita* calling the *Santa Teresita*. *Santa Luisita* calling the *Santa Teresita*. *Santa Teresita* come in please."

Or a strange voice proclaiming, "Steam yacht *Polaris*, calling the Lerner fishing launch. Mr. Lowe left a message with Miss LaMonte about Mr. Lerner's rod."

Tocopilla is truly a fisherman's paradise, but its waters in the winter season are even rougher than those we encountered off Cape Breton. It is a weary party that lands at the end of a long day, climbing with the heavy camera equipment from a heaving boat onto the dock steps. After that the day's catch must be hauled up by crane onto the mole, weighed-in while it is fresh, and left until we can get daylight for a photographic record. The fish are much too large to bring back whole to the Museum laboratories, so our records depend for accuracy on a careful examination on the scene of capture, and on our photographs.

Our day's catch of marlin and swordfish is photographed the next morning. Then, followed by the anglers, the expedition members and a crowd of interested observers, the fish go off down the road on a cart drawn by two unwilling burros. We wind our way toward our shed laboratory, past gleaming heaps

David D. Duncan photos

(Above) NATIVE BALSA RAFT used to carry the market catch over the surf to shore. If the surf is high, the ride is a dizzy one

(Left) NATIVES congregating on the beach to buy the fish as fast as they are landed. Black and turkey vultures flock in great numbers to snap up heads and entrails, thus performing the laudatory service of keeping the beach clean. Both vultures are almost never seen together elsewhere. Where the land is warmer than the ocean, the turkey vulture is the coastal bird; where the land is colder than the ocean, the black vulture takes this place. Here in a transitional zone both are present

of blue, green and purple minerals. Around us dart the photographers.

Everyone at some time has probably entertained a secret desire to be in the movies, but nothing is more disillusioning than to find yourself really on the screen. And on an expedition, any remaining illusions are entirely liquidated by shouts from the cameramen, "Get out of the way—you're covering the *fish!*"

Once in the laboratory, we begin the exhaustive external measurements. Then we examine the stomach contents to discover what and where the fish has been eating. The swordfish and marlin we have encountered on all our Lerner Expeditions appear to be opportunists about their food, eating what is nearest them. Off Peru and Chile they were feeding exclusively on large squid. These were present in great quantities at that time; fishing them on rod and reel was inaugurated by our party as a new and exciting sport.

We became very popular in Tocopilla when it was found that, after we were done with our strange ceremonies over the fish, large circular slices of the cleanly pink flesh of swordfish might be had for the asking. This prize is well worth a little patient waiting, for swordfish meat is a great treat there and a welcome variation from the *congrio* (cusk eel) and the extremely unattractive *peje sapo*. Occasionally the wait is long, for there are always a few of our catches earmarked for Museum exhibition halls.

In this case, after the measurements have been made, our two guide-captains, Bill Hatch and Doug Osborn, reveal hidden talents. Plunging their hands into a pail of milky plaster, they begin covering the huge fish as it lies on the dissecting table. After the plaster hardens, a lightweight mold is lifted off the fish. This mold, sawed in two or three pieces, is packed for shipment to the States. There a manikin will be cast from this mold and the tanned skin drawn over it.

After the mold is taken off the small cuts necessary to extract stomach and sex organs are made. Then the guide-captains begin skinning the fish and preparing the skin for shipment.

Our labors with our specimens by no means end in the field laboratory. We always know that we shall spend a few hours in Customs with them when we land. Even with all the patience of good-natured Customs men, it is still a lengthy and nerve-wracking task to examine over a hundred pieces of equipment, and this is sometimes impossible until all the other passengers have left the Customs shed and practically all the luggage and strange-looking crates scattered about the dock bear the label, "Lerner Expedition. American Museum of Natural History."

Many more hours are spent in laboratory and in exhibit halls. Finally the last specimen is examined, catalogued and labeled, and completion of the mounting, coloring, hanging, lighting, and labeling of the fishes makes them ready for public display.

But all this happens after we have come back to our daily work. The real expedition ended for us when, for the last time, we watched the sunlight on the great greenish fault in the cliff below Tocopilla; while below us the boatmen loaded our cans, bottles, boxes, cameras and tackle trunks; and the steamer finally moved out from winter toward autumn again.

AMNH photos

(Left) THE BABY SWORDFISH sports two swords instead of one. Within the narrow glass tube at left is a two-week-old swordfish in which the division between the two projecting jaws is faintly visible. He began life as an egg the size of a pinhead, and had he lived he might have ranged through the four-and-a-half foot specimen *(below at right)* to the giants at upper right—all in the course of one year!

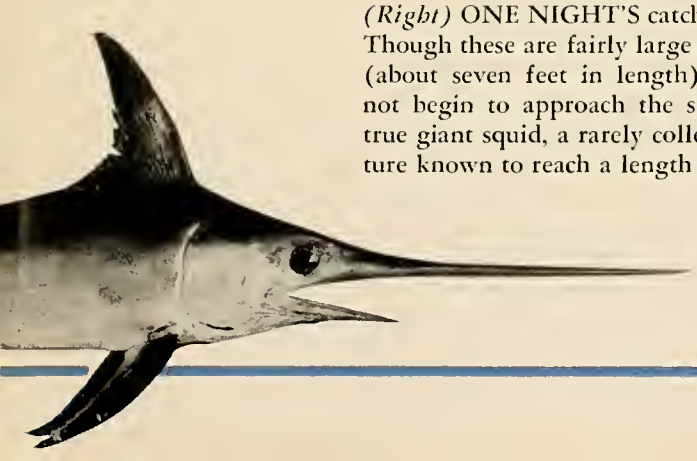
LABORATORY WORKERS have hatched the eggs and brought the fish through thirteen days of life. Swordfish grow so fast and travel so far that scientists have yet to learn the breeding grounds of those native to this hemisphere. Only the self-contained Sicilian run which sticks entirely to the Strait of Messina has been thoroughly investigated

(Left) TWO SWORDFISH taken in one day off Tocopilla by Mr. Lerner. They weighed 668 and 454 pounds, respectively. The latest record is 860 pounds

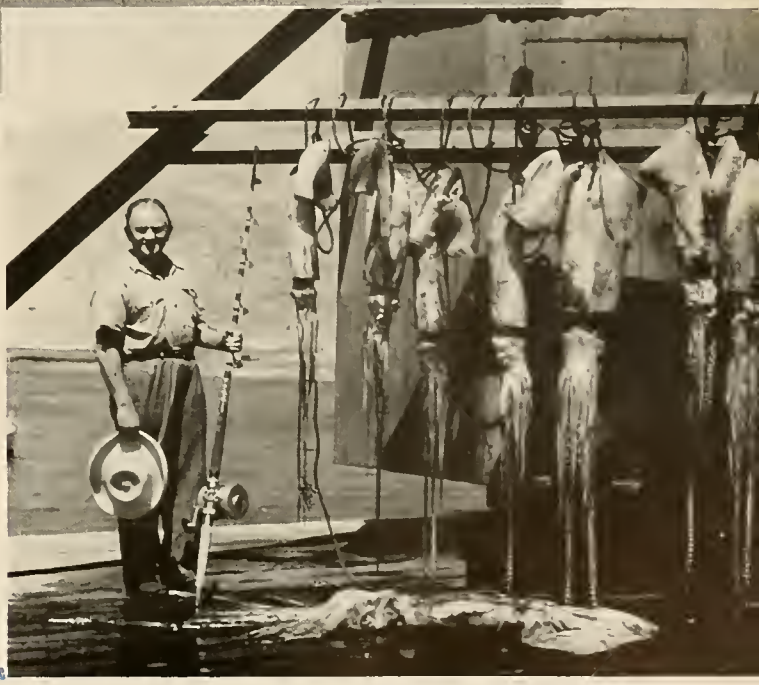
(Right) MRS. LERNER with striped marlin. Whereas swordfish are the same the world over, there are several varieties of marlin. Though related, their respective families have been separated for many million years

(Above) MISS LA MONTE and Mr. Lerner examine a catch of assorted smaller fish

David D. Duncan photos



(Right) ONE NIGHT'S catch of squid. Though these are fairly large specimens (about seven feet in length), they do not begin to approach the size of the true giant squid, a rarely collected creature known to reach a length of 52 feet



David D. Duncan photos

(Above) AN UNWILLING BURRO hauls the expedition's catch off to the field laboratory *(see opposite page)*. The fish are too large to be transported back to the Museum and hence must be dissected on the spot.

Such dissections prove that length and weight do not necessarily indicate the age of the fish. Forty-seven separate internal and external measurements are made, which yield the intricate relationship of individual organs to the whole and enable scientists to judge the stage of growth each specimen has reached

(Right) THREE VIEWS of the expedition's laboratory. The crowd in the upper picture is not drawn by scientific curiosity. They know that when the measurements have been completed, slices of fresh swordfish will be distributed gratis.

Lower insets show assistants skinning a large swordfish *(left)* and making a plaster mold *(right)*. Both skin and mold will be shipped to the American Museum of Natural History, where a manikin will be cast and eventually covered with the tanned skin. The great fish is then ready to take his place as a public exhibit

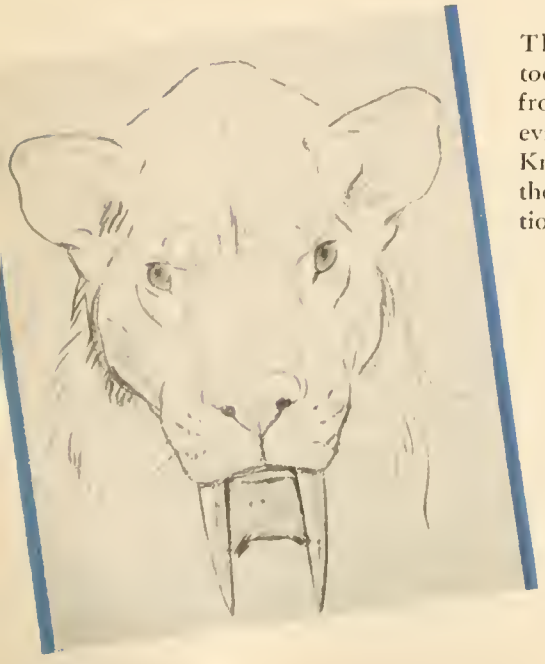
THE TAR PIT TIGER

A voyage into the remote past, in which you will see that even his terrifying eight-inch daggers were helpless against the fate that befell this distant cousin of your gentle mouser

By EDWIN H. COLBERT
Assistant Curator of Vertebrate Palaeontology, The American Museum of Natural History

THE great sabre-toothed cat, *Smilodon,* arose slowly from the angle in the cliff wall and stretched himself in the warm light of the rising sun, pulling himself forward by his powerful forelimbs so that his body seemed to elongate and taper into his extended hind legs. He opened and closed his front paws, alternately disclosing and sheathing the scimitar-like claws with a series of rippling motions that flickered along his strong forearms and up into his tremendously powerful shoulders. Having done this, he pulled himself together and looked out to the west, sniffing the fresh morning air.

Evidently some message was borne to him, for he pricked up his ears and lashed his short, stubby tail back and forth. But the message brought to his keen nostrils was relatively unimportant, for he soon abandoned his alert air, and again stretched himself with lazy grace. This time he yawned as he stretched, dropping his lower jaw down and back until it almost touched the swirls of fur on his powerful chest, exposing in all of their ominous beauty two immense sabre-like teeth which protruded down like two ivory daggers from his broad muzzle. Back and back went the lower jaw, up went the whiskered lips in a snarl, and the daggers flashed in the early sunlight, each of them an eight-inch sword of cruel death. Then the lower jaws came back into place, swinging up between the sabres, until as his mouth closed tightly, the two teeth projected as long fangs, far below the lower border of his jaw. Thus the ceremony was completed, and *Smilodon* was awake to a new day.



The extinct sabre-toothed tiger drawn from accurate scientific evidence by Charles R. Knight. (Courtesy of the Carnegie Institution)

He looked out through the hazy light enshrouding the southern California hills, sniffing the air and peering intently at the miles of landscape stretched before him. His hunting earlier in the night had been fruitless, and he was very hungry. The short nap that he had taken in the early morning sun had been a brief respite from the hunger that gnawed within, but now that he was awake again the pangs seemed even more acute as a result of his brief rest. So he looked out to see what the morning's hunting prospects might be.

Before him in the valley a herd of large mammoths browsed along a watercourse. Swinging their ponderous elephantine bulks from side to side in a slow, gray rhythm, reaching up with their trunks for tender leaves high in the trees, fanning their large ears, prodding with their ivory-white tusks, they moved along in a peaceful but irresistible mass, unhurried, unworried and unafraid. They gave to the scene what might seem to us an African touch, yet they were entirely within character zoologically and environmentally. For this was California of 20,000 years ago, at the end of the Great Ice Age, in the days before man had spread out to despoil a primitive world, perhaps even before primitive man had reached a new home in the Americas.

So it was that in the California of those ancient days there were various animals long since vanished

(Above) The famous La Brea Pits, near the modern city of Los Angeles, where sabretooth, giant sloths *(right foreground)*, and many other animals were trapped as described. (From a mural in the American Museum by the celebrated artist, Charles R. Knight)

from the American scene, animals which in some cases were to continue life in other parts of the world, in some to disappear completely from the earth. Therefore it was entirely plausible that a small herd of camels grazed in the wake of the elephants, moving along in a series of fits and starts, now cropping at a patch of good forage, now stopping in statuesque attention, alert for the danger of a prowling marauder, now moving on to the next feeding place. And in the stream a tapir splashed heavily.

But of all the strange creatures inhabiting southern California in those days, none were more bizarre than the giant ground sloths, the much magnified cousins of our tree sloths now living in the tropical forests of Central and South America. These giant sloths were huge, clumsy creatures, exceeding in weight the largest bull bison who tossed his shaggy head at the edge of the herd grazing on the nearby plain. And although their family history links them with the tree sloths that climb their sleepy way through the green roof of the tropics, these giant sloths in reality resembled in appearance nothing now alive. Their great, barrel-like bodies were supported on heavy legs that would seem in some ways to have been ill-adapted to travel on the ground. While the flat hind feet were serviceable enough, the animal was forced by the peculiarities of his structure to the anachronistic device of walking on the sides, rather than upon the soles of his front feet. To direct this lumbering and ponderous mass, there was a rather tubular-shaped head, from the middle of which there gazed a pair of small and probably somewhat expressionless eyes.

Mingling with these vanished and outlandish creatures there were other animals that even today seem more or less at home in a California environment. There were large herds of horses—the original native horses of America that became extinct long before the Eurasiatic horse was re-introduced into the New World by the Spanish conquerors. There were pronghorns on the plains, and deer and peccaries in the woodlands; bears of various kinds waddled through the little sunlit parks and across the open grasslands, while lynx and puma lurked in the treetops.

It would seem that with this profusion of game, both large and small, the great sabre-toothed cat should have little reason for hunger. Here was the most highly perfected killing mechanism in the history of mammalian evolution, the archpredator of all time, the product of many millions of years of progressive adaptation to a life of hunting, killing and fighting, unable to satisfy his hunger among these wandering animals.

Why should this be? Perhaps it was because *Smilodon* had become a victim of his own high degree of specialization. Strong and powerful, and equipped with a pair of short swords capable of piercing the toughest hide of his toughest victim or adversary, the sabre-toothed cat was admirably fitted to a hurly-

burly life where strength and power were at a premium. But it may be that he was sadly lacking in the agility and cunning so characteristic of his feline cousins, for they were able to bring down the swift and alert animals that were coming more and more to prevail in a world where intelligence rather than brawn was of vital importance. Perhaps his food was being eaten out from under his nose by some of these quick cat relatives of his.

Of the several cats contemporary with the sabretooth, probably just one was a real threat in an active way. This was the giant jaguar, now extinct and known as *Felis atrox*, a powerful feline with all the cunning of his kind; of prodigious size and strength, he was fully a fourth again bigger than the largest lions of modern Africa. Perhaps he was not as strong as the sabretooth; certainly his weapons were not so formidable as the huge sabres of *Smilodon;* but perhaps what he lacked in power of attack, he made up for in finesse.

Thus it would seem that the sabretooth had his problems. Of course he was not conscious of them as such, for like most animals he took life as it came, with all thought for the expediency of the moment and with little or no attention to the trials and difficulties of an uncertain future.

So it was that having looked out across the valley and the distant hills beyond, the sabretooth descended into the brightening day to try again in his never-ending quest for food. Padding noiselessly down the slope, he soon reached the valley floor, to begin a process of reconnoitering.

Following a course up the wind, he sensed a buck deer browsing in a small glade. Here was a chance for his long-sought meal. He crept forward slowly, utilizing every bit of available cover in the way that only cats can do, flattening himself out, creeping forward again, freezing to post-like rigidity whenever the deer showed signs of restlessness. It was a long and a slow process. But at last he had gained his position—now, he thought he was within striking distance. The deer continued to browse, unmindful of the danger on his flank. Now! Like a raging wind, the sabretooth burst from the thicket that had protected him, in a headlong rush at his quarry. But his attack, sudden and furious, was not quite fast enough. With a whistle of alarm the buck leaped away, and with his antlers flattened against his back, he vanished in a series of long jumps through the open woods.

The sabretooth snarled his disappointment, but without further delay he again took up the never-ending hunt.

An hour or two of prowling, an hour or two of disappointment. Then there came an odor that made the hackles on his back rise up. His archenemy, the giant jaguar was near, feasting at a kill. The sabretooth followed the scent, watching with unceasing vigilance. There was the jaguar ahead, in a small field at the edge of the open woods, mauling and tearing at the carcass of a camel which he had just brought down. He growled fiercely as he attacked his meal, and his long tail switched back and forth in cat-like exclamations.

The sabretooth watched the giant jaguar, and as his hunger mounted at the sight of the food, anger arose within him, lashing him to an ever-increasing state of fury. It seemed beyond all reason that this hated enemy should be eating while he went hungry. As this feeling became ever stronger, caution became weaker. With a boldness spurred by hunger, the sabretooth crept out of the forest border, towards the giant jaguar and his prey. This latter cat, for the first time aware of his danger, suddenly ceased his eating and swung around to face the sabretooth. With the unmistakable language of all cats, he laid back his ears, lashed his long tail, bared his teeth and loudly warned the sabretooth away. *Smilodon,* not the least frightened by this demonstration, circled the giant cat, trying him out, seeking an opening. His powerful shoulders were tense, his short, stubby tail was vibrant, his huge daggers were bared to their full length.

With a roar he closed in on his enemy, throwing all of his strength into the attack, striking with his sabres. For the brief space of fifteen seconds the world seemed to explode within that little clearing. A writhing, roaring mass of fury shook the ground—and then it was all over. The two warriors separated, to glower at each other, to roar and to hiss. The giant jaguar stood his ground over his booty, the muscles of one shoulder laid bare by a long, clean cut from one of the sabres. The sabretooth backed away, having failed in his first assault and not having the resolution to take the risk of another. Better to go hungry a little while longer than to run the chance of a fight to the death.

The long afternoon wore on, and still there was no food. It seemed that the big clumsy sloths, the slow tapirs and the young mammoths, which fell easy prey to the power of the sabretooth, were nowhere to be found. And the deer and the horses were too swift for him. Lesser animals were out of sight long before he got within striking distance of them. So he was hungry and tired, for he had traveled far. His wanderings had taken him in a long circuitous route through the valley. Now as the sun dropped nearer and nearer to the western horizon, he became increasingly aware of game nearby.

He had come to the dreaded tar pits. In this section of the valley, heavy sticky tar oozed out of the earth, the scum from great petroleum reservoirs far down

underground. This tar would collect in pools, which were cruel traps for the animals, both great and small, that might be roaming in the vicinity. Any unwary beast that ventured too near the treacherous tar pit might get one foot into the sticky mass. Then a struggle would ensue. In an attempt to free itself from this new and unforeseen terror, the animal would struggle more and more violently and become more and more enmeshed in this black giant flypaper.

Or perhaps it would be a windy day, and a cloud of dust would blow across the tar deposit, covering the black surface with a film of dirt. This would give to the tar pool the appearance of solid ground, and woe to any unsuspecting animal that might walk into this deceptive trap, so efficiently and so unfeelingly created by the processes of Nature!

Thus were many animals caught: the inoffensive deer and the rabbits and the peaceable mammoths and sloths by the trend of circumstances and by their own lack of experience or forethought. Trapped and struggling, the herbivores would inevitably attract a host of meat-eating animals, intent upon an easy meal. And these beasts, in spite of their cunning, would sooner or later be caught in the tar, as if by outstretched, grasping fingers.

As the sabretooth approached the tar pits he became conscious of a great commotion, caused by a gathering of animals. Swinging towards the scene of activity on noiseless pads, he saw ahead of him the struggling mass of a giant sloth, surrounded at a respectful distance by a small pack of wolves. On the dead branches of a nearby tree were the black forms of some vultures. All were intent upon the efforts of the sloth. The unfortunate animal heaved with all of the strength of his huge muscles, but to no avail. He was hopelessly mired. The wolves circled and whined, anxious to partake of so easily procurable a meal but suspicious in some way unknown to them of the sticky, vicious tar. The vultures were huge black lumps, sitting in patient anticipation.

The sabretooth broke through the restless circle, scattering the wolves right and left with his snarling threats. These sagacious animals retired to a discreet distance to watch the course of events. Here at last was the food for which the sabretooth had searched through so many weary hours! Here within easy reach was his meat, something to stop the relentless inward gnawing—yet he was suspicious. Something was wrong, and he sensed it. This was his first visit to the tar pools, yet without the benefit of previous experience he realized that here was danger. Even so, his hunger drove him on. Perhaps he could leap from the edge of the pool onto the prostrate form of the giant sloth, there to feast at his leisure, and then with a leap back again, be on firm ground.

Some moments of indecision—then at last he made the leap onto the struggling form of the sloth. But his footing was not so certain as it might have been, and the sloth, now completely terrorized by this new menace and by the danger that already engulfed him, made one last effort of violent movement—a futile attempt to extricate himself. In landing, the sabretooth was thrown off balance, one foot slipped into the tar. With a growl he tried to pull it out, but it was held firmly by the black death. Then another foot became entrapped. With this he began to be afraid, and his struggles became violent. But the more he fought the tar, the more firmly it gripped him. The black fingers were pulling him down and down, and fight as he would he could not get loose. By now all four paws were caught, and he was sinking down to his belly in the loathsome stuff. He growled and roared, he struggled with all of the strength of his powerful body—but to no avail.

The red light of a sinking sun gave way to the chill of evening. As the night darkened, a full moon rose over the eastern horizon, and in its soft light could be seen the two great forms in the tar pit—one now quiet, the other heaving and pulling with failing strength. With great staring eyes the sabretooth glared out at the ominous figures of the closely circling wolves, and as he summoned his remaining strength in a defiant growl, the leader of the pack lifted his muzzle to the moon, and howled a long, dismal wail.

* * *

Sabretooth and jaguar, mammoth and camel, sloth and bison, all of those long-extinct and silent beasts which to us seem like dissolving dream shadows, once lived and fought and died around the dark pools of Rancho la Brea. The tar pools, once such fateful traps for uncounted numbers of animals, now lie tamed within the quiet confines of a city park, and the black bones which have been dug out of the pits, literally by the thousands, have gone to many museums, where row upon row they are arranged as tangible evidence for the interpretation of a bygone age.

To the casual observer they are dull and lifeless, but to the student who has spent hours and weeks and months comparing and measuring, studying and questioning, these ancient relics seem almost to spring to life before his mind's eye. These are not dry fossils but the moving parts of living animals, vibrant and tense. Out at the tar pits is not the modern city of Los Angeles, ever spreading and rising from the plain in a hum of peaceful industry, but the wild valley floor as yet unknown to man, where the great herds roam and where the giant cats silently stalk their prey.

WHERE

A Diagrammatic Story

20,000 YEARS AGO

From a drawing by Charles R. Knight, Courtesy of the Carnegie Institution of Washington

WITH the advent of the Oligocene period, about 35 million years ago, the first cats appeared as descendants from civet-like ancestors of Upper Eocene age. These earliest cats were highly specialized along the lines that culminated in their Pleistocene and modern descendants, and from the beginning of their evolutionary history they showed a primary branching into two distinct groups.

On one hand there was the group of the sabre-toothed cats, characterized by enlarged, dagger-like canine teeth. These began in the Oligocene and culminated in the gigantic *Smilodon* of Pleistocene times *(above)*. Of all the cats these sabre-toothed types were in many respects the most specialized for a predaceous mode of life, yet they were unable to survive the change from Pleistocene to Recent times and became extinct only a few thousand years ago.

The other group was that of the "typical" or "feline" cats as we know them, perhaps not so highly evolved as the sabre-toothed cats but evidently more suitably fitted for survival.

At the present time there are many kinds of typical cats throughout the world, but in spite of their differences in size and coloration they are essentially similar to each other. These cats in turn may be divided into two groups.

One of these, which may be called the *Felis* group, comprises all of the modern cats with the exception of the cheetah or hunting leopard, *Cynailurus*, a distinct type that alone constitutes their other division. The cats of the *Felis* group may again be divided into the long-tailed cats, large and small, and the short-tailed lynxes.

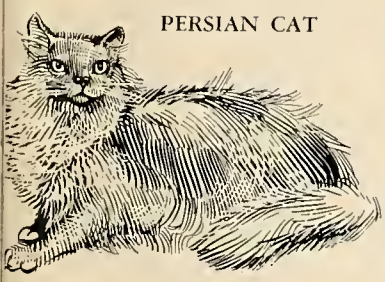
It was from some of the small Old World cats of the *Felis* group that the domestic cats were derived.

THE CATS CAME FROM

Compiled by EDWIN H. COLBERT for NATURAL HISTORY MAGAZINE

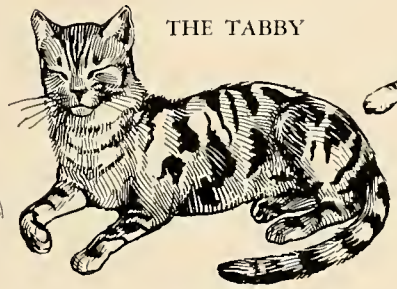
Drawings below by Margaret M. Colbert

(Below) The Persian is a long-haired cat either of solid color or with variegated markings. According to some students, it is thought to be descended from Pallas's cat; by others this link is denied



PERSIAN CAT

The tabby is probably the central type of which most of our domestic cats of the Occident are variants. The tabby is distinguished by stripes or by blotches on the shoulders, back, and flanks

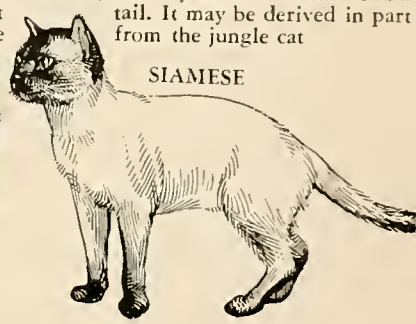


THE TABBY

The Manx is a peculiar variety of domestic cat, characterized by a very short or even a nonexistent tail and by abnormally long hind legs. The origin of this breed is obscure; it may have come originally from the Orient

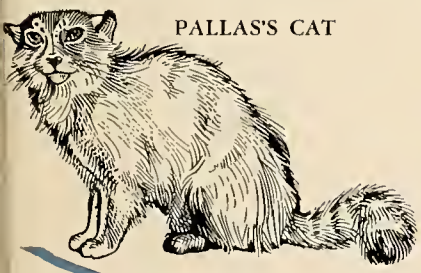
MANX

The Siamese is the most distinctive of the domestic types, yellowish-white in color, with a dark "smoky" face, blue eyes and a rather small tail. It may be derived in part from the jungle cat



SIAMESE

Pallas's cat *(Felis manul)* is a long-haired wild cat of the northern Asiatic deserts. It is distinguished by its broad head and by the contraction of the pupil to a circular disk instead of to a slit



PALLAS'S CAT

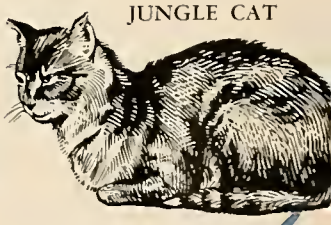
(Below) The European wild cat *(Felis sylvestris)* is now almost extinct. The cross between this cat and the Egyptian cat is commonly regarded as the ancestral type for the striped tabby and for a majority of the domestic cats

EUROPEAN WILD CAT

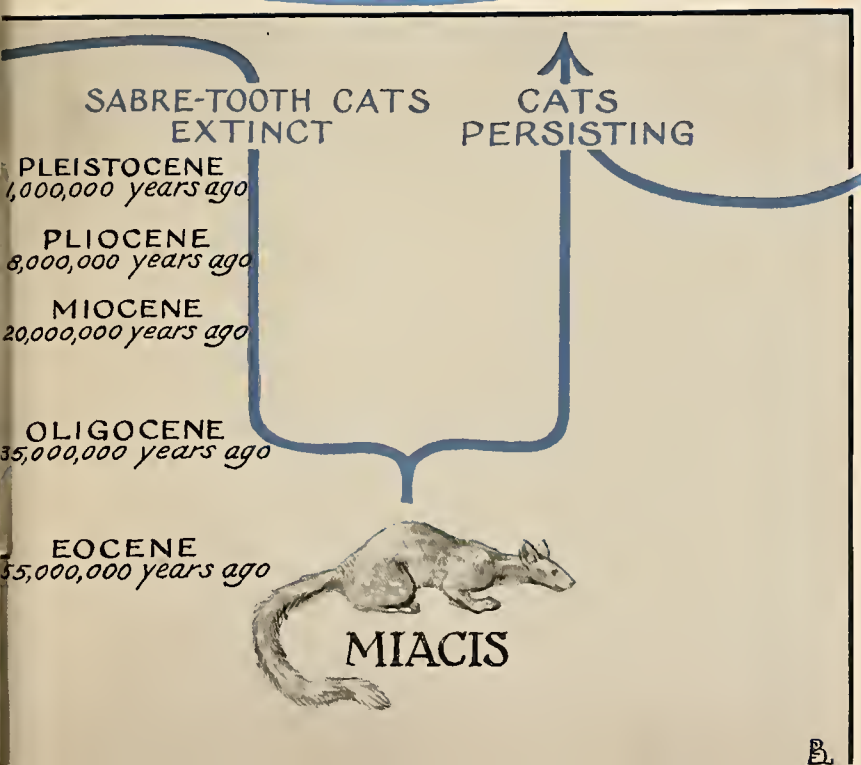
The Egyptian cat *(Felis ocreata)* was one of the first of the wild cats to be domesticated. This cat was brought to Europe by early traders, and there it crossed with the European wild cat

EGYPTIAN CAT

The jungle cat *(Felis chaus)* of Africa and the Orient is said to interbreed in India with domestic cats. Another small Oriental cat, *Felis bengalensis*, may have contributed to some of the domestic types of Eurasia



JUNGLE CAT



The origin of the domestic cats is complex and obscure, and beyond certain basic facts there is considerable difference of opinion among authorities as to the derivation of the several varieties of "house cats." It is generally agreed that several types of small wild cats have contributed to the domestic cats as we know them. Furthermore, most students of the cats regard the Egyptian cat and the European wild cat as being the two most important progenitors of the domestic cats. It is probable, however, that the domestic cats in different parts of the world have origins that are at least in part separate.

LORD JITTERS

By Roy Chapman Andrews
Director, The American Museum of Natural History

The true story of an aristocrat of the cat world who, though born to a soundless existence, epitomizes the ever-fascinating qualities of his ancient tribe

Lord Jitters walked deliberately down the stairs from his bedroom. I was in a hurry so I gave a gentle push to his lordly rear. He turned, withering me with an indignant look, and stalked into the living room to seat himself on the couch beside a vase of tulips. He sniffed delicately at each of the blossoms and then stood off to criticize their arrangement.

"Not so good, if you ask me. Much too massed. A little more separation would make them much easier to smell." Quite evidently that's what he thought, although as a rule he keeps his opinions to himself.

"Now these on the piano. Much better. You see I have no difficulty in inhaling the odor from each separate flower without disarranging my hair. Yes, this is quite satisfactory. I shall remain here and let the perfume drift over me. As a matter of fact, if I close my eyes I can imagine that I am in the rock garden at my country estate . . . that it is summer . . . and the sun is shining . . . and there are butterflies to catch and crickets . . . and leaves to chase across the lawn . . . all sorts of exciting things to do. . . . and warm smelly earth to snuggle into when I am tired . . . and want to sleep . . . to go to sleep. . . ."

I forgot to say that Lord Jitters is a white Persian cat. He got the last part of his name when he was only a fluffy ball of fur because he was never still. Elevation to the Peerage came by divine right at the age of four months; at that time he assumed his seat in the House of Lords. His inheritance included me, my wife Billie, an automobile, an apartment in New York, and a place in the country. For a cat he has done very well for himself. He, however, does not consider that to be so. There are certain annoyances in his life which he bears as a cross; to wit, a black Persian cat, Poke-Poke, and a Llewelyn setter dog, name of Queen. But more of these anon.

Lord Jitters has an infirmity which he endeavors, catfully, to conceal from the public. He is stone-deaf. Not a sound can penetrate his eardrums. Were he consulted on the subject by a psychoanalyst, I am sure he would maintain that deafness is an asset. His thoughts are not disturbed by sounds which could hardly fail to be of less importance. It enables him to live in a world of his own.

Lord Jitters was a precocious child; I might even say, an infant prodigy. Still, he could not entirely escape the intrusion of certain inherited instincts which at his early age it was impossible to understand or analyze. One of these was the desire to watch a hole. His New York apartment does not abound in holes. After diligent search, the only one he could discover was the drain pipe in the bathtub. He very shortly made it evident to Billie and me that it displeased him to have the rubber plug left in the pipe. Then he settled down to prolonged concentration upon the hole. I do not think that he was clear in his mind as to what might possibly emerge from the cavity. Nevertheless, it was a place to be watched and a duty to be done.

His Lordship's bath

Being pure white, Lord Jitters accumulates a vast amount of soot during his excursions on the roof garden of his New York apartment. He just has to be washed with soap and water. Talcum and brushing only change the black to a dirty gray. In regard to baths, he has informed us as follows. "I admit that I like to be clean. Being scrubbed and soaked is not my idea of fun, still I will not object if you perfume the water with bath salts and use sandalwood soap." Ferdinand the Bull has nothing on Lord Jitters when it comes to appreciating pleasant odors. Also when it is all over and he is white as an Arctic fox, he spends hours admiring himself before a mirror.

I regret to have to admit that Lord Jitters is exceedingly vain and laps up admiration with more avidity than he does cream. When we have guests, he waits for the proper moment to make a stage entrance. Stalking into the room, his white plume waving, he introduces himself to each guest in turn.

With gentle dignity he will allow himself to be stroked, purring in response. Then he selects a spot on a green stool, the back of a sofa or a yellow satin lama coat where he can pose in full view of the room. While he will court the attention of strangers, Billie and I or any of the maids are not allowed to pick him up except when we are in the motorcar.

We have often discussed this matter with him. His viewpoint is logical.

"I have a lovely apartment," says he. "I am decorative as everyone knows. I also am host. Therefore it is my duty to be gracious to our guests and to enhance the beauty of our surroundings by showing myself to the best advantage. This, however, does not mean that I have to submit myself to being pawed after the guests are gone. I do not like to be touched as you well know."

An ultimatum about "Spooky"

Once we made a great mistake by agreeing to care for a tiny monkey belonging to one of our friends. Its body was only about eight inches long. The little beast, which rejoiced in the name of "Spooky," was as near perpetual motion and chain lightning as any living thing I have ever seen. Lord Jitters was absolutely outraged at the presence of the animal in the house. The limit of his endurance was passed when Spooky one day made a flying leap from the curtain pole, landed on Jitters' back, tweaked his tail and disappeared behind a chair.

The Lord delivered an ultimatum to Billie and me. "I have endured the presence in my home of this distasteful creature," it ran. "I have endeavored to overlook the undignified conduct of both of you in the traffic you have had with it. I will not, however, be subjected to such personal attacks as that which you have just witnessed. I intend to retire to the rock garden, and I refuse to enter this house again until that objectionable animal has been permanently removed."

Out in the garden he went, and there he remained for two days. Even though it rained Lord Jitters preferred to crouch under a bush (where we could witness his misery, of course) rather than capitulate. That broke us down, and the monkey was sent away.

At the age of seven months, Lord Jitters was taken in a motorcar to inspect his country estate, Pondwood Farm, at Colebrook, Conn. Not being entirely sure as to his reactions to such transport, his guardians, Billie and I, deemed it advisable to ensure his safety by purchasing for him at the most exclusive shop in New York a beautiful green leather harness. Lord Jitters, however, would have none of it. In a language of his own, which Billie and I understand perfectly, he said "I will not be trussed up like a street dog and led about on a leash. If you persist in fostering this indignity on me, I shall not get to my feet. My decision is final."

His deportment in the car, of course, was exemplary as we should have known it would be. Stretching out on the top of the driver's seat, he watched the passing show interestedly until such time as he decided it had received enough of his attention. Then he settled in Billie's lap to sleep away the hours before our arrival at his countryseat.

Pondwood Farm, however, offered so much that was new and unexpected that for the first time we saw his dignity shaken. Grass in the orchard was three feet high, interspersed with daisies, black-eyed Susans, and lesser flowers. Each one must be sniffed and investigated. Almost before he knew it he had ventured far into what to him was an unknown jungle. Great stems of grass stretched far above his head; enormous branching weeds cut off his view of the sky; a tangle of creepers made it well nigh impossible to walk. He could hear nothing, see nothing. He was lost—hopelessly lost. For the first time in his life, fear descended upon him like an enveloping cloud. Gathering all the breath his lungs would hold, he wailed in terror. Billie and I heard the first shriek and waded through the grass to his assistance. We found him crouching at the base of a huge milkweed, his little face contorted with fright. Into Billie's arms he came with a soft croon of happiness, clasping both paws tightly about her neck. Then in a series of "pur-r-r-ups" he related the terrifying experience through which he had passed.

What goes up must come down

The great maple trees in the yard offered the next adventure. His sharp claws clung easily to the rough bark, and before he realized it he was sitting in a crotch twelve feet from the ground. It was wonderful up there in the leaves and swaying branches. He had a feeling of exhilaration and achievement such as he had never known before. For an hour he stayed until a certain discomfort in the region of his tummy told him it was dinner time. All right, he'd come down—but how? It was easy enough to go up head first, but that didn't work on the down trip. Finally he gave it up and sent out an S.O.S. Billie came on the run, as he knew she would, and stretched up her arms. That must mean she wanted him to jump, so jump he did. Lord Jitters landed on the top of her head clinging desperately to her thick blond hair and slid down to a seat on her shoulder, leaving several claw marks on her face.

I had viewed the performance with disapproval. "No cat of mine," said I, "shall go for another hour without learning how to come down a tree."

Therefore after his heart had regained its normal rate, we gave him the first lesson. In a few minutes he had learned how to switch his rear end about while hanging on with his front claws and to come down backward. This was a turning point in Lord Jitters' life for it opened up to him the World of Trees.

Setting his mental compass

To go on a walk with us through the woods of his estate is a delight. Trotting along at our heels, mile after mile, splashing through mud in the swamps or climbing over great glacial boulders, he finds it a most exciting adventure. When we stop, he settles down comfortably on a log and purrs in contentment. At first he often got lost in the underbrush and ferns, but he soon learned a trick which helps him out. Since he can't hear, he has to depend entirely on sight. Now when we have disappeared, he climbs the nearest tree, looks about until he has located us, sets his mental compass, and makes a beeline through the ferns, yowling for us to wait.

Lord Jitters distributes his affection equally between us and obviously feels that our safety is in his keeping. If we separate while in the woods, he is in a terrible quandary. He runs frantically from one to the other, trying to keep us both in sight, and finally sits down and howls miserably. If I go out of the house and my wife remains indoors, Jitters is most unhappy for he can't decide where his duty lies. Running to the end of the porch he pleads, "Please come back and get Billie, I want to go with you but she mustn't be left alone. No one can tell what will happen to her."

Strangely enough, he rather likes water. Unless it is absolutely pouring, rain does not drive him indoors. One day he was with us in the canoe on the pond. We landed, but he remained playing with a bug. The canoe floated off ten feet or more before Jitters discovered that he was adrift and all alone. Without the least hesitation he jumped overboard, swam to shore, shook himself, and continued about his affairs.

As a hunter, Jitters rather fancies himself, but really he is not so hot. Being white, deaf, and wearing a bell are handicaps. To date he has caught six field mice, two shrews, one mole, and a six-inch garter snake. All of these are presented to us most proudly. Billie doesn't mind live mice, but she hates dead ones. Jitters doesn't appreciate this fact and insists upon placing his catch in her lap.

He always sleeps on our bed, but one night we put him out about eleven o'clock. At first he could not believe that I really meant he had to go. Then with the greatest dignity he stalked down the stairs, giving me what could only be called a "dirty look." At two o'clock in the morning a scratching and howling at the door waked both of us. There was Jitters with a mouse. He jumped on the bed and deposited the limp rodent on Billie's pillow. "You show me out of my room," said he. "I return good for evil. I rid the house of mice while you sleep."

Having delivered himself of this reproof, he walked sedately out of the door. For two nights he punished us by refusing to come into the bedroom.

"My property"

Lord Jitters never had seen a dog until a week or so after he went into residence on his country estate. One of our neighbors came on the lawn followed by his Irish setter, Cob. Jitters was in the garden sniffing the flowers. He looked up, saw us fondling the big red animal, and every hair on his body stood straight up. He crept toward us, eyes blazing, and suddenly flew at Cob like a white demon. The setter yelped in fright and legged it for the road. Lord Jitters followed to the gate and stopped, glaring. Then he paraded up and down the stone wall to make sure that the dog did not venture again upon his property. Moreover, we got a lecture upon what would happen if he ever saw us touching that red animal again.

Billie and I wanted a black Persian kitten and a setter dog. For a long time we debated whether or not we dared introduce them into our household. At last we decided we could not continue to be ruled by a cat and keep our self-respect. The setter and the kitten arrived. Lord Jitters was indignant at first, but, when he learned that the arrangement was permanent, he did what we might have known he would do—brought them also under his authority. He still remains undisputed autocrat of the Andrews family.

THE DOG AND THE RABBIT

By Harold E. Anthony*

Curator, Department of Mammalogy, The American Museum of Natural History

When we watch the behavior of a dog who is putting his intelligence to the solution of a problem confronting him, we cannot help wondering what passes through his head. If he cannot logically solve it, and if the situation is crucial enough to arouse an emotion of hate, love, or fear, the result is apt to be interesting.

The following incident observed by an experienced field naturalist is unique in that it shows a dog in a position comparable to that of the small boy who volunteers to hold the magician's hat while the latter fills it with rice, only to see him lift a kicking rabbit out of it. Magic, to us, offers pleasant diversion; the equivalent of it in this incident certainly afforded no pleasure to the over-confident dog concerned.

My father was standing near a well-site in eastern Oregon one morning as men were starting their work. The well was being driven in a sagebrush plain, and several lengths of ten-inch casing were lying on the ground. A rancher came through the sagebrush toward the well, and his dog jumped a jack rabbit. The rabbit was cold and did not let out his full burst of speed at once. This encouraged the dog to believe he could really catch the rabbit, a lifelong ambition which he never missed a chance to attempt.

The rabbit was headed toward the well and, before he realized it, was right among the men and seemingly blocked from escape. The dog, obviously bursting with canine enthusiasm, was right at the heels of the jack. These rabbits do not ordinarily run into holes but this particular animal was hard pressed and confused by enemies all about him. He saw the inviting opening of the well-casing and ran into the long pipe. The eager dog figured out the proper answer to this maneuver and fairly burned the breeze racing to the far end of the casing where he could seize the rabbit as it emerged, he hoped.

The jack rabbit went only a short distance inside and then stopped, as one would expect. But a wood rat that had selected this convenient cavern as a place to spend the day was disturbed by the rabbit and thought the immediate environs were getting a bit too crowded. The rat moved on ahead of the rabbit and made a rather leisurely exit, blinking in the bright daylight and halting a moment to get his bearings. The dog and the rat met with perfect timing.

The rat had not been particularly alarmed by the rabbit, was not expecting a dog, and was just slow enough in reacting to the situation to convey an impression of nonchalance and indifference to the dog.

The dog, however, was keyed up to the very margin of his nervous threshold and reacted instantly. His one-track mind expected a large, gray and timid rabbit. His eyes beheld a dark, greatly shrunken creature that did not care a hang whether he was there or not. The shock was too much of a strain, and the dog popped his tail between his legs and bolted in terror.

Of course it is impossible to reconstruct the mental processes which governed this dog's behavior, but it seems reasonably safe to deduce that his action demonstrated fear of the unknown. It might be too much to argue that the dog believed he was witnessing a supernatural manifestation by a rabbit with magic powers. If the rabbit could change into something smaller and fearless of meeting the dog, what was to stop it from becoming greatly larger and pursuing the dog? The facts were observed as I have stated them. The interpretation is up to the reader.

*The author's career and personality are recounted on page 304 in this issue.

ANIMALS IN AN AIR RAID

Continued from page 275

previous summer hundreds of miles away, at Wigtown. On the south coast of England the guns brought down a teal, smallest of our wild duck, which someone had banded in Wales. I have heard of some young gunners confusing the flying chevrons of wild duck and wild geese breaking through the clouds for airplanes, and have brought them down with their pom-poms. These accidents are understandable in air raid defense, as everyone has to be so quick, with only split seconds to make decisions.

The Navy has been using powerful depth charges in the North Sea and the Channel during its destruction of enemy submarines. These depth charges take a fairly big toll of fish life for they literally blow up great waves of the sea, and for hundreds of yards after the water has subsided, the surface is covered with the floating forms of dead fish. The effect is exactly the same as when a poacher uses dynamite to make a quick load of salmon from a river. The sailors, of course, welcome fresh fish on the menu, and with buckets instead of hooks upon their lines, they enjoy some impromptu fishing.

Finally there is the way in which use has been made of the reaction of wildlife to war activity. During the last war it was discovered that birds with sensitive hearing—like pheasants, guinea fowl and ducks—could often hear the noise of heavy guns fired 200 miles or more away, when humans failed to notice anything. It was because the sound of battle goes upwards and is reflected from the Heaviside layer of the atmosphere to a point a considerable distance away, as in short-wave wireless. During the battle of Jutland, for instance, although no news was then at hand in England, pheasants in Norfolk and Cheshire were noticed to become unduly alarmed, crowing loudly in the trees as they would do when disturbed in the night.

In this war an attempt has been made to use the sensitivity of some birds to detect the noise of approaching enemy planes, which are heard long before they are in sight. Another idea has been to detect the landing of invaders in some lonely spot, for a flock of gulls or terns, rooks or partridges will quickly resent any strange arrival by parachute in their favorite nesting haunts, thus revealing their curiosity by circling in a noisy flock over the spot where the invader has landed. As yet it is impossible to say how successful these observations have been, for they have not been fully exploited. In my own work I have been able to adopt many of the camouflage methods of wildlife for camouflaging cars and buildings; and I think that there is more that we can learn from wild things.

One of the greatest lessons we learn from our war-harassed wildlife is that a single enemy tracking its prey—a stoat pursuing a rabbit, a merlin chasing a sparrow—arouses fear, but the general confusion of a mass attack like an air raid need not add fear to confusion, for we are not singled out individually, and the wreckage and the death-toll after the raid is far below anything the terrible noise and the high flames suggest at the time of action.

(Above) BIRD OF THE INCAS: Peruvian cormorants or guanays (which means "guano birds" in an ancient Indian tongue) above the precipices of their island stronghold. Beyond the water is the South American mainland near Callao, seaport of Lima

(Right) GUANO-COVERED SLOPES. White in the sunshine, dark in the shadow of the ridge of San Lorenzo Island, lie thousands of tons of the world's most precious fertilizer, with the producers thronging on the surface and filling the air above

Conservation's Silver Lining

By Robert Cushman Murphy

Proving that the fable of the goose that laid the golden egg is applicable many times over in modern conservation

The exciting story revealed by a series of photographs taken by David D. Duncan, Official Photographer of the Michael Lerner Peru-Chile Expedition

THE arid section of the western coast of South America, comprising practically the entire shore line of Peru and northern Chile, presents the interesting combination of a land relatively poor in plant and animal life and a sea extraordinarily rich in both. During the past quarter century the circumstances have become widely familiar, not only to the geographically minded but also to the whole traveling and reading public. Stories about the vagaries of the famed Humboldt Current, and of their colossal effect upon fish, birds and other marine organisms, now appear regularly in American newspapers, following the arrival at New York in certain seasons of steamers from the ever-fascinating West Coast. "Guano," a word well known to our grandfathers but forgotten in the days of our parents, has once more come into its own. This best of all fertilizers, the dried manure of fish-eating sea fowl, is again being exported from the Peruvian coastal islands and imported for the improvement of agriculture in the United States, as was true before our Civil War.

In any recollection or in any imaginary picture of the desert coast of Peru and Chile, sea fowl have come to hold an overwhelming place. We have been told over and over again, and truthfully, that in no other littoral region of the world can birds be found in such spectacular abundance. There is likewise no region in which wild birds, requiring no human care other than to be left sufficiently alone, are so closely associated in the popular mind with direct economic benefits to man himself. This also is true, because guano is a commodity of commerce, worth millions of dollars annually to those who control its production and to those who purchase it for the enrichment of their crops.

It would be superfluous to become diverted toward the romantic story of guano, because the essential facts are readily available in recent publications. On the historical side, the tale is the familiar one of discovery, insatiable greed, erring faith in the inexhaustibility of such treasure, and then ruin; but, happily, the sequence can in this instance be continued through to a revival due to the application, while there was still time, of enlightened scientific principles. The restoration of the Peruvian guano industry or, rather, its conversion from a purely destructive exploitation to the status of a true and lasting industry, represents one of the greatest examples of practical conservation that the world has yet seen.

On the biological side, the story is equally interesting and even more complicated. It involves a long, interacting series of cosmic phenomena, including the varying heat given off by the sun, the wind systems of the region, the peculiar circulation in the eastern part of the South Pacific Ocean, and the maintenance of extraordinarily low water temperatures in tropical latitudes. On such foundations depends the existence of a teeming microscopic plant life which is the pasture of the sea. This in turn supports directly or indirectly the higher and larger living organisms, all the way from crustaceans and small fishes up to birds, seals and whales.

But no matter how conversant we may become with this amazing chain of life, pictorial representations of the well-nigh incredible scenes of the guano coast never cease to thrill and stir us. This is eminently true when the photographic product is as vivid and beautiful as that obtained by David D. Duncan, official photographer of the recent Michael Lerner Peru-Chile Expedition. The photographs here shown represent but a single and minor facet of the field work. Mr. Lerner has financed and conducted a number of marine expeditions for the American Museum, to the great benefit of its Department of Fishes and of scientific research in general. This year he turned his attention to the little-known swordfishes and other game species of South America's West Coast. Certain aspects of this work are narrated elsewhere in this issue of NATURAL HISTORY (see page 276). Here he has generously placed at our disposal a group of photographs from the guano islands and adjacent waters which rank high in the annals of bird photography, both for their artistic excellence and scientific meaning.

Man's weight in Nature's balance

What is the significance of the composite scene here laid lavishly before our eyes? Does it picture a static condition? Do these sea fowl, shown in their bare, wild homes, comprise a myriad population which, in terms of time as man understands it, was, is and ever more shall be? Far from it. These birds are representatives of an ever-shifting, ever-fluctuating population, one that is tuned to vast rhythmic cycles in Nature. They have probably occupied this coast for millions of years, or ever since the uplift of the Andes first established the fundamental geographic conditions that have continued to the present. Throughout short periods of years their numbers expand prodigiously, as a result of the bounty and surplus of food in the coastwise, northward-moving Humboldt Current. But then the oceanic circulation abruptly changes: warm surface water from the north and from the outlying tropical ocean flows

THE MOST VALUABLE BIRD IN THE WORLD: nesting guanays, well stuffed with the inconceivably abundant anchovies and other small schooling fishes of the Humboldt Current, and at peace with the world. The trail of the island guardian and

toward the coast; conditions of life suddenly become unfavorable for the oceanic pasture; and the whole pyramided structure begins to topple like a house of cards. Dead fish line the beaches and the stench is carried miles inland. The birds, too, perish in quantities not to be measured by concrete numbers but rather by the hundreds of miles of their strewn corpses along the tide line. Their death is not usually due to starvation but to maladies such as overtake animals whose vitality has been sapped by the knocking from beneath their feet of the whole complex system upon which healthy existence depends.

On the western coast of South America the cataclysmic cycle, thus briefly described, appears to be one with a period of about seven years. Some of the manifestations are much more severe than others, and there are indications of cycles within cycles, culminating at times in such extreme conditions as those of the early months of 1925. In any event, there is likely to be a gradual build-up during seven years toward a peak of population, to be followed successively by a more or less widespread dying-off, a period of readjustment, and then a renewal of the upswing. A graph of the production of Peruvian guano during a long period of years shows very clearly the alternating peaks and depressions which are an index of the varying population of birds.

All of this is a familiar concept to naturalists. It is merely another example, although an extremely striking one, of the rhythmic fluctuations, marked by terms of various lengths, that characterize most of the life on earth. It is one in essence with what we call good or poor fruit years, with the swarms of caterpillars that defoliate forest trees about once in a decade, or with the pests that periodically overtake lemmings or hares after they have once reached the pinnacle of their abundance. It is an appropriate scheme in the regime of Nature, which reckons the individual as so little but the species as so great. Always there remains a residue with which to build again, and after a million years of such fluctuations—without the added interference of man—the average population of guanays and pelicans along the coast of Peru and Chile probably remains substantially unchanged from what it was at the beginning.

"Without the interference of man!" There's the rub and the whole fundamental crux of the conservation problem. Under primeval conditions the delicate balance of Nature swings up and down, but the mean is maintained. At intervals the death rate flares up in a meteoric burst, but the mechanism of recovery still functions. Then man appears on the scene, lays the dead weight of his hand on the falling beam of the scale, and the result may be to throw the whole normal rhythm out of kilter, or even to bring about the extinction of species after species.

his water-carrying donkey cuts a clear swath through the horde. The view shows only half the population of adult guanays in a portion of the colony; for one proprietor of each nest is away foraging while its mate covers eggs or young

That is what happened to the Peruvian guano birds between 1840 and the beginning of the present century. They were regarded not as everlasting producers but as a nuisance and an encumbrance on the thick and "inexhaustible" beds of fertilizer that their ancestors had laid down throughout thousands of years. Many species had no place to deposit their eggs because of the continuous "mining" operations on the countless islets along the coast. Others, such as the Peruvian penguin and diving petrel, were reduced to a minute fraction of their former numbers by the carrying away of the material in which they had constructed their burrowed nests. By the time the last cargo of ancient guano had been transported from these islands, the future looked dark indeed for a country which required at least 70,000 tons a year to support its own essential agriculture.

Man as co-operator and restorer

Now if the heedless human animal can act so adversely upon the world of life, not to mention his own interests, it should be equally plausible that by using his brain he should be able to bring himself into harmony with Nature. That, fortunately, is what has been ultimately accomplished along the guano coast of Peru. In the present century the sea bird is king; it has been literally recognized as the goose that lays the golden egg. Such changes in point of view do not come easily; like all true reforms, they must be fought out against the obstacles of entrenched habit, selfishness and prejudice. Furthermore, any such cause demands an inspired leader, an individual who not only possesses vision but who is also capable of rallying around himself the forces that can carry a great campaign to success. The champion of Peruvian guano restoration is just such a man, Señor Don Francisco Ballén, of Lima, who has long been a Life Member of the American Museum of Natural History. On many occasions Señor Ballén has furthered the interests of the Museum: he enabled us to obtain the group of guano birds at the Chincha Islands, which now forms the central exhibit on the east side of Whitney Memorial Hall; and he provided Mr. Lerner with the facilities which made possible the accompanying photographs.

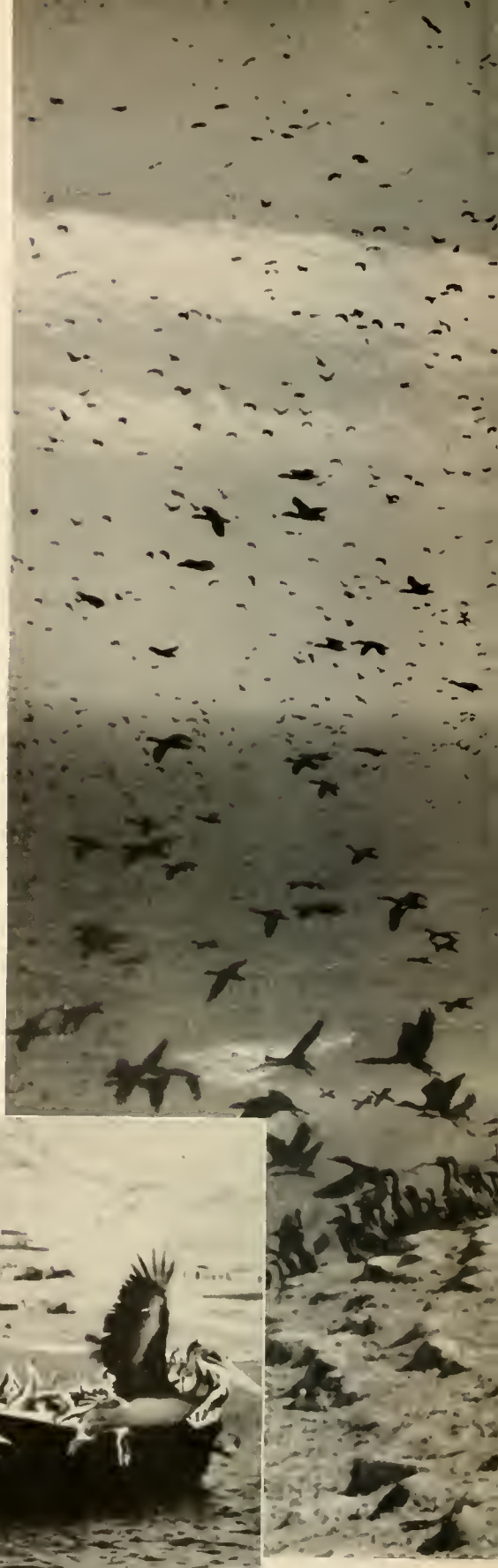
For considerably more than a quarter century Señor Ballén has labored unceasingly for the protection and general welfare of the sea birds along the coast of his country and for a consequent increase in guano production. He has assembled a corps of trained associates who share his own spirit of scientific integrity and efficiency. He has sought the advice of foreign biologists, agriculturalists, engineers and other visitors to Peru, whose experience elsewhere might prove to have a bearing upon his particular aims. He has also contracted with specialists from the United States and elsewhere, enabling them to spend long periods of research on the guano islands and in the neighboring waters. Mr. William Vogt, formerly of the National Audubon Society and a past contributor to the pages of NATURAL HISTORY, is at present in Peru for a three-year term of investigation under the auspices of the Guano Administration. Señor Ballén has also sent members of his own professional staff to study aspects of their problems in the laboratories of museums, universities and industrial organizations of the United States. In all of this well-ordered program he has had the hearty backing of a board of far-seeing directors, comprising some of the most distinguished citizens of Peru, which now controls the assured destiny of guano and its producers.

Thus, out of the wreck of the past, a great civilized and beneficent system has evolved. The guano islands are now, first of all, bird sanctuaries, and by far the most impressive sanctuaries of their kind to be found anywhere on the face of the globe. Increase of a commercial product is their underlying object, but the crop removed in any one season is not allowed to exceed the limitations imposed by Nature. The long view takes precedence over the immediate demand. It is fully realized that the guano output can never be expected to be equal each year, that operations must permanently be attuned to the seven-year periods, and that a watchful eye must always be kept upon exceptional and minor circumstances affecting the wanderings and reproductive capacity of the sea fowl. In other words, the bird itself has at last become the determiner of what man shall undertake. Human intelligence is now directed toward ameliorating the periodic and inevitable falling of the scales; human intelligence likewise endeavors to enhance the population peaks that as surely follow. By means of blasting and grading, the area of windward slopes on the islands, which are best suited to support dense aggregations of nesting birds, are being gradually increased. Wise laws, based upon fundamental ecological research, not only guard the birds themselves but also prevent any undue human competition for their food resources in the coastal ocean. The average yield of fertilizer, as figured by seven-year terms, has grown phenomenally ever since Señor Ballén assumed charge of the Guano Administration, and there is reason to believe that the maximum possible capacity of the islands still lies many years ahead. Here, at any rate, is one part of the world in which native bird life will remain safe as long as wisdom prevails. Here is a case in which Peru holds up a flaming beacon for all other nations and peoples to admire.

(Right) THE ICING OF THE CAKE. Guano softens the rugged contours of the rock, except on the sheer cliffs. A rainless climate not only permits its accumulation but also maintains its fertilizing efficacy by sealing up the organic compounds that would otherwise be lost by leaching and evaporation

(Below) AERIAL HUNTERS. Most cormorants are primarily swimmers, diving in likely places and searching fathoms deep for their prey. But the strong-flying guanays spy out the shoals of anchovies from aloft, and only then descend upon the water for their orgies

(Left) TAKING OFF TO WINDWARD. Slopes facing the prevailing southerly winds of the Peruvian coast offer the best breeding spots for the guanays, which choose their nest sites according to preferences as definite as those of any housebuilder. Slope in relation to wind and surface temperature thus largely determines the distribution of guanay populations



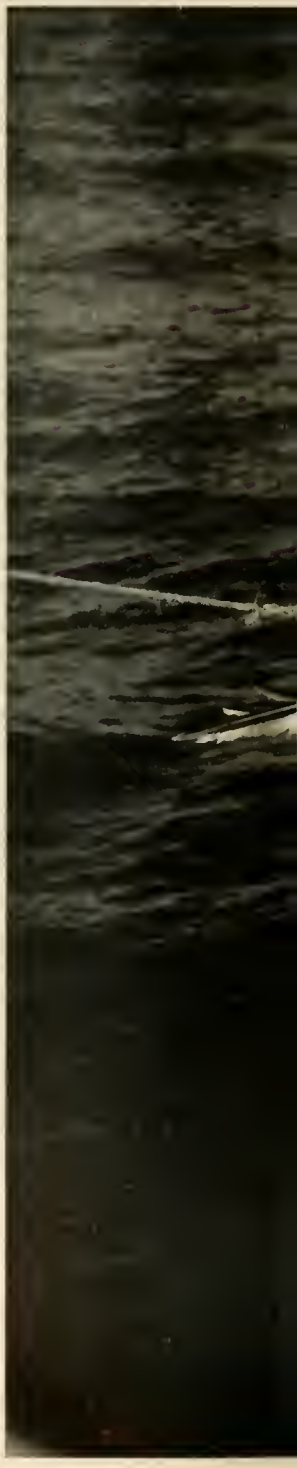
(Above) GALLEYMEN. Like the oarsmen of Odysseus or Lief Ericson, these West Coast pelicans line the gunwales of a lighter in the north Chilean port of Tocopilla, while resting and digesting their meals

(Right) THE PEPPERED FIRMAMENT: countless thousands of guanays above the sea mists of San Lorenzo. In the foreground, on the funereal brow of the hill, are empty, trampled and evenly-spaced nests made of guano, relics of broods that have already taken wing

(Below) MODERN PTERODACTYLS. More than any other living creature, pelicans bear a superficial resemblance to the great flying reptiles that vanished from the earth before the Age of Mammals. The pelican of the Peruvian and Chilean coast is similar to our own brown pelican, but much larger

(Right) FISHERMEN'S "CAROUSE." Mingled flocks of West Coast pelicans and guanays at Tocopilla. The voracious birds have followed a school of small fish close to the beach, and the nearer pelicans are taking flight ahead of Mr. Lerner's launch

(Below, right) ROYALTY OFF TOCOPILLA: a royal Albatross and a royal sportsman. Mr. Lerner, assisted by Captain Osborn, measures the span of a victim of the sea. The bird was found afloat, dead from an unknown cause. The Royal Albatross is a totally different species from the Wandering Albatross, but it shares with the latter the distinction of being largest of flying creatures in the modern world



(Above) SMUGNESS INCARNATE: an immature pelican, substantially planted on the rocks of the Peruvian coast. This gorgeous statuesque portrait is the only photograph of the series which was not obtained on the Michael Lerner Expedition. It was made by a distinguished citizen of Lima, the late Señor Don Eduardo Dibos

(Below) SEA SERPENTS OF TOCOPILLA: guanays flying, swimming, plunging, devouring, as the swarm hurtles along, with the hinder part continually pouring over the vanguard, each bird obsessed by the single purpose of filling its belly with anchovies, the raw stuff of guano

(Right) THE LIVING REEF. As the launch bears down on the seething mass of feeding guanays off the dead coastal hills of Chile, the ocean is whipped into foam, and the approaching mariner shudders in the illusion that he faces a grinding crash on an exposed reef

PORTRAIT OF A MAMMALOGIST

Harold E. Anthony has traveled some 200,000 miles of the earth's surface, in all climes and seasons, to preserve within museum walls a vivid replica of animal life all over the world

By D. R. BARTON

THE PRIMARY aim of a museum is to preserve the physical evidence of the past. But this is no static undertaking. The past grows with each tick of the clock and to attain their objective, museum men must work with one eye cocked to the future, the other riveted on the present. This is particularly true of the American Museum of Natural History, for the face of our country is changing daily. Lumbering, new methods of agriculture, the emergence of the dust bowl, all profoundly affect the native wildlife. And here as elsewhere the broad onslaught of a machine age jeopardizes the status quo. In all classifications of fauna and flora living or dead, as in anthropology, it is the same story. The watchword of the hour is: collect what you can *while* you can, lest mere scraps remain of the natural history of our times and great cities rise on our richest fossil fields.

Perhaps the most energetic exponent of this preachment is the Museum's Department of Mammals. Controlling nine of the Institution's 28 exhibition halls, it outranks any other department in sheer size. Yet these halls display only a fraction of the approximately 150,000 specimens in a total collection that has increased 500% since Curator Harold Elmer Anthony first came to the Museum in 1911.

And during these years of growth, Doctor Anthony was always in the vanguard. Gun in hand, he has visited every continent on the globe, traveled some 200,000 miles from the Arctic to the Antarctic, the Bering Straits to Tierra del Fuego, from the jungles of Burma to the African desert. Few careers have been more crowded with incident. Ever on the trail, he has been lost in the Central American jungle, hobnobbed with Cuban revolutionaries and Ecuadorean head-hunters while participating in 22 major expeditions over a period of less than 30 years. Indeed, so impressive are the results of these expeditions and others undertaken by his department, that probably no living mammalogist has played so large a part in expanding our knowledge of the present for the sake of generations to come.

Ralph Morgan Photo

HAROLD E. ANTHONY

Doctor Anthony is unique among the Museum's curators in that he comes naturally by his flair for collecting. His father, one of the outstanding Pacific coast bird men of the last century, owned two schooners which he used to sail into Mexican waters on long ornithological cruises. Anthony Senior was a true pioneer. Much of the groundwork in Californian ornithology was accomplished by his efforts, and he was well known to Museum men in the East — his very sizable private collection eventually being sold to the Carnegie Museum in Pittsburgh.

But a free-lance collector made even less money in those days than he does now. Ornithology cost the elder Anthony's family rather dearly, and after both schooners were lost in a storm the pressure of hard times forced him to give up the hobby which absorbed much of his life. By the time young Harold was old enough to trap and handle a gun, the cruising days were over. But on the outskirts of his home town of Portland, Oregon, Harold spent a good many afternoons and holidays collecting mammals which, for some obscure reason, he always preferred to birds. He liked to trap just as other boys might like to hunt and fish, and his father's mantle seemed to fall on him alone, as his brother cared little for the out-of-doors. Moreover, his relatives, mindful of his father's misfortunes, gave precious little encouragement and might well have turned him away from professional mammalogy had not a former crony of Anthony Senior admired the boy's perseverance and found him a summer job collecting for the Biological Survey.

This was a turning point and led to a considerable number of assignments which helped to defray the cost of his education. Previously, he had worked in a gold mine, then as a mail carrier, and lastly as an employee in a wholesale drug house. But when he entered Pacific College, he was able to quit odd-jobbing. Here he became an assistant on the faculty in zoology and chemistry as well as aiding in the acquisition of a local museum.

About this time, Doctor Townsend, then Director of the American Museum, wired an invitation of three months' work aboard the collecting yacht, the *Albatross*. This boat cruised along the coast of Lower California covering some of the territory over which the elder Anthony had blazed a pioneer trail many years before.

Soon thereafter, the Museum offered a post on the Staff together with an opportunity to complete his education at Columbia. Anthony accepted immediately, and under the curatorship of the late Doctor Allen, joined forces with a prominent ornithologist, Frank M. Chapman,[1] and an unknown youth by the name of Roy Andrews in what was then the combined Department of Birds and Mammals. Within the next 20 years, Chapman was to build "the ornithological center of the universe" on the corner of 81st

Street and Central Park West, Andrews to fill the headlines with his momentous discoveries in the Gobi Desert,[2] and Anthony to supervise the accumulation of one of the two largest collections of mammals in the Western Hemisphere.

During the War, Anthony's swift promotion to the rank of Captain of Artillery caused him to toy with the idea of following an Army career. But the Museum countered with an attractive offer and, in seven years' time, Anthony virtually duplicated his army success by rising to the curatorship of the Museum's largest department.

In the early '20's, mammalogy, like the country as a whole, entered its boom phase. Wealthy men bent a sympathetic ear to scientists who dreamed of complete faunal collections from each continent to be sorted among exhibition halls and study files. The vision, as these men saw it, was an entire hall devoted to each continent; the world within the museum. Today two of those halls are now completed and two more are well on their way.

Exploration

Spreading a map of our planet upon the table, Anthony can run a pencil over it with a sense of pleasurable recollection. A particular peak in the Andes, a stretch of tundra in Alaska, a sleepy port somewhere east of Suez, a dense jungle in Burma, all have a special meaning for him. In Ecuador he rode muleback over precarious mountain passes, hot on the trail of zonal specimens from these lofty regions. For, though South America lacks the large mammals of Africa, its smaller creatures are abundant and ever-fascinating to taxonomists, who know that this continent was an island for about 50 million years during which peculiar mammal strains had time to develop.* Anthony has described every marking and structural characteristic of many such species. In addition, the day's work calls for reports of their life history and the ecological circumstances under which they were found, together with the range of their distribution.

In Ecuador, he tramped through the jungle in the company of Indian guides who shot birds with twelve-foot blowguns. But Anthony held their sense of direction in even greater respect than their marksmanship. They could always tell where camp lay, no matter how tortuous a route had been covered. Indeed, Anthony could have used this faculty himself some years earlier when he completely lost his way in the jungle of Darien, a peninsula off northern South America. Having followed the historic route of Balboa, he took it into his head to have his own peek at the Pacific in a setting that had changed little since the time of the early explorer. He got his view all right, but in digressing to climb a suitable tree, he lost the trail back to camp. Dusk came swiftly and Anthony rued this deviation from the sober practice of science as he settled down for a night alone in the jungle. By dint of patience and all the woodcraft at his command, he managed to coax a tiny flame out of saturated wood gathered from the humid jungle floor. With a flame to dry the top wood, the fire crackled higher and Anthony breathed easier, knowing the more dangerous animals would steer clear of the blaze. As for food, he had previously shot a local partridge-like bird called a tinamou, which browned beautifully in the flames.

After dinner, Anthony lay there, slapping at gnats and other insect pests, listening to the faraway boom of the old-fashioned muzzle loader which his guide Pedro was firing in the hope of setting him on the right trail. But Anthony took one look at the black wall of the surrounding jungle and stayed put until morning.

Later, in Cuba, he thought he was lost for good. He had gone out alone on horseback to look for likely caves that might contain fossils. Coming on a large, root-filled hole he dismounted and leaned over the edge to gauge the advisability of making the sixteen-foot descent. He had just about given up on the idea when he accidentally knocked off his glasses and was dismayed to see them drop into a murk of roots and loose sand. He decided he might as well have a look around while he was recovering his glasses and went down hand over hand on a trailing root.

Not only were there no fossils, but he found to his horror that a large boulder which he had managed to slip past in coming down, was so placed as to completely block his path on the way up. Exerting every ounce of strength, he finally squeezed past the obstruction and up to ground level, where he lay panting for half an hour. Had luck not been with him, he would almost certainly have starved to death in that hole. For he was miles away from human habitation and had left no word where he was going.

It was in Cuba that he and Mrs. Anthony sought refuge in a mining camp far up in the back country during one of the periodic revolutions. They were somewhat disconcerted when the worsted revolutionary leader fled to this same mine and hid there for some time. Presently the fugitive sent word to Mrs. Anthony to type out a letter which he believed would enable him to escape to the States. Naturally, the Anthonys were glad to help him in any way that would hasten his departure. But his flight was not successful. He stopped in for one too many beers on the way down to the coast, was trapped by the opposing faction, and taken into custody.

Animals and geology

The Cuban venture intervened between other expeditions to Porto Rico and Jamaica, the occasion for all of them being a large-scale project inaugurated by the New York Academy of Sciences, the American Museum* and the New York Botanical Garden. The idea was to make an exhaustive study of the insular forms—both living and fossil—in the hope of ascertaining the geological origin of the West Indies. Were these islands simply the peaks of undersea mountains? Or did they once form a land mass connected with the mainland? If so, which mainland? An absolutely conclusive answer has not yet been reached save that no trace of North American animals was discovered, thus eliminating the likelihood of any previous connection with the modern Florida area. Nevertheless, the project brought to light much evidence in support of the mainland hypothesis.

Readers of Doctor Simpson's biography, which appeared here last month, will recall that his work in South America's early fossil mammals tended to substantiate the theory that up to about 60 million years ago, the northern and southern continents were joined by a land bridge even broader

[1]See "Apostle of the Birds," by D. R. Barton, NATURAL HISTORY, January, 1940, p. 48.

[2]See "Gambler on the Gobi," by D. R. Barton, NATURAL HISTORY, February, 1940, p. 118.

*Two distinct land bridges are generally believed to have connected North and South America. The present Mexican corridor is, geologically speaking, a relatively recent phenomenon.

*Several other Museum men were working on this project, among them Doctors Frank E. Lutz and Roy W. Miner, and John T. Nichols.

than the present Central American corridor. The evidence accumulated by Doctor Anthony and others in the West Indies indicates that the islands may have been a part of a small continent occupying much of the western Caribbean, and that this now vanished continent was attached to the ancient north-and-south-going land bridge, possibly in the vicinity of modern Honduras.

Anthony's chief objective was to comb the islands for fossil remains of extinct mammals in order to compare them with forms still living on the continental mainlands and in Central America. Many of these fossils were not "prehistoric" in the conventional sense, but quite recent, a few having died out since Columbus. If they matched similar species in South or Central America, then the argument for the theory of a land bridge across the Caribbean would be, if not overwhelming, certainly conducive. Previous investigators had advanced the hypothesis that floating islands and similar storm-blown flotsam breaking off from the mainland had served as Noah's Arks to carry the now extinct mammals to the West Indies. But this seems a haphazard explanation by comparison with the land bridge theory which, as a result of these West Indies expeditions, is one frequently supported in scientific circles today.

It was in Porto Rico that Anthony made his choicest scientific discovery, not a new species or subspecies—rare enough in latter-day collecting—but an entirely new family of fossil mammals, the *Nesophontidae*. Altogether, Anthony undertook four separate expeditions to the West Indies and considers them about the most important of his career from the scientific standpoint. He made large and varied collections of the living mammals of the Antilles which in the case of Porto Rico meant bat-hunting purely and simply. The island has no land animals at all. Though lacking in popular appeal, owing to the small physical size of the specimens, these collections were sometimes new to science and "of very considerable interest" to research men.

However, Anthony's favorite collecting ground is South America—a continent dear to many collectors in the Museum. Stimulated by the pioneer work of Frank M. Chapman in South America's bird life, Doctor Anthony has focused his attention on Peru, Bolivia, Chile, the Argentine, and Venezuela, in addition to a pair of expeditions to Ecuador.

Though he would much like to get his teeth into the vast task of gathering, sorting, comparing and adequately describing this unique fauna, the wildlife conservation movement in our own continent has sought him as a leader in the protection of native North American mammals, particularly those predatory animals so strenuously campaigned against by the farmers and herders of western states.

With powerful lobbies in Washington, these special groups have brought pressure to bear on the U. S. Biological Survey in an effort to exterminate crop-hampering rodents and livestock-predators. As a member of a committee of the American Society of Mammalogists, Anthony was active in a survey of the wholesale poisoning methods employed by government agencies. The exhaustive report showed that the poisoning might well be indiscriminate and that it might lead to the slaughter of many innocent bystanders in the animal kingdom, thus throwing Nature completely out of balance. Anthony twice testified before Congressional Committees on the proper control of predatory animals and other conservation issues. As one of the Directors of the Audubon Society, he has remained prominent in the whole conservation movement. Over many years, the demands made by following these issues have interfered considerably with his scientific career.

Administrative work within his own department and official duties as Secretary of the Museum Pension Board, have also cut deeply into the time available for research, so that assistants like George G. Goodwin, G. H. H. Tate, T. Donald Carter, and John E. Hill have been chiefly responsible for recent Museum studies in the field of mammalogy. Nevertheless, his long years of exploration have given Doctor Anthony so complete a knowledge of collecting areas throughout the world that he has been able to exercise an invaluable supervision over their projects afield and in the laboratory.

Within the last five years, however, Doctor Anthony has found time to lead an expedition to widely-publicized Shiva Temple in the Grand Canyon and to make another to Burma, both of which he has reported in these pages.*

In the organization and leadership of such collecting trips, Doctor Anthony is in his true element. Remarkably successful in the important task of promoting expeditions, he is ever watchful lest the Museum be hoodwinked into lending scientific respectability to a mere hunting binge. Yet this scrutiny of prospective sponsors has in no way slowed up his program of world-wide collecting, as the record of his departmental administration amply testifies. He is a great collector and, like Roy Chapman Andrews whose career has been markedly like his own, he is first and foremost a "leg man," an out-of-doors scientist who has worked his way up in the business of mammalogy and placed a huge province of the animal kingdom within reach of the average city-bound American.

*See "The Facts about Shiva," NATURAL HISTORY, December, 1937, p. 709; "A Winter in Remote Burma," NATURAL HISTORY, December, 1939, p. 263.

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LIVING LIGHT

- - - - - - by E. Newton Harvey

Princeton University Press, $4.00

FIREFLIES flashing in fields and meadows and jewel-like lights of the so-called "phosphorescence" of the sea are the usual introductions to the world of animate light. Less well known is the fact that similar illumination is to be found widely distributed among living organisms, from lowly bacteria with "lamps" producing 20-quadrillionths of a candle power, upward through the animal kingdom to brilliantly and complexly illuminated squids and fishes, some of the latter possessing elaborate inverted candelabras beneath their chins, while others have tentacles with lights at their tips that turn on and off at will.

Although the production of light by animals is considered as unusual, in reality it is commonplace, especially so in our oceans both near the surface and in the great depths. The observations made during the bathysphere descents confirmed and amplified our knowledge of the ubiquitous use of animal light in the deeps.

Why animals have lights at all is a question that cannot be completely answered. Some employ lights for mating signals, others as lures to secure their prey, while some fish have their lights in patterns so that they serve as marks to enable fellow members of a school to recognize each other in the dark. The reasons for other lights still remain unfathomed mysteries.

Doctor Harvey gives us in *Living Light* a carefully documented and scholarly presentation of the results of 25 years' search for the why and wherefores of this strange property of animals. He reviews systematically the groups of light-producing animals, lists the various kinds of luminescence and tells how at times this is capable of being controlled by the animals that possess the light. He describes the chemistry and physiology of light production and discusses the physical nature of this strange type of illumination. In an abridged bibliography extending over 30 pages, he indicates the complexity of the material and the extent of scientific interest in this fascinating subject.

"Cold light," which as Doctor Harvey says "is only relatively cold," is of intense interest not only to biologists but to the physical world of science and especially to lighting engineers. In relation to the latter the author states, "We can say that commercial lighting has already turned from incandescence to luminescence, thus adapting the method of the firefly."

Possibly the "will-o'-the-wisp" of heatless light will be solved through information gathered from the animal world. Doctor Harvey has done his utmost to bring together in a comprehensive résumé, our present-day knowledge of cold or living light.

JOHN TEE-VAN.

ISLAND YEARS

- - - - - - - by F. Fraser Darling

G. Bell & Sons, Ltd., 12 *s*

ISLAND books have been coming rapidly from the pen and photographic taste of Doctor Darling. This one differs from the others in being deliberately subjective. Instead of a report on the native life of roaring islets off the coast of Scotland, it concerns rather the lives of three persons during three years—a man, a woman and their son—in such a setting.

There is beauty in abundance, and always a whiff of terror in the picture of the stark rocks of ancient and unpronounceable Gaelic names, lying in the boiling cauldron of the Atlantic. Scrupulous planning, long waiting, hazardous landings, backbreaking labor, execrable weather, suspense in many forms, precede the ultimate peace and sunburst. There is nothing like an uninhabited islet to make a man drunk with the primordial sense of his own self-sufficiency. It seems always enough to light a taper from the old Odyssean fire.

This book has substance as well as flavor. So full is it, indeed, of the variability, the distribution and the behavior of plants, birds and seals of the cave-worn rocks, that of necessity it will take its place in the naturalist's bibliography.

The geographic names of the text and maps must be welcomed, despite their Brobdignagian aspect. When it comes, however, to vernacular terms of landscape and mundane surroundings, it seems as though Doctor Darling had gone ahunting for words not to be found in the abridged editions of even the Oxford Dictionary. Strath, ploys, shieling, scart, bieldy, keeked, scut, dunt, scriddy, are only a few which may prove tough for readers in Kalamazoo or Tombstone or, for that matter, even in Calgary and Canberra!

As a scientific man, the author should know that the curvature of the earth would prevent him from seeing North Rona, an islet 355 feet in altitude, from a distance of 100 miles; if it were ten times that high, it would still lie below the horizon, but it is barely possible that he saw its mirage.

R. C. MURPHY.

WHITE WATER AND BLACK MAGIC

- - - - - - - - by Richard C. Gill

Holt, $3.00

TODAY, as through the ages, humanity is fascinated by lore and legend of swiftly death-dealing poisons and *White Water and Black Magic,* skilfully wrought about one of the most interesting of these, will be widely read. It would, indeed, be rather widely read if it were but a legendary tale. Instead, however, it is a vivid, authentic account of the nature, the preparation and the use by jungle Indians of the remote upper Amazon basin of South America, of the arrow poison curare (coor-ah-ray). On this they depend almost entirely for game; it is so potent and acts so quickly that a bit of it smeared about the tip of the slender dart of a blowgun will cause paralysis of the nerves of motion almost immediately after it has entered the flesh of an animal. Then, after describing delightfully and with sympathetic understanding, the Indians that inhabit these jungles and the jungles themselves, Richard Gill tells how the very death-dealing poison which he carefully acquired for such studies was discovered to be, in very attenuated form, of prime importance to the treatment of one of the most refractory and distressing of human ills—spastic paralysis; "a discovery," the author suggests in his preface, "of an importance hardly second to insulin."

H. B.

THE FIRE OX AND OTHER YEARS

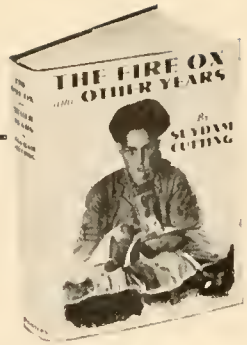
- - - - - - - - by Suydam Cutting

Scribner, $5.00

UNDER an intriguing title, Mr. Cutting has written a very readable account of his many interesting expeditions to places off the beaten trail. "The Fire Ox Year," by the way, is the Tibetan chronology for 1937, at which time the author made the last of three trips to Tibet.

Suydam Cutting is one of those fortunate individuals with the means and the time to go where he pleases but his travels are not the result merely of the normal, healthy curiosity to see distant lands. This curiosity he has in good measure, but to it he has added the desire to return with constructive additions to the advancement of our knowledge about these places. So we find him associated with museums and other institutions having definite plans and purposes.

His itinerary, in this book, ranges from southern Asia to the Galapagos, but most



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of the text deals with Asia and Africa. The author writes primarily for the layman and does not attempt any exhaustive discussion of the scientific research connected with the trips. This is left to the specialists. Cutting has traveled with open eyes, a keen sense of humor, and an appreciation of relative values.

The destinations of most of his trips are places much in the public mind but seen first hand by so few persons that the only way to learn about them is to read such books as this. The romance and tradition associated with the route of Marco Polo, the strange beliefs of Tibet, the inhospitable hinterland of Ethiopia are known to most of us only through the printed page, or its accessory, the motion picture film. The reader of *The Fire Ox and Other Years* can secure intellectual profit as well as enjoyment.

This book is beautifully made and exceptionally well illustrated, both in color and by black and white photographs. This volume will serve the dual purpose of informative interest and of permanent grace and beauty for anyone's library.

H. E. Anthony

The Golden Throng

- - - - - - - - by Edwin Way Teale

Dodd, Mead, $3.00

THIS book is concerned not so much with the practical aspects of bee-keeping as with the vitally interesting experience to be derived from daily observations of a glass-enclosed hive, where the privacies of bee behavior are transparently apparent. Based on this eyewitness testimony, supplemented by rather wide reading, the author has given an intimate and comprehensive account of the bee community, the division of labor within the hive, the foraging activities in the blossom-scented fields, the act of swarming, the mating flight, the rearing of brood, the enemies that endanger the community, and the bee's place in folk-lore.

Not all is known about the honey-bee in spite of the thousands of papers that have appeared, but the boundaries of the unknown are being pushed back and Mr. Teale has been able to include in his volume relatively recent discoveries that certain other works lack. Among these discoveries may be mentioned especially those of von Frisch regarding the "language" of bees—a language based not on sounds and their interpretation but on olfactory signals prefaced by characteristic movements on the part of the "speaker" to attract the attention of her audience.

A contribution to the distinctiveness of the volume is the author's vivid style, which has lost none of its attention-holding quality since he startled entomologists as well as lay-readers by his delightful homesite insect observations entitled *Grassroot Jungles*. Yet the text of the present volume, attractive as it is, meets its challenge in the really superb photographs that serve as illustrations. Through them the reader becomes an eyewitness of many of the significant happenings of the hive, to the inclusion of some incidents —like that of the worker bees attacking an invading queen—that belong to the rarities of bee observations.

Herbert F. Schwarz.

Look at Life!

- - - - - - by Lynwood M. Chace

Knopf, $3.50

WHEN one reads a book he receives one of three impressions: he likes it, he does not like it, or—he does not quite know what to think of it. To my critical mind *Look at Life* does not settle under any of these categories. If I do not like a book I ask to be excused from reviewing it, because I believe that there is some merit in every book published and my view may not permit me to discern the true merits of the publication under review.

This is a book of photographs of animal life—mammals, reptiles and amphibians and insects. Most of the photographs are posed, which does not dismay me in the least, because it is almost essential to pose most insects, in order to secure good "shots" of them. Unfortunately, a few of the "backgrounds" are unnatural—a Cecropia moth on an *iris*—and some others. Of course, the Cecropia *might* be there, but this would be rare indeed! It is these things (they might give the young mind a wrong impression) which cause me to withhold wholehearted approval of the book, and in this attitude I might well be wrong. Perhaps the generally excellent photographs and the educational value of the work, with its ability to familiarize us with the everyday animals about us, so greatly offsets the defects that the latter should remain unnoted. The scientist, with his analytical mind, is likely to criticize it severely, but the ordinary individual, who loves the things about him, will enjoy it, and some of the intimate "shots" will endear it to the nature lover.

C. H. Curran.

Marine Shells of Southwest Florida

- - - - - - - - by Louise M. Perry

American Paleontological Research Institution, Ithaca, N. Y., $3.50

THIS is without doubt the best manual on the marine shells of this region which has yet been published. It is comprehensive and concise and of a most convenient size to use in the field. While the descriptions are technical, they are clear, and with the large series of collotype plates from photographs made by W. Hammersley Southwick from the original shells it will be easy for any collector to identify his specimens without uncertainty. Each plate shows the shells specially enlarged for clarity and with the natural size indicated by an index line accompanying each illustration.

While no synonymy of the various species is give , the latest and best scientific name with its authority accompanies each description. This method promotes conciseness and convenience. The introductory material is interesting and clear, while the descriptions are practical and of great value. This is a most worthy addition to the library of the conchologist.

Roy Waldo Miner.

ECUADOR, THE UNKNOWN
- - - - - - by Wolfgang von Hagen

Oxford, $3.50

FROM the facile and versatile pen of von Hagen has come another very pleasing book on Ecuador.

Over a third of it is devoted to the Galapagos Islands lying 600 miles off the Ecuadorian coast. Here in 1935 he and his wife lived for six months, and during that time he erected a monument to Charles Darwin surmounted by a replica in bronze of the bust in our Museum. This was to commemorate the centenary of the visit of that illustrious naturalist to these islands where, in his splendid mind, the idea of the principle of organic evolution first took form from observations made upon the plants and animals which he found upon the individual islands of this archipelago. The author pleads eloquently for a program of conservation which would insure to posterity such interesting species as the giant tortoises which are now very seriously threatened with extinction.

In his bright, entertaining style he gives the colorful history of the islands, and devotes three chapters to his visit with, and study of, the Colorados, a tribe of Indians who dye their entire bodies flaming red. The remainder of the book by this experienced traveler and keen, studious observer is given to very interesting travel narrative illustrated by his own clear and well-selected photographs, and to chapters on cocoa, balsa-wood, panama hats and condors.

H. B.

THE BREEDING HABITS, REPRODUCTIVE ORGANS AND EXTERNAL EMBRYONIC DEVELOPMENT OF CHLAMYDOSELACHUS, BASED ON NOTES AND DRAWINGS BY BASHFORD DEAN
- - - - - - - - - by E. W. Gudger

Published by Order of the Trustees
American Museum of Natural History

NEARLY a century ago the famous Swiss naturalist Louis Agassiz published his superbly illustrated memoir on fossil fishes, which soon became the foundation for later knowledge on the oldest classes of vertebrates. To numerous shark teeth from the Lower Carboniferous age he gave the generic name *Cladodus,* meaning "branch tooth," because of their distinctive form.

In 1884 and 1885 Samuel Garman of the Museum of Comparative Anatomy, Cambridge, described the "frilled shark" from the deep waters off Japan as a living descendant of these ancient cladudont sharks and called it "the oldest living type of vertebrate." Whether or not this conclusion was entirely correct, it added valid importance to the anatomy and embryology of the frilled shark.

In 1900-1901, in 1905 and 1917, Professor Bashford Dean, founder of the American Museum's Department of Ichthyology, visited Japan and collected and studied the frilled shark, securing an important series of its eggs and embryos. He intended to publish a memoir on the embryonic development of this archaic fish, and produced a number of drawings of the eggs, embryos and young in collaboration with the Japanese artist, Isaburo Kuwabara. He was unable to write the memoir, however, and the task fell to Dr. E. W. Gudger, now Honorary Associate in Ichthyology of this Museum. This handsome volume, Article VII of the Bashford Dean Memorial Volume on Archaic Fishes, is the result.

This deep-water shark has evolved a special way of protecting its young and supplying it with a large amount of food. It still follows the ancient shark method of forming horn-covered eggs, but retains the eggs in its body until they become about four-fifths as large as ostrich eggs because of the huge yolk. A single female approximately five feet long contained ten ovarian eggs averaging three and a quarter inches in diameter, and the largest known embryo was over fifteen inches. Thus the newborn frilled shark enters the deep-sea world of darkness and great pressure well equipped to fend for itself.

The present memoir abounds in details which may afford important clues for future investigation and adds stature to the work of Bashford Dean and his successors in supplying new chapters in the history of fishes.

W. K. G.

THE NEW NOAH'S ARK
- - - - - - - by André Demaison
Translated by Eric Sutton

Macmillan, $2.50

THIS is a very entertaining account of what purports to be a young Frenchman's journey along the Guinea coast of West Africa, between the mouth of the Niger and Senegal. The trip was made in an old sailing schooner and the purpose of the cruise was to secure by purchase or barter various wild African animals from the natives. These animals were taken along on the schooner to be later transshipped to Europe.

The habits of the animals in captivity are vividly, intimately, interestingly, and for the most part accurately, described. Many of the animal passengers on this new Noah's Ark are named and referred to from time to time, until the reader becomes quite familiar with them. Unfortunately some of them are referred to by the wrong names, which is perhaps the fault of the translator. The lynx and agouti, for example, are not African animals, and it is not clear just what animals are meant by the author when he refers to them.

Equally interesting with the accounts of the animals is the story of life on the schooner, with a crew of West African natives and half-castes, the difficulties and dangers of entry into the mouths of west coast rivers with their sandbars, mud flats and odorous mangrove swamps, and the perpetual menace, especially to white men, of the tropical diseases of the region, principally malaria and yellow fever.

H. C. R.

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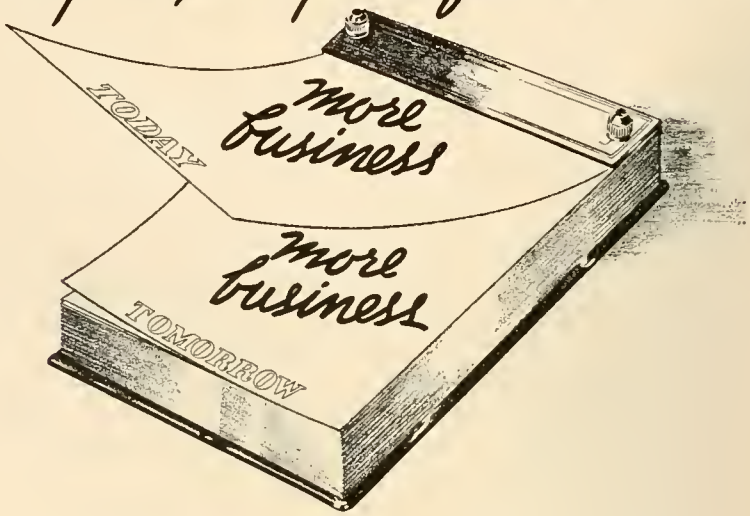

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FINNY PHOTOGRAPHS

Continued from page 254

placed some distance behind the tank to reflect light through the water and so relieve the murkiness that it would otherwise have. Needless to say, the water should be clean.

Exposures are measured by placing the meter against the front glass of the tank. A few measurements will quickly indicate the need for the most rapid film available, such as Agfa's Superpan Press Film. By using such a film, the shutter may be speeded up enough to catch the fish on the fly—like any good fly fisherman.

Artificial light

Indoors the lighting problem is not so easy. If enough photoflood lamps are clustered around the sides and top of the tank to provide sufficient light for rapid exposures, the water in the tank may quickly become too warm for comfort—that is, for the fish's comfort.

Synchronized flash equipment is a better solution to the indoor fish picture problem. A flash bulb is placed close to the top of the water and as near to the front of the tank as possible. A shield of paper is set up between the bulb and the camera so that no light flashes directly into the lens to cause flare. The bulb is connected to the synchronizer on the camera's shutter and fired when the focus and the fish's pose are satisfactory. The closer the camera is to the tank, the more critical becomes the focus adjustment and the shallower the depth of field. Good close-ups of tiny tropical fish are difficult to make but satisfying when well done.

Troubles and difficulties will really begin when color pictures are attempted. They have been made, though, and good ones, too.

If you want to experience the thrills of the hunt, take a bead on your aquarium through your camera sights and try some piscatorial portraits. If you get a good one, you've got something!

THE HAYDEN PLANETARIUM

Presents During DECEMBER:

"THE WISE MEN'S STAR"

With music and lights the Planetarium salutes the Christmas season throughout December. While we cannot with certainty identify the star of Bethlehem, we can at least speculate upon it. We do, in fact, illustrate some of the theories that have been advanced during the past centuries to explain it. Some students suggest its being a brilliant new star shining temporarily in the sky. A bright comet, an unusually prominent fire ball, or a combination of planets might also explain the story.

•

THE HAYDEN PLANETARIUM

Presents throughout JANUARY:

"OUR WINTER SKY"

Carlyle lamented "why did not someone teach me the constellations." Those who come to the Hayden Planetarium show in January will be shown the constellations that are overhead this season. The stars will be named and even telescopic views of important objects will be shown and described.

Orion and his hunting dogs embrace some of the brightest and most beautiful stars in the sky. The Zodiac, high overhead, presents other striking star groups, which we can study at night.

•

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INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 312

1. If you wanted to see the highest waterfall in the world, to what continent would you go?

2. What distant relative of the cat carried eight-inch daggers?

3. All the native mammals in Porto Rico have wings.

   True..... False.....

4. The Humboldt Current is a
   (a) Berry
   (b) Stream of salt water
   (c) Invisible lightning

5. What can be regarded as the most valuable bird in the world?

6. The language of bees is a
   (a) Sign language
   (b) Smell language
   (c) Spoken language

7. All domesticated cats have long tails

   True..... False.....

8. The world's highest waterfall is
   (a) Twice as high as Niagara
   (b) Ten times as high
   (c) Twenty times as high

9. Certain fishes use lights
   (a) In an attempt to adapt their vision to life on land
   (b) To keep themselves warm
   (c) As lures to secure their prey

10. Who were the first residents of England to hear of the battle of Jutland?

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3. PRIMITIVE SALAMANDERS in the early coal forests (Carboniferous period)
4. THE LARGE LIZARD-LIKE REPTILE, *Dimetrodon* (Permian period)
5. THE CARNIVOROUS DINOSAUR, *Allosaurus*, devouring prey (Jurassic period)
6. AN AQUATIC HERBIVOROUS DINOSAUR *(Brontosaurus)*, and an armored land form *(Stegosaurus)*. (Jurassic period)
7. A FLYING REPTILE *(Pterodactyl)*, and a connecting link between the birds and reptiles *(Archaeopteryx)* (Jurassic period)
8. THE GIGANTIC FLESH-EATING DINOSAUR, *Tyrannosaurus*. (Cretaceous period)
9. THE FRILLED HERBIVOROUS DINOSAUR, *Styracosaurus*. (Cretaceous period)
10. THE GIANT MARINE REPTILE from Kansas, *Mosasaurus* (Cretaceous period)
11. EARLY HORSE ANCESTORS, carnivore (Eocene period)
12. *Titanotheres* and other types (Oligocene period)
13. SABER-TOOTHED TIGERS and other animals from La Brea tar pits of California (Pleistocene period)
14. WOOLLY MAMMOTH and early man (Pleistocene period)

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(Continued from page 253)

to take no chances of your being sold out. . . .

And meantime let me thank you for a very rare treat.

THELMA BRACKETT.

Concord, New Hampshire.

A limited number of full-color covers of NATURAL HISTORY Magazine suitable for framing are available, at 5¢ each, plus 5¢ additional for packing and mailing any number up to ten. —ED.

* * *

SIRS:

I am much interested in the October issue concerning hawks. My hobby is color still-pictures of birds, but my collection contains no hawks. Please advise if the red-tailed hawk on the cover was photographed from life.

J. MURRAY HOLLISTER.

Schenectady, N. Y.

Positively, a living bird.—ED.

* * *

SIRS:

. . . You are to be congratulated on the magazine; it is becoming better with each issue.

WM. M. STERRETT.

Jamestown, N. Y.

* * *

SIRS:

As your magazine is my favorite of all the reading matter which enters my home and as snakes have been my hobby for well over 50 years, may I offer a little constructive criticism and receive enlightenment on certain statements made in the article "A Snake in the Hand" in the November issue?

In the statement that "the gopher is a friend of the rattlesnake," should there not have been a footnote stating that this particular gopher is the gopher tortoise? As most of our Western readers know, there is nothing that the large rattlers enjoy more for a meal than a nice fat gopher.

Another statement on which I would like to be enlightened is: "The venom flows through the fangs and out a hole in the side near the sharp point." Does the pit viper ever have the opening on the side of the fang? All the snake fangs I have examined had it on the front face, just above the point.

Also I would like to know if diamond rattlesnake venom is used as a painkiller. I know that the neurotoxic venom of the cobras is used for that purpose and that the venom of the South American rattlesnake (*Crotalus durissus terrificus*) likely could be, but how the hæmolytic venom of the diamondback could allay pain, I do not understand.

Yours, with best wishes for the continual success of NATURAL HISTORY.

D. P. LEFEVRE.

Cumberland, Md.

Mr. LeFevre's points are all well taken. Diamondback venom, according to available advice, has not been used to alleviate pain, and the hole in the fang of the pit viper is on the front surface.

The use of the usual Florida name gopher for what is elsewhere known as the box tortoise is explained in the following letter:—ED.

SIRS:

An interesting article, entitled "A Snake in the Hand," in last month's NATURAL HISTORY, contained a statement that will doubtless puzzle many readers, regarding the neutral or even friendly relationship between rattlesnakes and the "gopher." In Florida, and in the South generally, "gopher" means the gopher tortoise, a fossorial box tortoise found in that region. But in the Middle West "gopher" usually means a ground squirrel or, more rarely, the pocket gopher, a unique North American rodent. In the Far West and Southwest the name is almost exclusively applied to the latter animal.

"Gopher" comes from a French word *gaufre*, meaning a honeycomb, and was given by the early French Canadian voyageurs and explorers to the pocket gopher, which honeycombs the earth with its tunnels. The ground squirrel digs, although not so extensively, and the name was later applied to this better known animal.

Independently in Louisiana, a former French colony, the name "gopher" was given to the tortoise, because it, too, digs extensive tunnels. French influence was important in much of the Far South, so the name spread to Florida.

The pocket gophers found in Florida, Alabama and Georgia are certainly preyed upon by snakes and are not friendly to anything. In this region they are called salamanders, after the creature of medieval legend that went through fire unharmed. After extensive fires in the pine barrens of the South, people would notice the fresh mounds thrown up by pocket gophers which had been safe in their underground tunnels. Indeed, in the past century more pocket gophers than tailed amphibians have been called "salamanders." Outside the scientific world few people distinguish the latter from reptiles. The amphibians were called salamanders, because occasionally they would be found in hearths and they were supposed to have come out of the flames.

JOHN ERIC HILL.

American Museum of Natural History, New York City.

* * *

SIRS:

I have received with exceeding pleasure the current issues of NATURAL HISTORY Magazine. The beauty of this magazine's covers, illustrations, and exquisitely arranged pages cannot be told by mere words. I can honestly say that never have I seen a magazine that was such a masterpiece and I am proud to be a member of your wonderful institution.

Your magazine is too valuable, too beautifully made, to be tossed aside with other publications for subsequent burning or deterioration. I am therefore requesting that you mail me as promptly as possible the binder advertised. . . .

I shall look forward to each issue of NATURAL HISTORY Magazine and hope to be financially able to become a permanent member of your praiseworthy organization.

DANIEL V. BOESE.

Tigard, Oregon.

* * *

SIRS:

I just received my November issue of NATURAL HISTORY Magazine. That certainly is a beautiful cover. . . .

I was very much pleased to see the article on pigeons, because for quite some time I have been looking for information on homing pigeons and have been unable to get any.

BARBARA ELLEN ROGERS.

Winnetka, Ill.

* * *

SIRS:

In these days of unrest and terror your magazine gives, in its cover, retreat from destruction, and in its reading matter release from the harrowing details of suffering in the world. The whole magazine is a tonic we need now to keep us thinking in the right direction.

MRS. A. J. MONTGOMERY.

Beaufort, South Carolina.

HONOR

The American Geographical Society has awarded the Cullum Geographical Medal for 1940 to Dr. Robert Cushman Murphy, of the Scientific Staff of the American Museum of Natural History. Doctor Murphy, who has been a pioneer in the field of oceanic bird life, was recently elected hoorary president of the National Audubon Society, of which he had been president for three succeeding terms and a director for 20 years.

Answers to Questions on page 311

1. South America. The highest waterfall is Angel Falls in Venezuela. See page 259
2. The sabre-toothed tiger. This creature of 20,000 years ago was equipped with powerful eight-inch "swords" capable of piercing the toughest hide of its toughest adversary. See page 285
3. True. The island supports no indigenous land mammals except flying bats. Formerly seals inhabited the shore line, but they are no longer present. See page 306
4. (b) Stream of salt water. The Humboldt Current is a current formed as a division of the west-wind drift of the South Pacific, and directed north along the coast of Chile and Peru. See pages 295 and 296
5. The Peruvian cormorant or guanay, which produces great wealth in the form of fertilizer. See page 296
6. (b) Smell language. According to recent discoveries, the language of bees is based on olfactory signals, prefaced by movements to attract the attention of the audience. See page 308
7. False. True Manx cats have no tails and the Siamese cats have only short ones. See page 289
8. (c) Twenty times as high. There are at least 67 recorded falls higher than Niagara. See page 259 and Highest Waterfalls Chart
9. (c) As lures to secure their prey. See page 307
10. Pheasants and other birds. Because the sound of battle goes upwards and is reflected to a point a considerable distance away, birds with sensitive hearing were often the first "residents" to hear of a battle. See page 293

OUR READERS SPEAK

Sirs:

.... We have a good many magazines. I sometimes wonder why we have them. I never wonder why we have the magazine published by The American Museum. I always read it from cover to cover right away, and then look it over again. The make-up of the magazine is splendid . . . .

F.M.S.

Boston, Mass.

A MINISTER

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A PUBLISHER

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