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AN ILLUSTRATED MAGAZINE devoted to the advancement of natural history, the recording of scientific research, exploration, and discovery, and the development of museum exhibition and museum influence in education.

Contributors are men eminent in these fields, including the scientific staff and members of the American Museum, as well as writers connected with other institutions, explorers, and investigators in the several branches of natural history.

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The Journal of The American Museum of Natural History

HAWTHORNE DANIEL
Editor



A. KATHERINE BERGER
Associate Editor

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THE GIANT BALUCHITHERE

This colossal hornless rhinoceros is represented in the 1928 collection of the Central Asiatic Expedition by the long, massive bones of the forelimb and neck. Its shoulder height was 17 feet and the browsing height of the head 27 feet, exceeding that of the tallest giraffe

See "The Revival of Central Asiatic Life"

VOLUME
XXIX

NATURAL HISTORY

NUMBER
ONE

JANUARY-FEBRUARY, 1929



THE REVIVAL OF CENTRAL ASIATIC LIFE

A Triumph of Modern Palæontology—New and Unexpected Light on the Life History of the Globe for the Past 155,000,000 Years—Thirty more or less Complete Vistas into the Previously Unknown Life of the Mother of Continents—Hazards and Hardships but Finally Brilliant Success of the Fourth American Expedition into the Gobi Desert

By HENRY FAIRFIELD OSBORN

Honorary Curator of Palæontology, American Museum

WITH THREE DRAWINGS BY MARGARET FLINSCH UNDER THE DIRECTION OF HENRY FAIRFIELD OSBORN

REVIVAL or the bringing back to life of the plants and animals that lived on our prehistoric planet, thousands, millions, perhaps hundreds of millions of years ago, is the supreme art of the palæontologist and geologist.

This art is best practiced in a country which in the past was subject neither to the extreme luxuriance of abundant and more or less dense forests nor to the opposite extreme of aridity and sand erosion, and no section of the world seems to meet all the requirements for fossilization better than the partly uninhabitable, partly habitable, region of central Asia which formerly embraced the present Gobi desert of Mongolia.

On an 'equal area' map (see page 4) we observe that the very old continent of Asia has a commanding position as the center of our planet; that Europe is a mere western outlier of this great Asiatic land mass; that even Africa appears as a

giant appendage or peninsula to the far southwest; and that our own North America, with South America as an appendage, takes on the form of a large eastern peninsula.

Since Asia is truly the central continent, the fertile mother of all the other continents, and since its environmental conditions favor the preservation in fossil form of its life down the ages, how transcendently important becomes the revival of central Asiatic life! It is to this revival that the Central Asiatic Expeditions of the American Museum are devoted. The great outstanding result of the exploration and research under Roy Chapman Andrews, Walter Granger, Charles P. Berkey, and their gallant colleagues is that the most terrible desert of the entire world has been restored and revived into the very Garden of Eden of the period of the reptilian and mammalian creations. In the rela-



DIAGRAM SHOWING WORLD-WIDE MIGRATION OF THE GIANT DINOSAURS

(1) Central Asia, mother of continents, fertile center of life for 155,000,000 years, from which migrated waves of reptilian life into (2) western Europe, (3) the extremity of Africa, (4) the peninsula of India, (5) China and the East Indies, (6, 6, 6) North and South America. This diagram represents the actually known migrations and world-wide expansion of the giant dinosaurs known as Sauropoda, of Upper Jurassic time. These same migration routes were subsequently followed by many orders and families of mammals which chiefly originated in central Asia

tively brief period of six years between 1922 and 1928, the Central Asiatic Expeditions of the American Museum have fairly revived this sleeping giant of pre-history, as well as the outstanding events of its majestic life history during the geologic period now estimated by geologists and physicists at upward of 155,000,000 years, subdivided into the following time epochs:

AGE OF MAN

Recent and Pleistocene time	1,000,000	Man, Giant Ostriches	{ Gochu, Tsagan Nuru, Orok Nor, Shabarakh Usu
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AGE OF MAMMALS

Pliocene time	6,000,000	Horses, Camels from America	{ Hung Kureh, Tung Gur
Miocene time	12,000,000	Mastodonts from Africa	{ Loh
Oligocene time	16,000,000	Giant Titanotheres and Baluchitheres	{ Ardyn Obo, Ulan Gochu, Houl-djin, Hsanda Gol.
Eocene time	20,000,000	Mammals akin to those of the Rocky Mt. region	{ Gashato, Kolobolchi, Irden Manha, Shara Murun

AGE OF REPTILES

Upper Cretaceous	40,000,000	Closing Age of Dinosaurs	{ Djadokhta
Lower Cretaceous	25,000,000	Various Iguanodont Dinosaurs	{ Iren Dabasu
Jurassic	35,000,000	Giant Sauropod Dinosaurs	{ Ondai Sair, Ashile

From first to last this central region of Asia has been the homeland of waves of migrating plants, land reptiles, and mammals that successively spread over every continent along the general lines indicated in the map on page 4. Beginning in Jurassic time and accompanying the massive tread of the giant sauropods to the very extremes of South Africa and South America were the scions of hosts of other kinds of dinosaurs, such as the leaf-eating iguanodonts and the smaller and larger carnivorous dinosaurs known as megalosaurs or theropods. At the close of Cretaceous time, when the iguanodonts and related Ceratopsians, now famous for their nests of eggs, and the dire large and small carnivorous enemies of both these herbivorous dinosaurs, passed away, there followed in Eocene time a successive creation and evolution of smaller and larger types of mammals, which culminated successively in giant titanotheres, in overpowering Baluchitheres of the Oligocene, and finally in several kinds of mastodonts, including

the recently discovered 'shovel tusker' and 'serrate toothed' mastodon (*Serridentinus*). These mastodont proboscideans, however, were not of central Asiatic origin—they were invaders from the African or Ethiopian region passing through central Asia on their long trek into Europe, southern Asia, North and South America.

These successive waves of life, these arrivals and departures, these competitions and expansions of the older and newer dynasties of the animal kingdom are revealed in part in the rocks of upwards of thirty 'horizons' or 'life zones' to which our geologists have uniformly applied local Mongolian names—for example, 'Irden Manha', 'Valley of the Jewels'—from which we are granted occasional vistas into the long corridors of central Asiatic time. Twenty-one of these palæontological vistas, discovered in the years 1922, 1923, and 1925, have already been defined.¹ Two wartime years in China intervened, and now the year 1928

¹See Mongolia, Enc. Brit., 13th ed. supp. By H. F. Osborn



SURVEYING THE BADLANDS OF URTYN OBO

Tserin, trusty Mongol leader of the camel caravan, is gazing across these badlands, which appear exactly like those of Montana and Dakota

adds several new vistas into the previously unexplored Pliocene time and reveals new and stupendous forms of mammalian life.

THE BREAK BETWEEN THE GOBI AND THE ROCKY MOUNTAIN REGION

Immediately following the Lower Oligocene horizon of Ardyn Obo, and bringing to a close the long-continued friendly interchange and migration of fossil reptilian and mammalian life between the Gobi Desert and our Rocky Mountain region, there occurred a momentous break in the amicable international relations between central Asia and North America

that had endured almost continuously for 120,000,000 years. The cause of this break was probably geographic as well as climatic and environmental. From this time on until the end of Pliocene time, North America pursued its own way in uninterrupted evolution of the quadruped stocks which it had originally received from central Asia and the unexplored regions north of central Asia; it became especially the home of a great variety of horses and camels which, it is important to note, *were previously unknown in central Asia up to the time of the break between the life of the two continents.* Toward the close of Pliocene time new waves of south Asiatic and African life again entered North America, followed by the final wave near the close of the Ice Age which gave North America its present mammals, the bison, deer, and bear.

After this important Upper Oligocene break with North America there followed in the Gobi region of central Asia the most favorable climatic and environmental conditions that the mammalian kingdom has ever enjoyed, not excepting the highly propitious conditions of the modern equatorial African uplands. Under these favorable conditions of fertile and relatively well-watered uplands and broad level plains, of partly meandering streams bordered with forests and



PROFESSOR OSBORN IN CAMP AT IRDEN MANHA
It was here that the titanotheres were first discovered



AMERICAN MUSEUM CAMP AND WORKINGS AT CHILIAN HOTOGA

In the New Stone Age deposits of Chilian Hotoga were discovered teeth and bones that had been fashioned into artifacts by man

succulent vegetation, there arose new races of quadrupeds surpassing in size and grandeur even the great titanotheres of America hitherto known, or the great mammoths that in northern Africa and in southern Eurasia marked the close of the Age of Mammals and the beginning of the Age of Man. These new monarchs of the central Asiatic plateaus were partly endemic or native and partly migrant from Africa. They were offshoots of three entirely distinct families, namely, first, the Baluchitheres or giant hornless rhinoceroses; second, the giant bony-horned quadrupeds first discovered in America and known as titanotheres; third, the shovel-tusked mastodonts, a branch of long-jawed proboscideans.

These giants were not contemporaneous; they succeeded each other geologically as follows:

FIRST: Titanotheres, of Lower Oligocene age. Whereas in the Rocky Mountain region titanotheres reached their climax in the giant pair-horned *Brontotherium platyceras* of the Lower Oligocene, they survived and attained a superclimax in the still larger and more unique batter-

ing-ram-nosed *Embolotherium* (Greek ἐμβολή, signifying 'a battering ram') of the Oligocene of the Desert of Gobi. This animal somewhat exceeds in size the largest *Brontotherium* ('flat-horned thunder beast') of North America and develops in the front part of its face an entirely novel nasal battering ram composed of combined nasal and frontal bones. As the 'brontotherium' used its horns in tossing, the 'embolothere' used its horns for battering, assaulting, attacking, charging, and tossing. This bony horn rose 28 inches in the very front part of the face and was broadly expanded at the summit (Page 14). Roy Chapman Andrews informs us (August 22, 1928) that the ram-nosed titanotheres "are from the Ulan Gochu region, probably Middle Oligocene, and belong to the same group as the front portion of the skull found in the Shara Murun by Harold Loucks in 1925, although the new skulls are much larger than the Loucks specimen and are comparable to the largest of our American Oligocene titanotheres. There are no true horns but the frontal and nasal bones are produced upwards and terminate in a transversely broad blunt and rugose end. Fully as impressive as our finest American skulls, they surely represent a distinct phylum of titanothere."

SECOND: Baluchitheres, of Upper Oligocene age, including the *Baluchitherium*, named because of its original discovery in Baluchistan; also represented in *Indricotherium* of Turkestan and in



EXCAVATING THE TITANOTHERES BONES

Professor Osborn and Walter Granger, assistant leader of the expedition, examining the titanotherium jaw exposed at Irden Manha

Baluchitherium grangeri of the Upper Oligocene Hsanda Gol and Houldjin horizons of the Gobi. Discovered by the 1928 expedition is the still more gigantic stage fabulously known in the American press as the 'Woolworth' among mammals. This hornless rhinoceros is thus far unknown except in the Oligocene and Miocene of central and southern Asia.

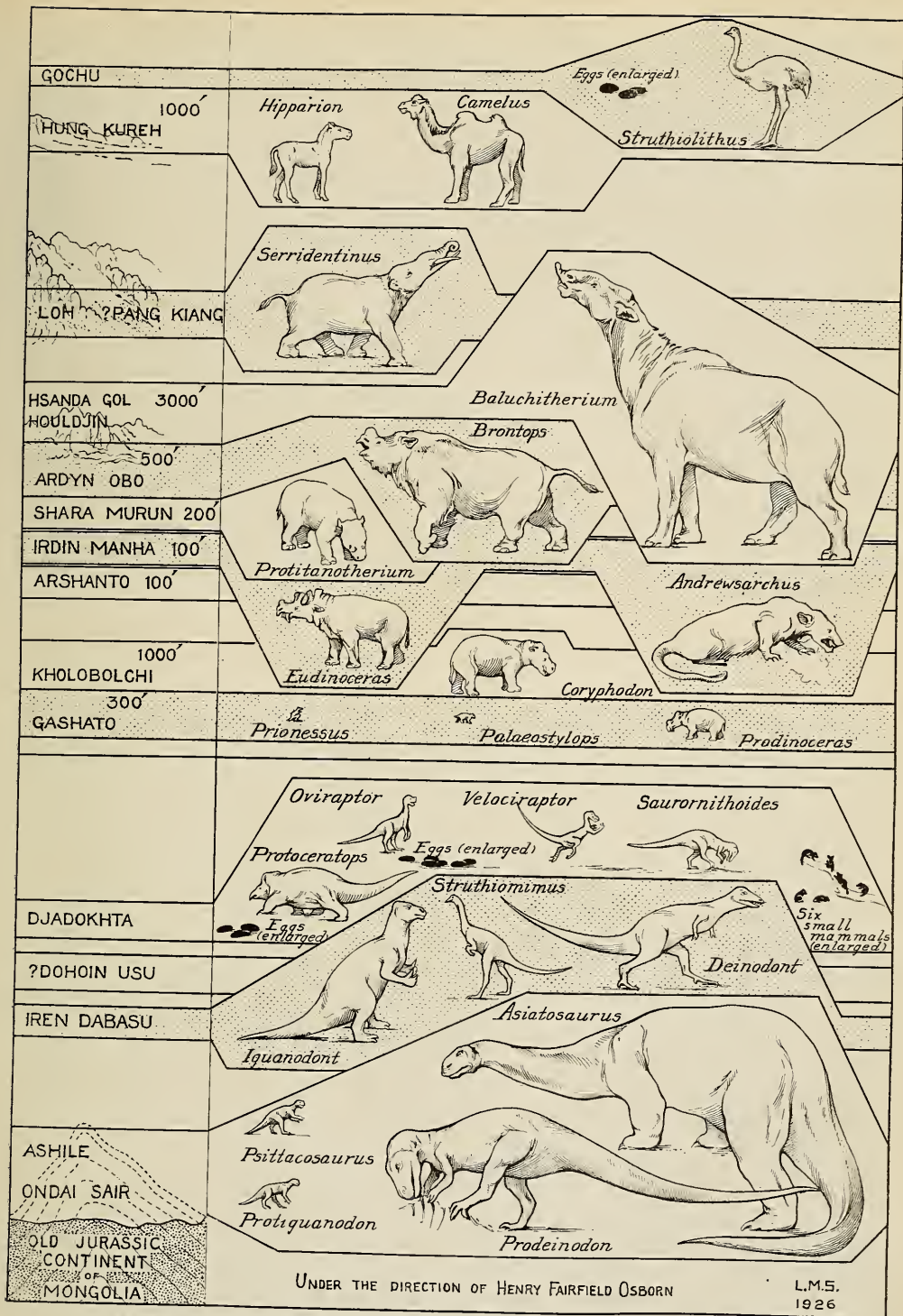
THIRD: Shovel-tusked Amebelodonts, of Pliocene age. Of less imposing size than the Baluchitheres or the battering-ram-nosed titanotheres, but of still more bizarre adaptation, are the shovel-tusked mastodonts, the direct ancestry of which can be traced back to the relatively small Oligocene shovel-tusker known as *Phiomia osborni* which frequented the ancient river Nile, the 'Ur-Nile' as it has been called, of the Fayûm region of northern Africa. The dramatic discovery of these animals is fully described below.

DISCOVERY OF THE GIANT SHOVEL-TUSKER

The leader of our expedition reported the sites of more than one of the 1928 camps as very rich localities, in which "great new areas of exposures have been discovered, a good deal of *Baluchitherium*

turned up, besides three skulls of that extraordinary titanotherium with the clubbed nasals that Doctor Loucks found, many 'Dune-Dweller' artifacts and some of a type entirely new to Pond, [our archæologist], and many other good things." He considered these sites worthy of a whole season's research. Despite this, the season of 1928 was one of extreme difficulty and threatened until the very end to be entirely unproductive of results.

Our dauntless explorers are very stoical regarding their hardships and disappointments; none but the most extreme difficulties are even alluded to. Northwest of the Ordos, occurred the most critical time in the whole series of our Central Asiatic Expeditions since 1922; no discovery of transcendent importance having been made, weather conditions being the worst our expeditions had ever encountered, the leader suffering from a painful and threat-



155,000,000-YEAR LIFE SUCCESSION OF THE GOBI SINCE THE JURASSIC

On each ascending geologic level are portrayed the dominant life forms discovered in successive ascending horizons, beginning with the giant sauropod *Asiotosaurus* of the Upper Jurassic and ending with the horse, camel, and ostrich of the human period (restorations mostly to the same scale of size). It will be observed that each geologic stage has its giant form of life, but never do two giant forms occur in the same period; it will also be observed that there is steady progress from the very humid environment adapted to *Asiotosaurus* to the very arid environment adapted to the bactrian camel (*Camelus*) and the ostrich (*Struthiolithus*)



MEASURING THE LEG BONE OF THE "MONSTER"

Chief Andrews and Assistant Chief Granger uncovering giant forelimb of the new colossal species of *Baluchitherium*, chief trophy of the expedition of 1928



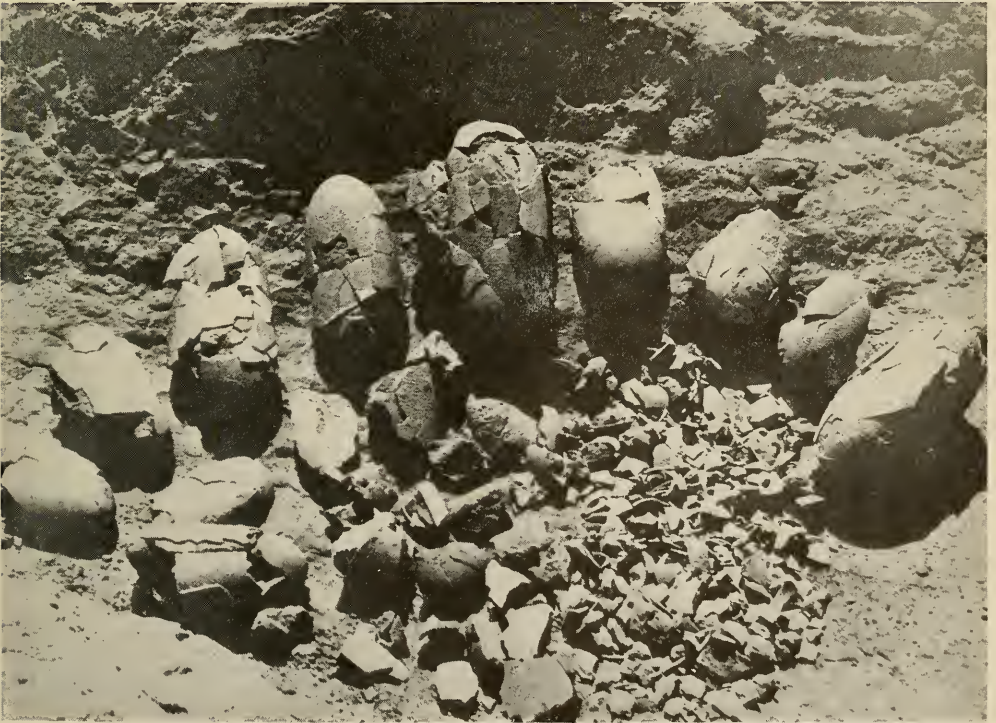
HEROIC LEADERS OF THE EXPEDITION OF 1928

Left to right they are, lower row: Perez, Andrews (chief), Granger (assistant chief), Spock (archaeologist), Thomson (palæontologist); upper row: Shackelford, Pond, Eriksson, Horwath, Young, and Hill



TAKING OUT DINOSAUR EGGS

New deposit of dinosaur eggs discovered near the Kalgan-Urga trail at Ehrlein being unearthed by Roy Chapman Andrews and Walter Granger



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CHIEF TROPHY OF THE 1923 EXPEDITION

The finding of several nests of dinosaur eggs during 1923 was the first positive proof that some dinosaurs laid eggs

ening wound and receiving surgical care under the most trying conditions, the western way to Chinese Turkestan absolutely blocked by mountains of driven sand, the party discouraged by the return of Sven Hedin's decimated and half-starved caravan—such were the conditions which roused afresh the fighting spirit of Andrews, Granger, and Young, and led to the practical reversal of matured plans and to an entirely new plan of campaign which involved retiring from the western post and turning eastward and northeastward.

The palæontologist always takes a gambler's chance, but fossil gambling in a country so many parts of which had yielded rich returns is so full of promise that we can well understand the renewed outburst of optimism on the part of our explorers even in the midst of their leader's acute physical distress. Thus with the face of the caravans and of the motor trucks turned toward the northeast, the expedition crossed the line of the Kalgan-

Urga trail at the telegraph station of Ehrlein and slowly worked northeastward, to be rewarded early in August by the discovery of extensive exposures of Pliocene age, 24 to 130 miles east of Iren Dabasu.

It was the enforced end of the collecting season; the gasoline supply was running very low, for owing to the frightful heat of May and June in the western part of the Gobi more than one-third of the cans had exploded, and our reconnoitering party had come to their last evening before facing southward toward Kalgan for the return journey. On his way to the summit of a high bluff on which were stretched the American Museum tents, Walter Granger suddenly struck his foot against a slight projection; even in the gathering twilight it seemed on close examination to be a fossil. Marking the spot, he hastened back to camp and said:

"Roy, we cannot move tomorrow morning; I think I have found something entirely new."

Hurrying down the bluff soon after

dawn, they exposed carefully what proved to be a complete lower jaw, eight feet in length, very slender in the middle portion and expanding in front into the most astounding pair of lower teeth fourteen inches in breadth!

The jaw was that of a giant shovel-tusker (Page 15). The two lower teeth are closely pressed together in the middle line, broadened and flattened at the sides, so that together they exceed the dimensions of



Wide geographic range of the giant hornless Baluchitherium belonging to different species in (1) Baluchistan, (2) Turkestan, (3, 4) Central Mongolia

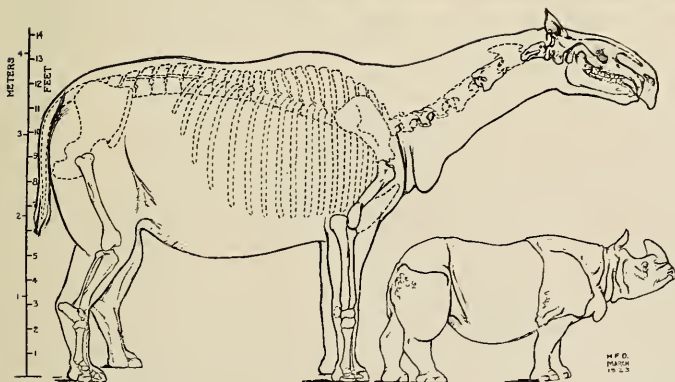
the typical Irishman's shovel. In place of the shovel handle is the long, relatively slender lower jaw by which the shovel tusks were pushed into the sand or, more probably, used to uproot nutritious tubers. Of the brilliant Gobi discovery which occurred at the very end of the 1928 season in Pliocene beds of eastern Mongolia, Roy Chapman Andrews writes, August 22, 1928:

We have one specimen of the lower jaw in which the front is well preserved. The incisor teeth are about one inch in thickness, seven inches in transversal breadth and over a foot in length and truncated at the wearing end. The alveolar border comes directly to the front edge of the teeth on the under side but on the lingual surface the teeth are bare for several



Above.—The giant Baluchitherium, chief trophy of the American Museum Expedition of 1927. After restoration by C. R. Knight. This record-breaking species now yields in size to the 'colossus' of 1928

9



Left.—Colossal scale of the giant Baluchitherium of 1927 as compared with a full-grown Indian rhinoceros

inches back of the cutting edge. The symphysis is broadest some distance back of the front and is rather deeply concave. It suggests a spoon which has been cut squarely across in front. Back of the symphysis the jaws seem to be of a more normal mastodont type. This mastodont comes from Pliocene beds to the eastward of the Kalgan-Urga trail and it may

be that Père Teilhard got traces of it when he explored the Talai Nor region in 1924, but it is entirely new to me.

This unique type of mastodont was first described by Prof. Erwin H. Barbour from a fossil jaw which he found in western Nebraska and to which he applied the



THE NEW BATTERING-RAM TITANOTHERE

It has been named *Embolotherium andrewsi* in honor of the leader of the expedition. This is a giant survivor of the great race of quadrupeds that roamed from the Balkans across Eurasia into Nebraska and Colorado. The position of the nostril opening is problematic.



THE GIANT SHOVEL-TUSKER

A new species of mastodont named *Amebelodon grangeri*, a descendant of the primitive long-jawed mastodont (*Phiomia*) of northern Africa. Adapted to uprooting bulbous plants, it frequented the shallow lake waters of ancient Gobi

highly appropriate generic name *Amebelodon* (derived from two Greek words signifying 'shovel' and 'end-tooth'). The Gobi discovery, which may be named *Amebelodon grangeri* confirms in the most surprising manner the adaptation so aptly named by Professor Barbour, and it demonstrates, as in the case of all the other quadrupeds, that the Gobi climate and environment were even more favorable than that of the Nebraska plains in Pliocene time, because in the Gobi shovel-tusker the dimensions are nearly double those of the Nebraska shovel-tusker.

But central Asia is still reluctant to yield completely to the supreme art of the palæontologist and geologist the most important fossil mammal of all, namely, the ancestors of the Dawn Man, which still elude dis-

covery. When found, the Dawn Man, a biped living in a partly open country, will be quite distinguishable from the anthropoid apes, which lived in the tropical forests of India to the far south. Andrews and Granger have been foiled this year in finding traces of the ancestry of man in Oligocene or Miocene time. This was to have been expected, because the coarse gravel and sand deposits which contained the giant quadrupeds unearthed by the expedition are not favorable to the preservation of the more delicate remains of the ancestral Dawn Man or of the anthropoid apes.

Finally, during this period of the triumphant revival of central Asiatic life, may we not conclude this preliminary and all too brief outline with the prophetic vision of Isaiah?

The wilderness and the dry land shall be glad; and the desert shall rejoice, and blossom as the rose. It shall blossom abundantly and rejoice, even with joy and singing; . . . for in the wilderness shall waters break out, and streams in the desert. And the glowing sand shall become a pool, and the thirsty ground springs of water.

ISAIAH 35: 1-7.



UNEARTHING THE BATTERING-RAM-NOSED TITANO-THERE *Embolotherium andrewsi*, ONE OF THE THREE GREAT TROPHIES OF THE EXPEDITION OF 1928. THE FRONT ASPECT OF THE 28-INCH NASAL FRONTAL HORN APPEARS IN THIS PHOTOGRAPH. THE PHOTOGRAPH OF MR. GRANGER GIVES THE SCALE



Courtesy of Northern Pacific Railway Co

Paradise Inn, Rainier National Park, in May

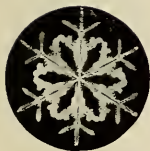
WHEN WINTER COMES

The Many Forms Taken by Frozen Water—
Snow and Ice—Sleet and Hail—
Glaze and Hoar Frost

By CHESTER A. REEDS

Curator of Geology, American Museum

WITH PHOTOGRAPHS OF SNOW CRYSTALS BY W. A. BENTLEY



EVERY winter the varied forms of frozen water, such as frost, rime, glaze, sleet, snow, and ice, afford not only the most pleasing sights, but they display natural phenomena that are of intense interest to everyone. All of the forms are exquisitely beautiful and worthy of the study of the most gifted scholars.

It may be noted that as autumn passes into winter there is a gradual lowering of the average temperature, and during clear nights the radiation from the ground may produce a temporary decrease of temperature of the land below the freezing point of water, although the general mass of the air above remains at a higher temperature. Under such circumstances the water vapor in the lower layers of the atmosphere condenses and, as it settles upon the cold objects on the ground, it freezes and forms a

light feathery deposit of ice known as *hoar-frost*. The heaviest hoar-frosts are formed under weather conditions similar to those under which the heaviest summer dews occur, namely: clear and calm nights, when there is no cloud or smoke layer to impede the radiation of heat from the surface of the land, which thereby becomes rapidly and completely cooled. Hoar-frosts provide one of the prettiest sights of winter, forming every conceivable pattern on the grasses, shrubs and trees, as well as the more unsightly objects, such as fences, railings, and telegraph wires. Hoar-frost is beautiful in that it presents a tracery of glittering whiteness, the result of the reflections and refractions from the small transparent spicules of ice which form the flower-like crystals.

Another well-known form of frost closely allied to hoar-frost is the crystal-

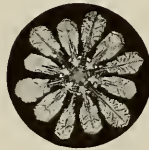


Courtesy of Northern Pacific Railway Co.

MOUNT RAINIER, WASHINGTON, CLAD IN ITS WINTER COAT

Mount Rainier is one of the highest perpetually snow-capped mountains in the United States, 14,408 feet above sea level. At Paradise Inn, 5500 feet, 789.5 inches of snow fell in the winter of 1916-1917. There are twenty-eight glaciers on the slopes of this mountain, seven of them being "live," and moving at the rate of sixteen to twenty inches a day

line deposit seen when the moisture in the air of a warm room condenses on the window pane that has been cooled by contact with the cold winter air outside. These frost patterns are a joy to everyone. Not only are these feathery and fernlike forms so intrinsically beautiful in themselves, but they are highly instructive. They are usually developed by rapid labile (shifting) crystallization; sometimes by a slower crystallization, when the ends of the branches show beginnings of definite crystals of hexagonal symmetry as may be noted on the illustration from Mount Washington, New Hampshire, page 20.



Another interesting frost-like deposit of ice is known as *rime*. It may be several inches thick on the windward side of exposed objects since it is formed from

undercooled fog particles and hence grows straight into the wind. It appears when a frosty fog is accompanied by wind, the fog drifting along and depositing spicules of ice on all surfaces exposed to it.

For the deposition of the rime it is essential that all surfaces be cooled by radiation below 32° Fahrenheit. As frost fogs in low-lying districts occur usually in calm weather, rime crystals are not often observed there, but are of frequent occurrence on hills, where the driving mists cover all projecting objects such as trees, fences, stones, et cetera, with great masses of loose feathery crystals of considerable thickness. When the sunlight appears, the objects of the familiar landscape appear as if dressed in garments made of closely studded diamonds. Close examination, however, reveals that

they are encrusted with ice-crystals of unusually large size, some an inch long. The exquisite splendor of such a scene endures but for a short time, for the very light rays which produce so wonderful a spectacle carry with them the heat rays which melt the crystals and destroy the remarkable sight.

In 1920 V. Bjerknes of Norway showed that when warm winds converge toward colder winds, the warm air rises above the colder air, and its moisture is condensed in the same way as in the air rising over mountain summits. Whether it be on mountain-side or on the slopes of a cold current, as soon as the warm moisture-laden and expanding air is chilled to the point of condensation, cloud formation begins and rain falls when the air reaches the point of saturation. When such a rain falls through a surface layer of air

cooled to below the freezing point, the raindrops freeze on touching cold solid objects and form a smooth coating of ice on the ground, trees, fences, et cetera, known as *glaze*. These ice storms are not uncommon in the United States and Europe.



In 1920 C. LeRoy Meisinger, of the United States Weather Bureau, by using records from kites and balloons, traced out the manner in which warm southerly winds overflowing cold winds from the north produced zones of rain, glaze, sleet, and snow. Often such storms are local and do not have a widespread effect, but once or twice in a winter they may occur over a large area. The ice storm that passed over Philadelphia and Baltimore at the time of President Taft's inauguration, March 4, 1909, may be cited as an example. The ice that formed



NIAGARA FALLS IN THE DEPTH OF WINTER

During the month of February the spray below the Falls freezes, and gradually the front of this natural wonder is encased in snow and ice.



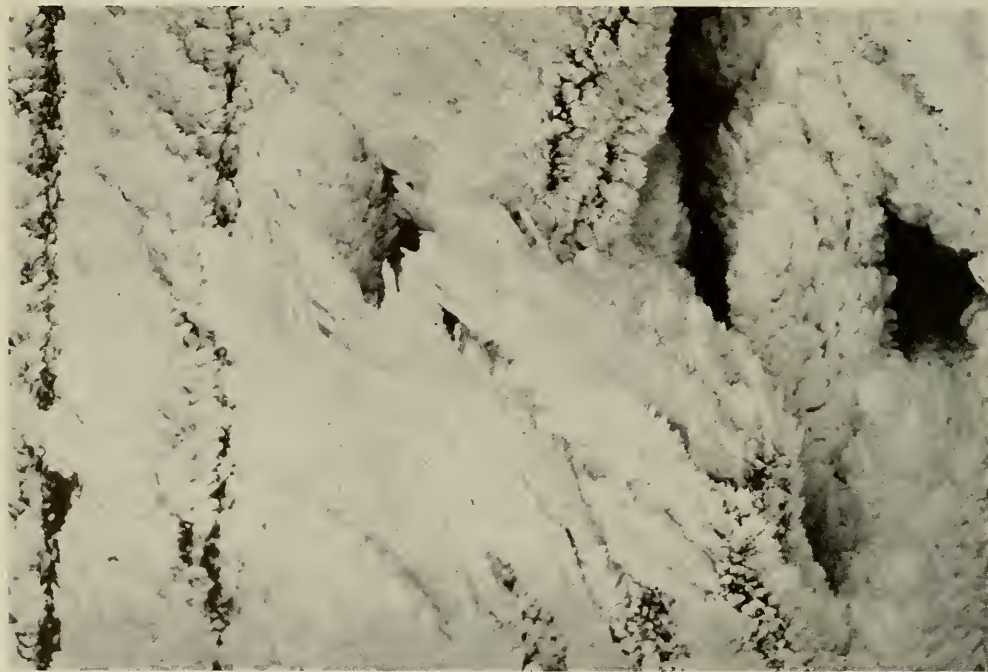
on the telegraph wires was so thick and heavy that many a wire and pole were broken down by the weight of it.

Telegraph communications were so badly interrupted at that time that trains could not proceed for many hours.

In the winter of 1919-1920 two ice storms of this type stand out prominently—one, January 20-25, covered practically all of the territory east of the 100th meridian, while a second, February 3-6, was confined to the Atlantic coast. The great precipitation consisted of snow in the northern portions, and of snow, sleet, and rain in the middle latitudes, which formed a solid, slow-melting cover. In both instances traffic on railroads and in cities was impeded and in many places completely tied up, and telephone and

telegraph lines were crippled and numerous accidents resulted. In New York City the streets were more effectually blockaded by snow than at any other time in the city's history. The removal of the snow from the streets was a difficult problem, since layers of ice had formed at different levels in the snow, increasing the rigidity of the drifts and packing them more solidly.

A form of ice which falls from the free air and produces a rattling sound when it strikes hard objects, such as a window pane or a tin roof, is known as *sleet*. It consists of partly melted snow or rain particles which freeze while falling from a warm layer of air through a cold one. Sleet is frequently driven by the wind, and it may be said that sleet falls are usually coincident with, imme-



FROST FEATHERS ON WINDOW PANE, MOUNT WASHINGTON, NEW HAMPSHIRE
The moisture of an inhabited room, coming in contact with the cold surface of a window pane, is often frozen into fantastic and beautiful designs

diately precede, or follow snowfalls. The occurrence of sleet is also known to be associated with the conditions of the atmosphere under which glaze is formed.

Another form of ice which falls from the air is known as *hail*. It consists of pellets, or hailstones, which frequently consist of a kernel of hard snow in the center, surrounded by alternate concentric layers of ice and snow; in other cases they have a radial structure. They assume various shapes, most commonly spheroidal, but some are pyramidal, others flat, and others irregularly oval. In size they usually vary from a tenth to a quarter of an inch in diameter, but masses measuring from twelve to fifteen inches in circumference and weighing more than half a pound are of occasional occurrence. The fall of hail occurs chiefly in spring and summer, and most commonly precedes or accompanies a thunderstorm. The time of its continuance is always short, generally only a few minutes. It is now believed that the continued retention and repeated elevation in the atmosphere, of a pellet initially small, which is several times carried by strong convection currents through successive regions of rain and snow, gives the requisite length of time for the accretion of the larger hailstones. Hailstones frequently damage fruit and grain crops, kill small animals, such as birds and rabbits, and occasionally cattle.

The most common of the free air



HOAR FROST ON TREES IN WINTER,
NIAGARA FALLS, NEW YORK

Frost is formed when dew collects and freezes during a drop in temperature

winter visitors is *snow*. It falls to the earth in flakes, each flake consisting of a distinct crystal, or more commonly, of combinations of separate crystals. The crystals are generally in the form of thin tabular plates, long needles, or columnar particles of ice formed in the air at temperatures below freezing. All are hexagonal in type, but of endless variety in detail. Many of the forms are exquisitely beautiful. The whiteness of snow is due primarily to the large numbers of reflecting surfaces arising from the minuteness of





the crystal particles.

Snow crystals are formed at high altitudes directly from the water vapor of the free atmosphere. The snow crystal solidifying as it does from the vapor of the cold upper air without passing through the liquid stage, is formed under circumstances exceptionally favorable to freedom of movement of the molecules. This fact, no doubt, accounts for the great variety of crystal forms observed, a variety not approached by any other mineral.

Mr. Wilson A. Bentley of Jerico, Vermont, has made more than 4200 exquisite photographs of snowflakes, no two of which are alike. Even when formed under identical conditions, he states, hexagonal, trigonal, oblong plate forms, six-petalled forms and columnar forms, have all been

found side by side. They are mostly of six-rayed stellate form, the rays being inclined at exactly 60° , the feathery form being produced by the main six rays developing off-shoots or branches to right and left at 60° . Many of them are like stars, the interspaces between the rays of which are almost filled in with exquisite lacework. The most perfect and largest of these stellate snowflakes are formed when the air is still, the moisture plentiful, and the temperature only moderately low; the columnar, tabular, and more complete solid crystals are produced at higher altitudes in a more intense cold. Reproductions of a number of Mr. Bentley's photomicrographs of snow crystals accompany this article. They show a considerable variety of crystal forms.

According to Dr. E. T. Wherry, 1920, the nucleus from which the growth of a snow crystal starts consists of a single ice



SCENE IN BALTIMORE, MARYLAND, DURING THE ICE STORM OF MARCH 4, 1909

The forecaster had predicted fair weather for President-elect Taft's inauguration at Washington, but due to the unexpected appearance of a cold air current from the north, glaze was deposited on trees and telegraph lines. For want of a better term, the storm was called a "flareback"



A CONNECTICUT LAWN IN WINTER

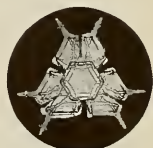
The summer house, trees, and ground are covered with sparkling ice called glaze. This winter phenomenon is particularly troublesome to railroads

molecule, which, as is indicated by the chemical evidence, consists of a group of four molecules of water (H_2O). As new material builds up around this nucleus, several different things may happen. If the growth is very gradual, relatively uninterrupted, and long continued, the crystal may retain the form of the nucleus throughout its development. Where conditions favor rapid growth, crystals in general tend to become elongated and needle-like, and when the growth occurs in several directions around an axis of symmetry, a skeleton crystal or a solid form will be produced. In snow crystals such rapid growth takes place in the directions of the three interchangeable crystal axes, or, counting from the center, in six directions, producing highly perfect hexagonal symmetry.

There is much evidence at hand to show that true snow crystals are formed directly from the minute invisible mole-

cules of water vapor in the air, and not from the cloud particles. Some snow crystals, however, are composed of flakes coated with granular ice. These coatings are in all probability formed by the freezing of actual minute droplets of condensed water, the material of clouds. Occasionally too, lines of secondary growth in snowflakes exhibit bilateral instead of hexagonal symmetry. This is one of the unsolved problems connected with the crystal forms of snow. Other degrees of symmetry are occasionally shown by snow crystals as the result of more or less accidental conditions of growth.

In some snow crystals tabular plates of different size and outline may be developed at opposite ends of a central column as shown on page 32. Occasionally a twelve-rayed crystal may be observed. It is like the above with





SNOWFALL MAP OF THE UNITED STATES

The snowfalls for the years 1895-1914 have been averaged, and the results entered on the above map. Depths in inches. Data from Chart XVII, *Monthly Weather Review*, Washington, October, 1919

one of the two basal planes rotated 30° on a short axis without disruption. By noting the difference in development of the alternate rays one may differentiate the two phases of such a crystal.

Snowflakes vary in size from microscopic forms to those 10 cm. in diameter or larger. In most snowflakes the three horizontal axes are more fully developed than the vertical axis, and the margin of the flakes are not infrequently turned upward slightly so that they resemble a round or oval dish. The edges are turned upward slightly by reason of the resistance offered by the air in their fall. During flight they may rock to this side or that, but as a rule they do not turn over. The larger crystals have been observed to fall at the beginning of a snowfall, when the ground temperature was but a little above freezing.

The forms of snow crystals are rarely noticed during a snow storm. It is only

when it is just beginning to snow in calm air and when the crystals fall on dark objects that their shapes may be distinctly recognized. This stage is the most favorable for photomicrographic work. It is usually a brief period, however, for as the crystals become more numerous they frequently reach the ground in a damaged state due to their collisions one with the other on their downward flight. As the fall of snow becomes denser, a number of crystals combine to form a conglomerate composed of crystal fragments. This is by far the most frequent form of snow in our snow storms.

The character of the snowfall also depends on its water content. The large flaked "wet" snow that falls at temperatures above freezing and usually melts rapidly, should be contrasted with the "dry," "powdery" snow that does not pack.



It not infrequently happens that rain and snow may fall simultaneously, producing *graupel*, an opaque mass of snow and water resembling soft hail. Not infrequently these have the appearance of small pellets of snow, which are readily pulverized.

Snow, especially the deep snows which lie for weeks and months on the mountains and plateaus, has an economic significance somewhat different from that of rain. The snow furnishes a slower, and therefore a more lasting natural supply of water for power, for irrigation and general use than does rain, which has a quick run-off. In the drier sections of the United States many of the engineering and agricultural problems are connected with the depth and conditions of snowfall, and the amount of water which its melting will supply. This is especially true in the mountain-



ous sections of California, Nevada, Arizona, and the Rocky Mountain states. A winter snow cover prevents deep freezing of the ground; protects grasses and fall sown crops, and provides spring moisture for growing vegetation. This is especially true of the Missouri and upper Mississippi valley states. While snow facilitates lumbering operations in the western, northern, and northeastern states, it seriously interferes with the operation of steam and electric railways and involves great expense in its removal where city streets are covered to considerable depths.

A snowfall map of the United States, prepared by the United States Weather Bureau, is shown on page 24. It represents the average annual snowfall for the years 1895 to 1914. In examining the map it should be recalled that the amount of snowfall varies greatly and very



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ICE-INCRTUSTED STEAMER, SOO LOCKS, SAULT SAINTE MARIE, MICHIGAN

Winter comes early and ends late on the upper Great Lakes. Nevertheless, more cargo tonnage (iron ore, coal, grain) passes through these locks than crosses the Atlantic between North America and Europe

irregularly from year to year. This variability depends on the length and the severity of the winter, the number and intensity of the snow storms, the temperature, the topography, proximity to primary sources of moisture-supply, such as the oceans and Great Lakes, and the exposure to damp winds.

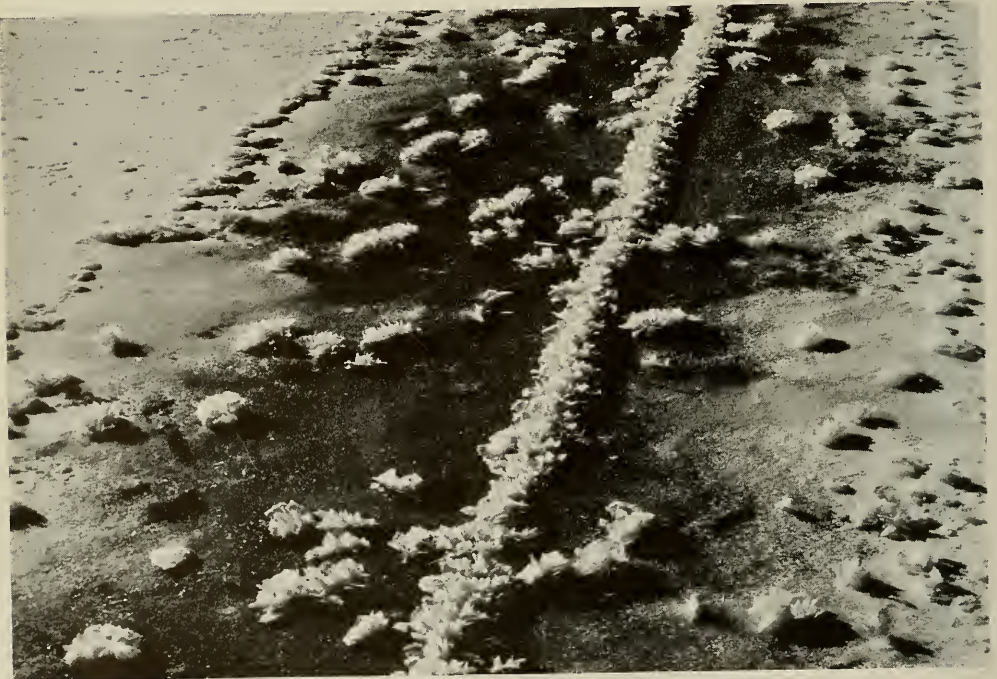


The heaviest snowfalls in the United States occur on the western slope of the Sierra Nevada and Cascade ranges, where snowfalls amounting to more than 400 inches annually are not uncommon. Although these mountains are regions of heavy rainfall and excessive snowfall, they are not perpetually covered with snow. On many of the higher peaks the snow disappears in May or June and usually does not reappear until October. The average annual snowfall at Fordyce Dam, California, (6500 feet), for 16 years, is 402.4 inches; the average at

Summit, California, (7017 feet), for 44 years, is 419.6 inches; and the average for eight years at Tamarack, California, (8000 feet), is 521.3 inches. The maximum snowfalls recorded at Summit,

California, occurred in the years 1879-80, 783 inches, and 1889-90, 776 inches. The greatest fall registered at Tamarack was 757 inches in 1910-11. The first snowfall report, 1916-1917, from the gauging station established November 24, 1916, at Paradise Inn on the south slope of Mount Rainier, Washington, at an elevation of 5500 feet, gave a total depth of 789.5 inches. It is not unlikely that still deeper snows will eventually be recorded at higher elevations on the slopes of Mount Rainier.

The most outstanding tragedy of the Sierra snows occurred in November, 1846. The Donner party, California bound, consisting of 83 persons, numerous cattle,



ICE FLOWERS, ST. MORITZ, SWITZERLAND

Here the sunlight has melted a portion of the ice along a crack and produced six-rayed cavities (negative crystals). The water within these cavities has re-frozen, forming beautiful "ice flowers"



Photograph by Bessie Wiley Fisher

A NATURAL BRIDGE OF HAILSTONES, NEAR RATON, NEW MEXICO

These hailstones, which were about the size of walnuts, fell during a thunderstorm on August 2, 1927. Dr. G. Clyde Fisher, Mrs. Fisher, and Mr. Severs of the American Museum, were passing Waggon Mound Station as the hail fell. The hail formed a deposit knee deep over many acres. The warmer waters of the stream, however, melted a number of the hailstones and thus formed a natural bridge

horses and "prairie schooners," was caught in a snowfall of twenty feet at Donner Lake. The cattle and horses were submerged and frozen, and of the 83 persons only nine survived the winter.

The effects of the high Sierra Nevada-Cascade mountain slope in causing a heavy precipitation locally and a decrease in the depth of snowfall to the eastward over the areas of the Great Basin, the Rocky Mountain district, and interior plateaus, is very marked. The heavy snows of the Rocky Mountains amount to more than 100 inches annually over fairly large areas as far south as northern New Mexico; restricted areas in southern Wyoming have as much as 300 inches, and those in Colorado 400 inches annually.

East of the Continental Divide the snowfall rapidly decreases with the lines of equal depth extending in an east-west direction under the

control of latitude until the Great Lakes and the Appalachian Mountains are reached. In the east the rising slopes of the Appalachian, Adirondack, Green, and White mountains exert subordinate, but nevertheless, important controls in the precipitation of snow.

The Appalachian Mountains carry the lines, 50 to 100 inches, as far south as West Virginia, while the warm waters of the Gulf Stream bend the lines northward along the Atlantic Coast. In the vicinity of the Great Lakes, especially on their lee or eastward shores and thence along the Canadian boundary as far as New England, there is a relatively heavy snowfall varying from 80 to more than 100 inches. Over the north Atlantic states the northeast wind from the Atlantic Ocean, being cold and damp, is the chief source of snow. The heaviest snows fall in February or even March. The northwest winds blowing on the rear of





A BEAUTIFUL WINTER SCENE NEAR GSTAAD, SWITZERLAND
This view is one of the many pretty winter sights along the scenic electric railway which leads from Montreux to the Bernese Oberland

the storms are cold enough to give snow, but are generally too dry. Exceptions for the northwest winds are to be made on the western slopes of the Appalachians and places to leeward of the Great Lakes. Most of the snow falls from December to March, but at the higher elevations it begins as early as October or even September and falls as late as April or May. In general, topography is seen to be the most striking factor of control in the western states, and latitude in the eastern ones.

It is a well known fact that ice is the solid form of water produced by freezing. It is a brittle, transparent, and colorless

solid, which assumes crystal forms belonging to the hexagonal system. It is characterized by a prominent habit of twinning in producing the beautiful ice flowers of hoar-frost. It is frequently precipitated from the air as frost, rime, glaze, sleet, hail, or snow.

Water in ordinary cases freezes at 32° Fahrenheit (0° Centigrade). When pure water, however, is placed in sealed tubes and kept perfectly still, it freezes spontaneously between -2° Centigrade and -1.6° Centigrade, mean -1.9° Centigrade. This difference of almost two degrees in the freezing state of water is due to the air being impregnated with germ crystallites of all common substances. It is to these germ crystals that most common crystallizations

of substances from their solutions and from the fused state are due. Freezing is retarded by substances in solution; for instance sea water freezes at about 27° Fahrenheit (-3° Centigrade). The ice thus formed is found to have rejected four-fifths of the salt which was originally present.

Under the influence of heat, ice itself behaves as most solids do, contracting when cooled, expanding when heated. As regards the evaporation of ice, it was shown by Barnes and Vipond in 1909 that it goes directly into



vapor without passing through a preliminary liquid phase.

Although there is no rise of temperature accompanying the melting of ice, a definite quantity of heat is absorbed, namely, about 80 calories per gram or 79.818 thermal units. The same amount of heat is evolved when water becomes ice. In other words, the amount of heat required to convert ice into water or vice versa would raise the same amount of water through 79° Centigrade. This is called the latent heat of fusion of ice or the latent heat of water. Because of this fact, ice is the most difficult of all solids to melt, as regards the amount of heat energy required to be put into it in order to effect fusion, and water the most difficult liquid to freeze, of all substances, owing to the relatively large amount of the latent heat needed. It is fourteen times as great as for lead, and twenty-eight times as great as for mercury.

Another remarkable property of ice is that its melting point is lowered by increase of pressure. The rate at which this occurs is 0.0075° Centigrade for every atmosphere of pressure. This fact was theoretically predicted by James Thomson in 1849, and demonstrated by Sir W. Thomson (Lord Kelvin) in 1850.

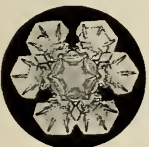
When winter comes, it

is of interest to note that the fresh water of lakes and ponds continues to contract with increasing cold. The surface waters being colder and thus heavier, sink, and the warmer waters from the bottom rise to the surface. These convection currents continue until all of the water in the lakes and ponds has been reduced to the maximum density of water, after which the circulation stops, for the surface waters, when cooled to lower temperatures, remain on top and grow steadily colder until they suddenly freeze at 32° Fahrenheit.

The temperature at which water reaches its maximum density and what



HIGH WALLS OF ICE FORMED BELOW NIAGARA FALLS
King winter reigns supreme amidst this labyrinth of crystal caves and towering buttresses draped with huge stalactites, stalagmites, and columns of ice





DEEP SNOW IN THE ALPS MOUNTAINS

A powerful snow plow on the Berniner Electric Railway which connects St. Moritz, Switzerland, with Tirano, Italy, enables the railroad to operate through any quantity of snow

follows needs a bit of explanation. According to the researches of Joule and Playfair, water exhibits the unusual property of possessing a maximum density at a temperature of 39.2° Fahrenheit (3.945° Centigrade). When cooled below this temperature, water expands instead of contracting, and the expansion goes on to the total extent of one-ten-thousandths of its bulk, until freezing occurs, when there is a sudden expansive leap of nearly a tenth of the whole volume of the water, as it freezes. On becoming ice, the water has increased in bulk by nine per cent, and this increase occurs instantaneously and with enormous, well-nigh irresistible force.

Large-scale operations of this phenomenon may be noticed during the winter and spring months along the shores of lakes and large ponds, by the appearance of newly made ridges, consisting of sand, gravel, and large boulders, which have been pushed up by the expanding ice.



This force is also brought home to all of us by the bursting of water-pipes exposed on cold winter nights, when they are full of water with taps all closed and no possibility of escape. Cannon shells filled with water, sealed, and allowed to freeze, burst in like manner.

The expansion of water to such a degree on freezing is, of course, of great value in gardening and agriculture, in the breaking up of the soil and its disintegration into small grains. It may be noted that in the spring of the year when the frost is coming out of the ground that the soil is spongy and easily worked as compared with the late summer, when it is dry, compact, and hard. Water finds its way between the joints in the rocks, rends them apart on freezing, and is thus an important factor in the decay and denudation of rocks.

By reason of this expansion, a piece of ice weighs less than an equal bulk of water. If a certain bulk of water weighs 1000 pounds, a piece of ice of the same

bulk will weigh 916 pounds. Thus ice, being lighter than water, floats in ponds, rivers, lakes, and the open sea, when broken up, with about one-tenth of its volume above water level.

Ice, like snow, forms six-rayed crystals. They are formed when water crystallizes into ice. Due to the fact that ice and water are so optically alike, the crystals are rarely seen, but have been observed as floating free on the surface when water freezes slowly.

When sunlight or the beams from an electric arc lamp fall upon lake or pond ice, six-rayed stars called *ice-flowers* may be formed. The heat rays dissolve the solid structure of the ice crystals with such regularity as to produce cavities in the ice which have exactly the same hexagonal symmetry as snow crystals. They may be termed negative crystals.

These cavities are filled as far as possible with the water produced by the melting of the ice; but as this water is less in bulk by 9 per cent, as noted above, it cannot fill the cavity, so there is an apparent bubble left, about the center as a rule, which is vacuous. All of these delicate flowers are formed parallel to the surface of freezing.

In the northern portion of the United States and in Canada, ice forms on the lakes as well as the rivers. The St. Lawrence River, for example, is completely closed to navigation from December to April, and sometimes in May. The Hudson River freezes over every year at and above Newburgh. Even the Niagara Falls are largely arrested by freezing during February. The mist below the Falls freezes, producing remarkable ice structures, which stimulate cave formations, forming columns, stalactites, and



A 1919-1920 WINTER SCENE IN NEW YORK CITY

In January and February, 1920, the streets were more effectually blockaded by snow than at any other time in the city's history. The removal was difficult, since layers of ice had formed at different levels

stalagmites. Ice is also formed above snow line in high mountains and the polar regions by the conversion of snow into glacier ice. It also forms on the polar seas as pack ice; in fact, ice is produced in unlimited quantities by the process of nature in all climates where the temperature drops to 32° Fahrenheit (0° Centigrade) or lower.

Ice also exists in the form of minute needles or spiculæ in the higher atmosphere. From the enormous height at which some cirrus clouds float, 30,000 feet, and the low temperature they must consequently encounter, -27° Fahrenheit, it is impossible that they can consist of water. There is no doubt that the tiny drops of which they are composed are frozen, and it is on account of the light refracted by these banks of minute ice particles that the formation of halos and similar phenomena are possible, for only when the light has passed the prisms of ice, do we discern these phenomena when we look at either the sun or the moon.

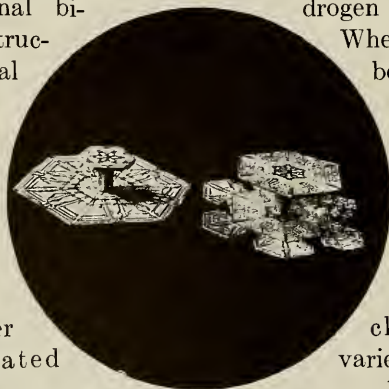
The new method of investigating crystals by x-rays, which was begun in 1912, has been applied to ice and its structure determined. Sir William Bragg (1926) shows ice to belong to the "holohedral" class 27, that of fullest hexagonal symmetry, the dihexagonal bi-pyramidal class. The structure is that of a hexagonal lattice made up of four interpenetrating trigonal prisms (length 4.52×10^{-8} cm. or $1/55,000,000$ inch; height 7.34×10^{-8} cm. or $1/34,000,000$ inch). Each atom of oxygen, diameter 1.30×10^{-8} cm., is situated at the center of gravity of four neighboring equidistant oxygen atoms, and between it and each of them lies a hydrogen

atom, diameter 1.46×10^{-8} cm., an arrangement which causes twice as many hydrogen atoms to be present as there are oxygen atoms. Each unit cell of the lattice contains four molecules of water (H_2O).

The structure is a very open one. It thus reveals why ice can be melted under pressure, for there is ample room to force the arrangement into smaller bulk, a state corresponding to liquid water. The molecules of liquid water are spaced just enough to permit of their free movement over each other, while in solid ice there are relatively large openings between them. This explains how it is possible for water to occupy less space than ice, and accounts for the sudden and relatively enormous expansion which occurs when water freezes.

We have now called attention to the various forms of ice which occur on the earth and up to the height of the highest clouds. We have also briefly referred to the various circumstances under which they appear, and noted some of the characteristics of each. By application of x-rays we have been able to ascertain not only the symmetry of the crystals of snow and ice, but actually also to determine the relative positions of the atoms of hydrogen and oxygen within them.

When we recall that the number of molecules in a cubic centimeter of ice is calculated by Dennison to be 31,540,000,000,000,000,000, we note that we are dealing with large and intricate figures. We may thus conclude that ice and its varied forms are not only beautiful to behold and to comprehend but that they are of interest to the layman as well as to the scientist.



AN ODD TYPE OF SNOWFLAKE

The crystals consist of two basal plates attached to the ends of a short vertical column or axis. One of the attached plates is more fully developed as compared with the other



Two Beduins Ask the Field Expedition for Water

EARLY MAN IN NORTH ARABIA

Geological and Archaeological Evidence Indicates that This Desert Area Was Once so Fertile and Well Watered that It May Have Supported a Large Semi-nomadic Population in Prehistoric Times

BY HENRY FIELD

Assistant Curator, Field Museum of Natural History, and
Leader of the Captain Marshall Field North Arabian Desert Expeditions 1927-1928

WITH PHOTOGRAPHS FROM THE FIELD MUSEUM OF NATURAL HISTORY

THE North Arabian or Syrian Desert is bounded to the west by Trans-Jordania and Palestine, to the north by Syria, and to the east by the "Fertile Crescent," lying between the River Euphrates and the River Tigris. To the south lies the great Nefud Desert, consisting of thousands of square miles of sand dunes, comparable to great expanses of the Sahara of North Africa.

The area in which these scientific expeditions worked lies between Damascus, Amman, and Ma'an, on the old railroad line which ran as far south as Medina, and the city of Baghdad to the east. During the World War most of the bridges and a great part of the railroad track was torn up south of Ma'an by Colonel T. E. Lawrence, and other British officers in that campaign. There is now, however, a regular train service as far south as Ma'an.

To the east of the railroad lies a wide bank of sand-covered flat country, with occasional low ranges of hills. There are numerous mud-flats of varying extent, indicating that at one time there was considerable water in this region. During the greater part of the year these mud-flats are waterless, and form wide patches of hard sun-cracked sand. Farther to the east rise the foothills of the great Harrat ar Rajil, covered with basalt boulders of various sizes. This lava bed is some 150 miles in length and about 100 miles in width. The highest peak, Jebel Ashqaf, rises to 3700 feet above sea level, and is surrounded by chains of high mountains. As there is no water anywhere in this entire area, it is completely uninhabited today.

The region lying beyond the eastern extremity of the lava bed consists of a hilly wilderness with large, flat, high



A BRITISH MILITARY PARTY ON THE DESERT

Owing to the kindness of the British Air Force, the expedition was allowed to accompany one of the military patrols and to visit places which otherwise would have been totally inaccessible owing to the danger of Beduin raiders. The Beduins are generally quite friendly during the day, but at night every precaution must be taken to avoid a surprise attack at dawn

plateaus of alternating bands of flint and sand, cut at intervals by old stream beds or wadis, which sometimes contain water in the rainy season.

The general lack of water and the rugged nature of the basalt country, together with the hundreds of miles of stony desert—waterless today save for the few wells known to the Beduins, have caused this territory to be known as a geographical migratory barrier. It was also presumed that the ancient migrations did not cross this dry and barren strip of land, but rather that they passed to the north through what is now called Turkey-in-Asia, and down the seacoast into Egypt. From the recent archæological survey it can be concluded that Man in a prehistoric phase of culture crossed or perhaps lived in this great stony wilderness. From these recent discoveries it

seems very plausible to suggest that in Palæolithic and Neolithic times water was much more abundant, and the stony wilderness was then able to support a considerable population. The Beduins today migrate over this large plateau with their thousands of sheep and camels, following definite routes and seasons handed down to them by their forefathers.

In December, 1925, Professor Langdon, Mr. Dudley Buxton, and I were on our way to join the Field Museum-Oxford University Joint Expedition at Kish in Mesopotamia. Owing to the political difficulties in Syria and the lawless raiders of the Jebel Druze mountains, the regular motor route from Damascus to Baghdad was impassable, and the Nairn Overland Desert Mail Convoy, with which we were traveling, proceeded via Jerusalem and Amman to Baghdad.

Following the Middle East Conference of March, 1921, an Air Route was laid out between Cairo and Baghdad. At intervals between Amman and Baghdad landing-grounds about fifteen miles apart were marked, and between these landing-grounds a plowed furrow was dug, so as to be visible from the air, and to guide the air pilots. At each of the landing-grounds a large letter of the alphabet was dug in the ground, to show the pilots over which landing-ground they were passing. Going east from Amman the letters continue in sequence as far as landing-ground "R," which is 237 miles east of Amman. From this point to Ramadi, Roman numerals are used, running from the numeral XI to I, which lies just west of Ramadi.

The morning following our departure from Jerusalem, the convoy reached a large mud-flat bounded on three sides by boulder-covered hills which formed a well

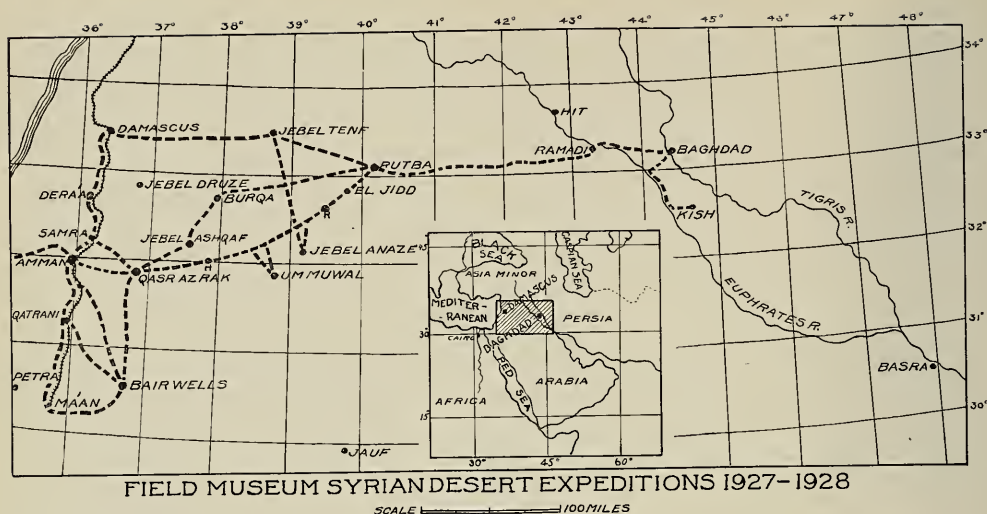
sheltered depression. It was here that Mr. Buxton discovered a chipped flint implement—undoubtedly chipped by man. This was indeed a very important discovery, and during the brief halt for breakfast, other specimens were collected. The time was very limited, but even this small collection proved the former existence of Man in that depression. The arrêtes were in all cases worn very smooth, and from the general characteristic features it was suggested that these were typologically palæolithic (probably Mousterian) implements. Many specimens were collected along the route whenever time allowed, and the places at which they were found were accurately recorded. Miss Gertrude Bell, honorary director of antiquities in Iraq, showed a keen interest in this collection, and gave us some valuable suggestions for further work.

Professor Langdon remained at Kish with Mr. Mackay to continue the excava-



A BRITISH ARMORED CAR

These machines, equipped with a machine gun and heavy armor plating, weigh about five tons and can travel fully loaded at seventy miles an hour over the hard mud flats



tions, and Mr. Buxton and I returned to Baghdad during January, 1926, to find that, thanks to the kindness of Air Vice-Marshal Sir John Higgins, whom we had approached by letter, we were allowed to accompany an armored car patrol as far west as landing-ground "H," and to make collections whenever compatible with the official patrol duties. The patrol consisted of two armored Rolls-Royce cars, and one Rolls-Royce tender, under the charge of Flight Lieutenant R. L. Sweeney. Several prehistoric stations were found before reaching landing-ground "H," where a more prolonged and careful search added materially to our previous series, and confirmed the hypothesis of human occupation at an early date, suggested by Mr. Buxton's discoveries some little time before. A close examination of the entire collection revealed the fact that typologically our series ranged from Mousterian right down to modern "strike-a-lights," which are dropped by the Beduins today. This general classification was accepted by the Society of Antiquaries of London, before whom a paper was read by Mr. Buxton in April, 1926. The Abbé Breuil of Paris, Professor Burkitt of Cambridge, Mr. Henry Balfour, and Miss Dorothy Garrod

of Oxford, accepted this classification and at once realized the significance and importance of the discovery.

Thus, when I was ordered to join the expedition at Kish for the season of 1927-1928, an opportunity for the continuation of this desert work immediately suggested itself. Following the approval of the Director, and with the coöperation of the Air Ministry in London, everything was arranged, providing that no local disturbance or rising of the tribesmen prevented the start of the expedition. Group Captain Rees, V. C., Officer Commanding Trans-Jordania and stationed at Royal Air Force Headquarters at Amman, assisted the expedition in every possible manner. Group Captain Rees, himself a keen archæologist, was able to make many valuable suggestions as to the probable localities where prehistoric man might have lived.

Leaving Amman in the Field Museum Cadillac and accompanied by Flying Officer Silcox as escort, the expedition proceeded south to Katrani, following the desert track along the railroad line. Leaving the railroad at this point, we struck off in a southeasterly direction for the famous Wells of Bair. We passed over many flint-covered hills, and at the end

of a long and tiring day reached our objective. In the gravel just below the Arab ruins, water-worn and rolled implements of Upper Chellean type were found at a depth of 11 feet 6 inches from the top of the gravel bed. These implements were found in place after some digging had been done in the face of the cliff. This was the first time that implements of lower palæolithic type were discovered *in situ* east of the Hejaz Railroad.

Charles M. Doughty, in his *Travels in Arabia Deserta*, quotes the following instance of his discovery of chipped implements, more than fifty years ago:

Walking in the torrent bed at Ma'an my eyes lighted upon,—and I took up, moved and astonished, one after another, seven flints chipped to an edge; we must suppose them of rational, that is an human labour. But what was that old human kindred which inhabited the land so long before the Semitic race?

In another place Doughty says,

I have found in it (the gravel bed near Mt. Seir or Jebel Sherra) such wrought flint instruments as we have from some river and lake gravels and loams of Europe.

These specimens are now in the University Museum at Oxford.

On account of the danger from raiding parties, we had to leave the Wells of Bair before nightfall. We were reluctant to leave this fascinating place, far from all habitations, amid perfect lifeless silence.

As we turned to the west toward the railroad, we passed the Wells of El Jefer, where young Mohammed Abu Tayi was encamped. He greeted us very cordially, and showed us three ostriches, which he very courteously offered to us. We were interested to see ostriches, because they had been reported between Amman and Baghdad in 1921, when the Air Force Route was being marked out. Mohammed is the son of the late Auda Tayi,



QASR BURQA, THE MOST EASTERN OUTPOST OF THE ROMAN EMPIRE

This fortress is built of large basalt boulders all faced and laid in position without the use of mortar. The Roman legions to whom this task was given must have spent many months in thus protecting themselves from the raids of the Beduins



THE APPROACH OF A SAND STORM

Sand storms often come with very great rapidity and violence. They are often very dense and suffocating, and when a party is out on patrol, it is necessary for each car to keep in touch with all of the other cars in the convoy to avoid being separated from them

whom Colonel Lawrence called "the greatest fighting man in Northern Arabia." Miss Gertrude Bell once said, "I fancy that when you have drunk the milk of the vega over the camp fire of Abu Tayi you are baptized of the desert, and there is no other salvation for you."

We took numerous photographs and moving pictures of the tribal tents and of the wild Beduins.

We continued westward to the railroad, stopping for one day to visit the rock-hewn fortress of Petra, "the rose-red city, half as old as time," and continued following the railroad back to Amman. We were pleased to have discovered a number of open-air prehistoric sites, and particularly to have found implements of Upper Chellean type actually in place in the gravels of Wadi Bair.

A few days later we were allowed to accompany a convoy of five cars that

were on their way as far east as landing-ground "R," to re-mark the landing-grounds which become obliterated owing to sand storms. We followed the Air Force Route to Qasr Azrak, an old Roman fortress which is now partially inhabited by Druze, who wish to be under British protection. A few miles to the east we entered the Harrat ar Rajil, and as we passed slowly along the very rough track, often not making more than eight miles in one hour, we observed basalt boulders arranged in the form of circular walled enclosures. These stone circles are of various dimensions, the largest being thirty feet in diameter. In most cases the walls are broken down and have obviously not been in use for a considerable period. Sometimes the stone circles are solitary, apparently always above the possible water-level of the valley in which they are situated, and usually on the slopes of low

hills. The Beduins told us that these stone circles were used as sheep-folds at night, and that in certain localities they are used for that purpose today. However, whether upon the hills bordering a mud-flat, or upon either bank of a dry stream bed or water course, we found numbers of stone circles which appeared to us as village settlements. In other localities the buildings appear to have been square or rectangular, and many of these walls are standing four or five feet in height, which would indicate that they are not of any great antiquity.

Flint implements, mainly of Neolithic type, were found in profusion in the immediate neighborhood of practically all of these stone buildings, although there might not be flint in the immediate vicinity. Collections of flint implements have been made from many of these sites, and it remains to study them in detail

before any definite conclusions can be drawn. Buildings of stone, both round and square, occur in hundreds dotted over the area covered by the archæological survey, but there are literally thousands of them in the great lava bed. Photographs from the air taken by the Royal Air Force at a height of about 9000 feet show numbers of these stone circles, also long walls built up of these same basalt boulders, apparently quite unconnected, and whose purpose still remains a mystery.

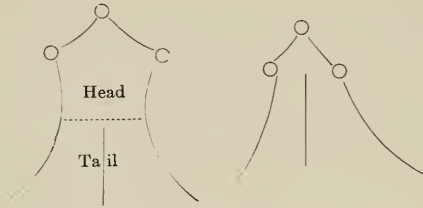
Strange ruins which, from their form have been called "kites" by Group Captain Rees, are very numerous between Azrak and landing-ground "H." These "kites" are composed of walls with a round tower at intervals, and with long walls called "tails" which extend for miles across the country. There are many different kinds of "kites," but one of the



THE ROMAN FORTRESS OF QASR AZRAK

This stronghold is about eighty miles to the southwest of Qasr Burqa across an almost impassable section of a great lava bed. This fortress is now occupied by Druze forces under British protection

simplest forms is shown in the following diagram.



Since these "tails" are sometimes eighteen miles in length, it does not seem plausible to suggest that they could have been fortresses of any kind, but rather traps for catching gazelle or some other animals. Group Captain Rees suggests that some of these "kites" whose "tail" opens upon a mud-flat some hundred yards away from the "head" were used as fortresses. To explain the dividing wall which sometimes runs

down the center of the "tail" of the "kite" he suggests that domesticated animals were kept on one side of the wall, and that rudimentary forms of agriculture were practiced on the other. Presuming that the mud-flat was at that time a small lake, it would have been possible to guard the wide area at the extreme end of the "tail" with one or two men, who could not fail to hear the approach of the enemy over water. At the first signal of alarm the animals would be driven into the "head" of the "kite," and the last wall hurriedly built up. In this position they would be safe from attack from any side. It is interesting to note that the walls connecting the towers are built on a curve with the highest part of the wall nearest to each of the towers. This would tend to make the attackers rush for



SHEIKH MOHAMMED ABU TAYI IS HOST TO THE VISITING SCIENTISTS

Mattresses are placed on the ground around the hearth, and for distinguished visitors the Sheikh himself always makes coffee, which is a very elaborate ceremony. The head men of the tribe sit in a circle around the fire, and in the evenings most of the conversation deals with religious subjects. The wonderful array of coffee pots can be seen in the photograph, all of them having been handed down for generations. The Sheikh's body guard is gathered behind him. This group is almost invariably within call



A BEDUIN BLACK TENT

The nomadic Beduins live in these black tents, which are made of camel's hair by the women of the tribe. The number of tent poles used to support the long strips of cloth indicates the wealth and power of the owner of the tent. For example, the tent of the Sheikh has the greatest number of tent poles, and is thus easily recognized from afar. In hot weather the sides of the tent are propped open in order to permit every possible breath of air to enter

the lowest part or center of the wall, and in their efforts to break through they could be attacked from the sides, as well as from the front. This is one of the principles of close fighting today. The machine guns are placed on the flanks, and every effort is made to make the enemy "bunch" at one place.

Flint implements are always found in these "kites," and these will have to be studied in detail. It is often very hard to follow or even to find these stone walls upon the ground, but air photographs help to overcome this difficulty. There are many types of "kites," ranging from the simple form described above to the most complex, which is only discernible from the air.

In various localities we found inscriptions upon the boulders of basalt which are presumed to be of Nabataean or Safaitic origin. Since the Nabataeans, according to Pliny, lived in the city of Petra about eighteen hundred years ago,

this would mean that the inscriptions copied by us are not more than two thousand years old. In certain rare instances camels, horses, and men were carved upon the rock and these were all duly copied and recorded. Arabic inscriptions are rare, and usually take the form of "Bismillah irraham irrahim," meaning "In the name of Allah, the Merciful, the Compassionate." A door lintel at Burqa has a clear Arabic inscription which we copied. The Beduins leave their tribal marks or cattle brands upon the walls of buildings or upon graves, to indicate, in the latter case, the tribe to which the deceased belonged. These markings are called *wašms*; they were all copied and the locality in which they were found was noted. As each tribe passes by a certain well-known landmark the *wašms* are hammered on the surface of one of the blocks of stone in the neighborhood. From a collection of these *wašms* taken at a given point, it is possible to say



A ROMAN ARCH AT QASR BURQA

This arch, after nearly two thousand years, is still standing exactly as it was erected by its builders

which tribes or sub-tribes have passed by in recent years.

Leaving the lava bed, we proceeded slowly along the Air Route, collecting flint implements and recording carefully the positions from which they came. Detours were made to search on the tops of any hills that seemed possible points of vantage for prehistoric peoples. On the top of Umm Muwal, twenty-two miles south of landing-ground "M," at a point 3200 feet above sea-level, we found the most important collection of typologically Mousterian implements, including a very perfect, heavily patinated, small *coup-de-poing*. So far as we know, we were the first Europeans to visit Umm Muwal, as this is actually in the territory of Ibn Saoud, king of the Hejaz, although we did not realize this at the time.

We left the convoy at landing-ground "R," and continued into Baghdad, with our heavy weight of stone, which proved the former existence of prehistoric man in

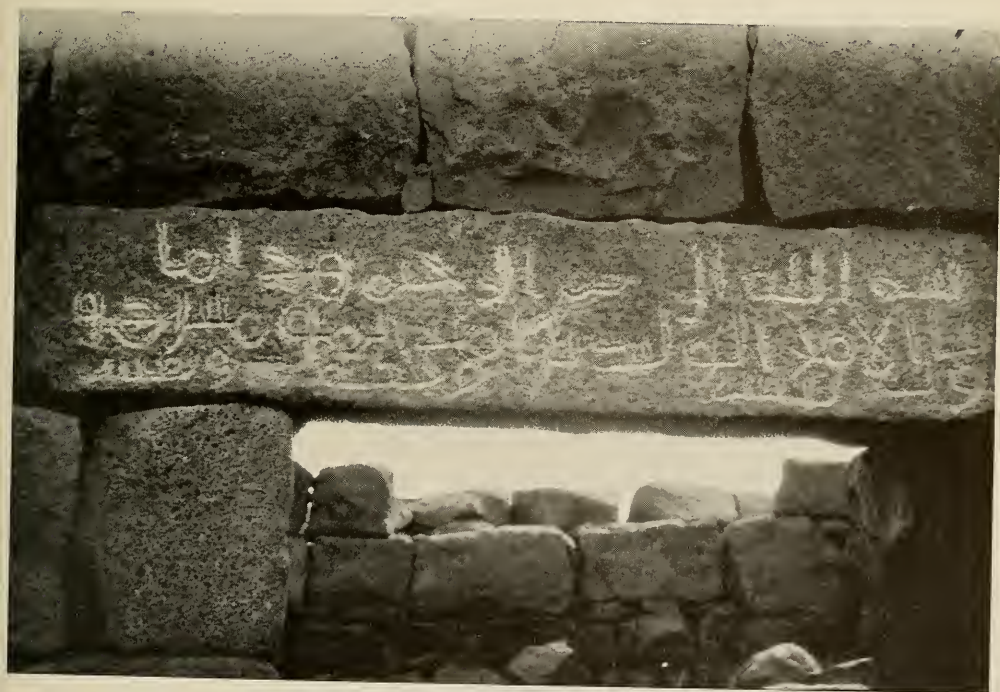
many different localities between the Hejaz railway and Rutba Wells.

The results of this first expedition seemed sufficiently important to warrant an additional survey to the north of the course that had been covered during 1927. With a further appropriation from the Captain Marshall Field Fund, it was decided to make a more detailed survey in a new area upon a larger scale. With the permission and coöperation of the High Commissioner and the Air Vice-Marshal in Iraq, the expedition, consisting of myself, Mr. Eric Schroeder, who was to study any historical ruins and inscriptions, Mr. Showket of Baghdad as moving picture operator and photographer, and a Russian named Vania as mechanic, was invited by Major A. L. Holt, to accompany the Turkish Petroleum Company's Pipe Line Survey from Samarra to the Mediterranean. During April and May of this year thousands of miles were



IN THE DRY BED OF THE WADI BAIR

At a depth of eleven and a half feet below the surface a large number of Upper Chellean flint implements were collected. They were badly water worn and undoubtedly had been carried down from some point higher up the stream



A DOOR LINTEL OF THE EIGHTH CENTURY

This inscription is dated "81 A. H."—that is, 81 Anno Hegiræ, or 81 years after the flight of Mohammed, which places it at 703 A. D., the Hegira having taken place in 622 A. D.

covered between Rutba Wells and Amman. As the survey party proceeded relatively slowly in making their observations and maps, we were able to make fairly detailed archaeological surveys along the traverses which they covered. The positions of sites where we collected implements of palæolithic and neolithic types were accurately recorded, and can be plotted on the survey party's map.

Among other important places visited was the Roman fortress of Qasr Burqa, which lies about 38° east and $32^{\circ}5'$ north, far out into the desert, about seventy-five miles from water. We were the next scientific party to visit this spot after a visit of Miss Gertrude Bell in 1913. We copied the inscriptions and planned the buildings, while Mr. Showket took numerous photographs and moving pictures. A large door lintel was found upon a Beduin grave. Although this weighed more than two hundred pounds, it was removed in order to study the Roman-Greek inscription, in the hope of finding a reference to the date of the Roman occupation.

The convoy consisted of six automobiles with twenty-eight persons in all, headed by Mr. W. E. Brown who, with Mr. H. F. Moon, was making the survey. We were escorted by ten native police. As the temperature often exceeded 106° in the shade, our water supply had to be very carefully conserved.

When the survey was completed between Rutba and the lava bed, camp was moved to Qasr Azrak toward the end of

May. Work was continued in this area for the next few weeks, after which we accompanied a patrol to Bair Wells. This afforded an opportunity for making further observations at several points.

Wishing to continue the survey to the north, we went on to Damascus and accompanied a Nairn Mail Convoy back via Rutba Wells to Baghdad. The specimens were packed and shipped to Chicago for study.

It is now possible to state with absolute certainty that Man in a prehistoric phase of culture inhabited this North Arabian or Syrian Desert over a long period of time.

Geological evidence supports the view that this area was once so fertile and well watered that in prehistoric times it may have maintained a large semi-nomadic population.

Many of the Mousterian types of implements found during the desert archaeological survey work resemble very closely the implements found in association with the "Galilee" skull in Palestine during August, 1925. These results prove the eastward extension of our knowledge of the area once inhabited by palæolithic man and it remains for future scientific expeditions to link the recent discoveries in Mongolia and the Ordos region of China with the Near East, North Africa, and Western Europe. I feel confident that the North Arabian Desert lies upon one of the main lines of migration between the East and West, and that prehistoric sites will be found from North Eastern Iraq to China.



MOSQUITOES AND OTHER FLIES

Despised but not Always Injurious—Sometimes of Remarkable
Form and Beauty—Often with Most Surprising Habits

By C. H. CURRAN

Assistant Curator of Insect Life, American Museum

ILLUSTRATED BY R. R. SCHULTZ

WHEN we speak of flies, most of us at once visualize the common house-fly, the bluebottle, or one of the near relatives of unsavory habits. In short, the average conception of a fly is that of an insect which is disgusting in its habits and also injurious to man. Such ideas are not unnatural, since it is because of their close association with us that flies have come to be considered something of importance in the civilized world and something of a menace to civilization itself. If it is true that malaria was responsible for the downfall of Greece at the height of her glory, resulting in a decided setback to the advance of civilization, there is ample reason for condemnation of flies, since it is a well-known fact that the mosquito, which is a fly, is essential to the development and spread of this disease.

The sportsman who spends any time in the woods, and the greater number of city dwellers (now that frequent visits to the country are possible as a result of improvement in transportation) come into contact with flies of a very different kind from those encountered about the home. The mosquito is probably the most commonly encountered fly in the nature of a pest that one meets in the woods, but it is not limited to such habitats. There are many kinds of mosquitoes and they have various habits. Some of them are carriers of malaria, while others are irritating merely because they are persistent "biters." Perhaps one of the most surprising things in connection with mosquitoes is that the aquatic young, "wigglers," of certain species occurring in the tropics live entirely

upon the young of other mosquitoes. This is an example of how nature has developed a certain check upon the race of mosquitoes as a whole by means of a near-cannibalism among their own kind, and it is not inconceivable that cannibalism sometimes actually occurs.

Another common blood-sucking pest which is very well known is the black fly. Many species go under this name and they vary in size and habits. Most of them bite humans, and the results of their bites are frequently most serious. Unlike the mosquito, they give no warning of their attack, either by buzzing before commencing their meal or by the injection of an irritating fluid. They feed until their small bodies are fully distended with blood, and then go peacefully on their way.

A short time after, the region in the vicinity of the puncture becomes inflamed and itches in a most tantalizing manner. It frequently happens that several flies have completed their meal and departed before they attack in numbers, and the irritation caused by their bites attracts attention to the newcomers, who are called upon to pay the penalty for the crime of their predecessors. Like mosquitoes, black flies live during their early stages in water, but unlike the former, they usually breed in fast-flowing streams, and are therefore encountered by trout fishermen more than by others. In addition to attacking man they attack various animals and some species have been known to kill young geese; others attack fish.

There are in all parts of the country



A FLY THAT KILLS SPIDERS

This fly and its near relatives reverse the usual order of things by depositing their eggs on spiders. The maggots develop inside the spiders, eventually destroying them

tiny flies which may cause a great deal of annoyance to warm-blooded animals, including man. They are known by various names, the most common being "no-see-ums" and "punkies." They are, all unconsciously, of course, something in the nature of insect jokers. Being true flies, they have only two wings but they are very small and of a grayish or smoky brown color, and, as the name used by Indians and travelers in the northern woods implies, they are not readily seen. If they lack something in size, they fully make up for the deficiency in numbers and the intensity of their bite. In actual bulk they do not nearly equal the size of an ordinary pin-head, in fact from fifteen to twenty of them together would be re-

quired to make up that bulk. One sees nothing when they bite, but the persistent itching is evidence of their presence; something must be blamed for it and frequently the victim selects some innocent insect as the cause of the trouble, with the result that henceforth that unfortunate animal and all its kind are condemned for the crime of another. But the "no-see-um" may not live to enjoy the joke, because the brushing of a hand over the itching parts is certain to destroy a large percentage of the biting midges.

The lover of the great outdoors is not permitted to rest from the attacks of flies after exhausting the three groups already mentioned. There are many others to annoy him. The "no-see-ums" are most

common at night, the black flies during the day, while the mosquitoes seem never to rest. They are joined during the day by horse-flies and deer-flies, and these inflict a very painful bite. Probably the majority of those suffering from bites by these flies believe that they have been stung by bees. To the naturalist they do not resemble bees, but everyone cannot be expected to know the difference between them. No one need feel badly about his inability to distinguish the members of these two orders of insects, because those who specialize in their study are much more frequently deceived by the live insects than they would care to admit, and probably the deception is

much more successful than these same specialists imagine. One may learn in time to distinguish them by the buzzing sound they make, but that is something apart from this story.

We will mention only one more group of biting flies which occur in America and which annoy the sportsmen in northern woods—the biting snipe-flies. I have never been subjected to their bites, but am assured that they are sometimes a major pest. It might be well to add to the list the stable-fly and the horse-fly, two near relatives of the house-fly, both of which are bad biters and exceedingly elusive. To kill them while they are engaged in their meal requires the



BIRD "TICKS"

The bird flies are parasitic upon birds. The group of flies to which these belong is known as Pupipara, because the larvæ live inside of their mother until they are ready to pupate or have already done so, when they are fastened by the mother to its host

development of a great amount of skill and consummate patience. One's temper is liable to suffer greatly if these pests are present and they may be much more annoying than mosquitoes or deer-flies. If we lived in Africa we might consider the tsetse flies, also related to the house-fly, which cause sleeping sickness. The tsetse is, however, a pest of quadrupeds, and man is not greatly bothered by it.

Mention has been made of several kinds of flies which attack man directly. Many others injure man indirectly by destroying his crops or at least reducing their yield, and by attacking animals. The house-fly and its relation to the spread of disease is too well known to need more than passing mention. Some of its near relatives are among the most serious pests of garden crops, and we find among these the radish maggot, which makes radishes unfit for consumption, not alone because of the presence of the maggot, but because the root becomes hard and fibrous; the onion maggot which destroys young onions, the cabbage maggot, which delights in the destruction of newly transplanted cabbage plants; the seed-corn maggot which lives upon sprouting seeds of numerous kinds of plants, and a long list of other species.

Looking farther afield, we find many other injurious flies. There are flies which make galls upon almost all kinds of plants and there is the Hessian fly which was at one time the despair of the wheat grower. It is still a pest, but the damage it causes is either much reduced or it has been relegated to the background by the publicity being given other immigrants to America.

A peculiar habit of some flies is that of living upon birds, and those which have this habit are well adapted to the mode of life which nature has chosen for them. They are leathery in texture, very flat, and usually of a brownish color. They are found under the feathers of

birds, most frequently on the neck. Birds are attacked by other forms which, however, are parasitic upon the young and are often responsible for the death of a whole brood.

From what has been set forth in the preceding lines one might conclude that flies are terrible insects and that they are utterly useless. Such a conclusion would hardly be fair to flies as a whole. It happens that this group of insects is one of the two really important groups connected with the control of the major insect pests. A very large number of flies are insect parasites. It is true that some of them are parasitic upon beneficial insects, but the number is relatively small. For the most part, parasitic flies prey upon caterpillars, beetles and beetle larvæ. Their methods of attack are varied, and often most ingenious. In some cases the flies deposit thousands of small black eggs upon the leaves of low plants and grasses. There seems to be no system of the deposition of the eggs and it seems a very haphazard way of doing things. But eventually a caterpillar comes along and eats the leaf, swallowing the egg along with it; and in due time the egg hatches and the young maggot proceeds to feed upon the cutworm which swallowed it. Some other species have quite as interesting habits: they deposit living maggots on leaves. These are peculiar black things and they fasten themselves to the surface of the leaf and remain there for a varying length of time—in fact until some unfortunate caterpillar comes along. As soon as a hair of the caterpillar touches it, the tiny black mass comes to life, crawls up the hair, and pierces the body wall of the caterpillar, eventually killing it.

Some flies lay eggs or perhaps deposit maggots on bees while they are in flight—at any rate they are parasitic upon bees. There is one group of flies which does not believe in working for its food. These

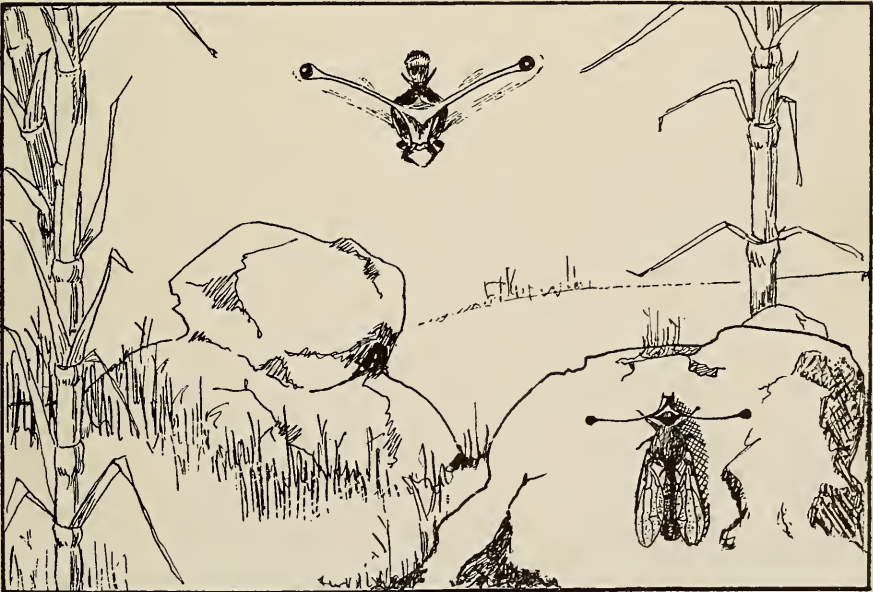
insects allow solitary wasps to go forth to battle and bring home caterpillars, spiders, or flies which they have overcome and paralyzed by stinging. The flies are evidently cautious while the wasp is about, but they are also very patient, for they will watch the wasp prepare the home for its young and will wait about until food is brought, then, darting in quickly, they will drop living maggots upon the food. Since the wasps lay eggs which will not hatch for some time, the fly larvæ have a distinct advantage and are well on the road to maturity before the young wasp maggot has gotten fairly started.

There is a general impression that spiders are the sworn enemies of flies and that a fly invites death by approaching a spider. In the main this is true, but here we have another case of "the worm turning," because there are flies which are parasitic upon spiders. These are peculiar creatures, with a small, round head, often a long proboscis or beak, and a large, roundish abdomen. Often they are very

beautifully colored, being metallic green, blue or black, although our eastern species are dull colored. The flies lay their eggs upon the spiders and the maggots develop within the host, ultimately destroying it.

Remarkably shaped flies are not uncommon in the tropics. In the Old World there are many species of stalk-eyed flies: in America we have but one species of which the eyes are scarcely "stalked," although there are in Central America some distantly related forms which have the same character of head development. The true stalk-eyed flies are predaceous in the adult stage, and are frequently very abundant on stones in streams and upon grass stalks in swampy land.

There are many more beneficial flies and a host which are of no great economic importance, although the fact that they pollinate flowers is not to be overlooked. Also there are many injurious ones, but on the whole the preponderance is probably on the side of the beneficial.



STALK-EYED FLIES

These strange creatures which prey upon small insects are not uncommon in the Old-World tropics. The "head on" view of the fly in the air shows plainly the antenna-like "eye stalks," with the eyes placed at the ends. The other fly shown in the drawing illustrates the fact that, aside from their eye stalks, these flies are not greatly dissimilar to their more common cousins



The Schooner "Morrissey" in the Arctic Ice Pack

TO THE ARCTIC FOR WALRUS

Collecting a Group of Pacific Walrus for the American Museum of Natural History

BY H. E. ANTHONY

Curator, Mammals of the World, American Museum

The Stoll-McCracken Arctic Expedition was organized with the intention of expanding a sportsman's trip to Alaska and the Arctic Ocean into a Museum expedition, with the collecting of group material and study specimens as the features of major importance. Mr. Charles H. Stoll, of New York City, financed the expedition, and Mr. Harold McCracken was the organizer of the undertaking. Mrs. Merle L. Stoll accompanied her husband and took an active part in the work accomplished. The schooner "Effie M. Morrissey" was chartered for the trip and, under Captain Robert A. Bartlett, sailed from Newfoundland by way of the Panama Canal to Prince Rupert, British Columbia.

Here the party from the American Museum, who in company with Mr. McCracken had crossed the continent on the Canadian National Railways, came aboard, and on May 1, 1928, the expedition started northward. The scientific staff was in charge of H. E. Anthony, curator of mammals, and included Edward M. Weyer, archæologist, F. L. Jaques, artist, and Andrew Johnstone, preparator. Mr. and Mrs. Stoll joined the expedition at Port Moller, on the Alaskan Peninsula.

The most important achievement of the season in the Arctic was the collection of the group of walrus, but the party had interesting experiences throughout the entire itinerary, such as hunting the big brown bear of the Alaska Peninsula, collecting seals and cetaceans, searching for the so-called "mummies" on Unalaska, and visiting Bogoslof Island and St. George of the Pribilofs.—THE EDITORS.

WHEN the vicissitudes of navigation in Bering Sea had landed our schooner in Grantley Harbor with a broken propeller shaft (landed is used advisedly, for we were aground for fifteen days there), the expedition was threatened with an early ending.

Our luck turned finally, and with a new shaft from Nome we were ready to start north once more. The morning of July 27 found us passing Cape Prince of Wales,

and well out in Bering Strait we crossed from the green waters of the North American shores into a blue stream that marked the Arctic branch of the Japan current. The line of demarcation was surprisingly sharp and exact and stretched as far as the eye could see to north and south. To borrow a pedestrian's term, we crossed this line in a single step. By afternoon we reached the Diomed Islands, where we planned to take on Eskimo hunters from

Little Diomedes, and also to collect birds and make studies for a group of Arctic bird life for the Museum.

The Diomedes rise sheer from the sea and stand as sentinels at the gateway to the Arctic Ocean. To the southward Fairway Rock does similar sentinel duty for Bering Sea, and on clear days one sees the two continents reaching toward one another, North America jutting out at Cape Prince of Wales, Asia at East Cape. While all this is interesting terrain and stirs the imagination, only when the sun shines (a not too frequent occurrence) can one find even a remote justification for the use of the words "friendly Arctic." At all other times these shores are bleak and inhospitable, unless indeed one has, like the Eskimo, never known the attractions of a less rigorous clime. But the sea birds find such a spot vastly to their liking and they throng to these islands in

innumerable hosts. Auklets, puffins, murre, kittiwakes, and cormorants come and go in countless numbers, and in the early morning or evening the noise of their wings creates an all-pervading rush like the hiss of escaping steam from some titanic factory. Overhead, at such a time, the eye senses myriads of flying forms in numbers that defy estimate.

When at last we saw the Diomedes falling astern, we prepared for the real undertaking for which a specially chartered boat was necessary, the search into the Arctic Ocean for walrus and polar bear. We knew from the reports of traders that we should not reach the ice fields until we had sailed several days to the northward, but nevertheless we began to spend long hours on the deck, eyes strained ahead for whatever living forms this northern sea might hold. Great flocks of fulmars and shearwaters were



SEA GULLS VISIT THE "MORRISSEY"

The sea gulls were remarkably tame and lit about the schooner to pick up food which was scattered to attract them



ESKIMO VILLAGE AT LITTLE DIOMEDE

Two small islands make up the Diomedé group. The eastern, or smaller island, is a possession of the United States, the other belongs to Russia. The village is perched precariously among the rocks at the very edge of the surf, for there is no level beach on these islands

flying low over the waves where the northward flowing current carried the teeming marine life that is their food. These birds are known to the whalers as whale birds, and where one sees them one may also expect to find the cetaceans. We discovered this to be the case.

Well toward the close of a beautiful, clear day we encountered finback and humpback whales in large numbers. These monstrous mammals were all about the schooner and afforded us a never-to-be-forgotten exhibit of marine life. The air was calm and quiet, the sea smooth and unruffled, and as the whales came up to breathe, the sounds of respiration could be heard for an incredible distance. This was especially true of the finback whales, which make on inspiration a very loud noise like an exhaust of live steam, audible at a distance of at least a mile under favorable circumstances. Singly and in small

groups up to six or eight, the whales were rolling up to the surface or loafing about in a small area. One even appeared to be asleep on the surface and I thought the vessel would run it down, since it was directly in our course, but it sensed the vibration of our propeller just before we reached it. One of my most vivid memories of the Arctic Ocean will be the cetaceans that we saw both on entering and on leaving this body of water. On one occasion we must have seen at least one hundred of these big fellows; their columnar spouts were rising in every quarter of the compass. Some were surcharged with energy and threw themselves clear out of the water, so that the blue sky could be seen between the animal and the ocean. It was a frequent occurrence to see the great flukes rising high above the water in a graceful flourish which the mass of the creature belied as

the whale dove for some deep feeding ground. Besides the larger whales, we also met the smaller beaked whales and the large porpoise or killer whale, a predatory creature with a towering dorsal fin that cut the water with the sinister suggestiveness of a shark's fin. But the killer whale is far more deadly than any shark and takes toll of any and all of the ocean life.

Our first sight of the ice came on August 2, late in the afternoon. Seemingly far off against the horizon, there appeared a mass that looked like a distant island, and one of the Eskimos, who should have known better, identified the object as Herald Island. According to the reckoning, we were too far south to see this island, and conjecture was rife until, in a surprisingly short time, the schooner had shortened the distance and we could make out a good-sized iceberg. The

Arctic atmosphere plays queer tricks at times, and mirages and other deceptive conditions of the air tempt an observer to draw strange conclusions.

When we came on deck two mornings later, not only did the ice extend as far as we could see ahead of us, but there was the added thrill of Herald Island against the horizon. This island is but seldom visited and only on rare occasions can parties penetrate the drifting ice fields and make a landing there. Not only would it have been an achievement to set foot ashore, but there was a good chance that we might see walrus or polar bear in the vicinity, so the Captain tried to work the "Morrissey" in for a landing. Twisting and turning to follow the narrow lanes that ran back through the loose ice, we finally arrived within four or five miles of the rocky beach, but were forced to give up the



ESKIMOS PUT OFF FOR THE SCHOONER IN AN UMIAK

The umiak is a large, light canoe made of walrus-skin stretched over a framework of wood. It can be hauled up on the rocks without danger of puncturing the sides, for walrus hide is very tough and strong



LITTLE MUD BAY AT LOW TIDE

One of the difficulties in navigating about Moller Bay, where the party hunted the Alaska brown bear, is the presence of extensive mud flats at low tide. Only at high water is it possible for even shallow draft craft to reach the firm shore line

attempt when the pack presented a closed front. As a change of wind might shift the ice and force the schooner into a dangerous situation in the vicinity of Herald Island, Captain Bartlett navigated the vessel back to the fringe of the pack and we began to cruise to the north-eastward.

Now began a series of days of nearly identical routine. The period of daylight was long, and in addition to some one in the barrel at the masthead (usually the Captain) one or more of us kept a constant look-out from the deck for walrus or bear, from early in the morning until dark. We were in the ice or at the outer edge of it continuously, and although walrus were sighted from time to time, they were all in the water, going somewhere, and we were not able to follow them until they pulled out on the ice. The only certain way of hunting walrus is to shoot them when

they are up on an ice pan. If shot while in the water the animal sinks, in the great majority of instances. Occasionally a swimming walrus may be harpooned, and a float attached to the iron marks the progress of the quarry, which may be shot and retrieved in due course of time. We could scarcely hope to harpoon a walrus from the schooner, and our best chance was to search until we discovered some that might be stalked on the ice.

After days of scouting we at last located a good-sized herd of walrus. A single animal was observed some distance ahead swimming rapidly on a course to take it across our bows. The Captain sang out from the barrel to the helmsman and the schooner swung to starboard to follow the walrus. These animals when traveling toward some fixed destination progress by surging leaps through the water, swimming alternately on the surface and below it. When an ice pan



SNOW-COVERED PEAKS AT THE HEAD OF MOLLER BAY

The first camp in the bear country was at Little Mud Bay, an arm of Moller Bay. The snow had not yet melted from the mountains, and the tracks made by bears crossing the slopes and ridges could be readily seen

lies across their path they dive and go under it. On the occasion in question we were able to keep the walrus in sight for many minutes. Each time it disappeared we looked for its reappearance along the course it was obviously following, and eventually when it came to the surface some one discovered it. Among broken ice it is an easy matter to lose even as large an animal as a walrus if it be distant eight hundred to a thousand yards.

Finally the walrus ceased its direct progress and began to swim in small circles. It bellowed and seemed to be looking for something. We began to look for something, too, for we realized that the animal was trying to locate a herd which must be near by.

A mass of discolored ice a half mile away had attracted some attention, but had been dismissed as of no importance. I turned my field glasses upon it for a better look and was amazed to see that

the dark ice resolved itself into a great mass of walrus lying piled across one another. Now and then one moved or raised its head and bellowed. We had all heard the bellowing for the past two or three minutes, and now that our attention was properly focussed, we marveled that we had gotten so close without seeing the animals sooner.

At once the course of the vessel was changed and we withdrew a short distance to avoid frightening the walrus. As we slowly departed we noted the vicinity carefully, for an ever-threatening fog was lurking not far away and it was very easy to lose sight of the herd. Also we discovered a second lot of walrus on a smaller pan about an eighth of a mile from the first herd.

In a short space of time a plan of attack was outlined and the two launches were put over the side. In the large one Mr. and Mrs. Stoll, with McCracken and his



THE EDGE OF THE ICE PACK

The drift ice in the Arctic Ocean forms a more or less continuous edge. Scattered floes may be encountered at some distance from the pack, but the main body travels as a mass of loosely knit bergs and pans



ESKIMO GIRL FROM BIG DIOMEDE

The Eskimos from Big Diomedé came off to visit the schooner and impressed the expedition members as a fine lot of healthy and intelligent natives



THE LAND OF THE MIDNIGHT SUN

During the height of summer the daylight never completely fades north of the Arctic Circle. At the hour of sunset in southern latitudes the northern sun is yet high in the heavens



THE SCHOONER TIES UP FOR WATER

Water for use on the "Morrissey" was dipped up from pools formed in the ice. On large floes pools of fresh water are common and the tanks and barrels could be filled by a bucket brigade in an hour or two

camera, set out for the main herd, while I in the power dory headed for the smaller band. There was but little finesse to our plan, for each party ran up to within a short distance of the walrus and then attempted to pick out satisfactory specimens and drop them on the ice before the mad scramble carried the animals into the water. At the first shot the sleepy monsters, that had paid no attention to the noise of the motor, reared their heads and with one accord fell or slid into the sea. In a twinkling the shapeless mass of bodies had dissolved into individuals which took the most direct course for the edge of the ice. All, that is, except the few that had been struck in a vital spot by bullets.

Once in the water, the walrus collected into a compact band and began a leisurely retreat, coming to the surface frequently and rolling sullen angry eyes back at the strange creatures who had so

rudely disturbed them. It was possible to drive the boat right up to the milling walrus and to select a few more specimens to supplement those secured on the ice, and this we proceeded to do, making certain of a stricken animal by harpooning it and attaching the line to a float. In doing this there was some risk, for a walrus, by accident or intention, might drive a tusk through the launch or rise beneath the boat and overturn it. The Stoll-McCracken party had walrus rising close alongside and were kept busy for a few exciting moments when it looked as if some of the beasts would put tusks over the gunwhale. The engine of my launch was out of order this day and it died completely when we were right among the walrus, but none of the animals made hostile demonstrations. Incidentally, this engine trouble so hampered my ability to move about, that I soon ceased to take a very active part in the hunt, which was



WATCHING FROM THE BOW FOR WALRUS

All of the activity on deck drew to a focus at the bow of the schooner. Here a constant watch was maintained for walrus, polar bear, and seal

just as well since the other party secured all the animals necessary for our purpose, that is, all the females, yearlings, and calves, for these walrus were all of this category and we saw no bulls.

The schooner came up to the scene and the launches ferried the heavy carcasses over to it. A tackle was rigged and slings put around the walrus which were hoisted up on to the deck. There was great rejoicing that such fine material for the group had been secured, for we had imagined that we might have to search a long time for the young walrus. The cows were good-sized, typical animals, and the immature were represented by a yearling bull and two calves of the year. Now all that was needed to complete the group requirements were two prime bull walrus. As it turned out, this was to be much more of a task than we anticipated.

For the next seventeen days the schooner wandered about the Arctic Ocean. From a spot northwest of Point Barrow, Alaska, nearly 73° north latitude, west nearly to Wrangel Island, and south to the Diomedes and East Cape, Siberia, we cruised and scanned the ice for walrus. Luck was against us and the rare, fleeting glimpses of solitary animals never developed into a hunting opportunity. Strong winds arose and shifted the ice fields almost on an hour's



LOOKING AFT ALONG THE DECK

An ample supply of oil for the Diesel engine had to be carried and a large part of this had to be stowed on deck. This, together with cans of gasoline, barrels of water, launches, et cetera, filled almost all of the deck space. When the schooner ran aground and this had to be all set ashore, the party realized to the full just how much it weighed

notice. Depressing fogs enveloped us with but scant warning, and although they usually lifted soon, we could not venture very far inside the ice field when the visibility was poor. Following a day or two of high wind and stormy seas, we ran close to the ice not far off the Siberian coast, presumably about Cape Serdze Kamen, and were tantalized by the sight of huge bull walrus riding the crests of the waves. It was far too rough to put over a small boat or attempt to



BULL WALRUS ASLEEP ON THE ICE

These are the walrus shot by Mr. and Mrs. Stoll and the photograph was taken from the approaching launch.. Unable to assume an upright position because he would cut into the field of a motion picture machine, the photographer had to expose more or less by guess



THE END OF A SUCCESSFUL STALK

The bull walrus killed by Mr. and Mrs. Stoll have unusually large tusks. The larger of the two shown here has a fine symmetrical pair 31 inches long. These specimens are to be mounted for exhibition in the American Museum



AN ESKIMO BILLIKIN

The modern Eskimo has created a two-man skin boat which serves a purpose intermediate between the large umiak and one-man kayak. Having no traditional name for it, he has borrowed a foreign word and calls it a "billikin"



MR. STOLL AND MR. JQUES ON THE "PROMENADE DECK"

During clement weather the personnel spent most of the daylight hours on deck. Mr. Stoll (wearing glasses) usually was to be found up near the bow watching for walrus and bear, while Jaques favored the stern and studied the birds

go after the quarry and we had to pass on, hoping for another encounter when the weather moderated.

Low visibility prevented the Captain from locating our position on the map as he slowly retreated southward, feeling for the lee of the ice and seeking for the southern limit of the field. There was the possibility that the "Morrissey" might be caught in a pocket of the ice if the descending wings of the eastern and western fields beat us to Bering Strait and consolidated before we got there.

The wind had been steadily from the northward and the ice was moving rapidly southward. We knew that the western ice was unusually far south for the time of the year. We hoped that the eastern pack had not advanced so rapidly. On the morning of August 27 we were close to the Siberian coast and with the Diomed Islands in sight to the southward. Everywhere between us and Siberia stretched closely packed ice, while toward the Diomedes and Bering Strait there was no visible opening through the ice pans. As far as we could see the Strait was packed with solid ice!

All that day the schooner made the best speed it could to the eastward, skirting the ice, while up in the barrel the Captain looked for the eastern limits of the field. There was considerable relief when it was finally discovered that the Strait was open from Cape Prince of Wales almost to Little Diomed. None of us liked the prospect of having to spend the winter ice-bound in a small schooner, and while a knowledge of what could be expected told us that a southerly wind would soon clear the ice out of the Strait, it was a more comfortable feeling late that afternoon to be on the southern flank of the ice field with open water between us and civilization and looking out on the ice from the safer side.



CAPTAIN BARTLETT SHOOTS THE SUN

Captain "Bob" Bartlett never missed an opportunity to "take the sun." The constant presence of clouds and fog force a skipper to keep his position on the chart up to the minute, for he does not know when or for how long they may hide the sun



A FUR SEAL PUP

The fur seals begin to come to the Pribilof Islands in May and leave in November. Early in this season the pups are born, a single young to a mother, and by the end of the season they have grown enough to be able to accompany the old seals on their long migration at sea



A BULL FUR SEAL AT ST. GEORGE

At St. George Island, one of the Pribilofs, the expedition spent a morning visiting the large rookery there. The seals are not alarmed very much at the approach of man. On the contrary, the male seals are aggressive, charging fiercely if a visitor comes too close to the harem

As luck would have it, we ran across a large herd of walrus this same afternoon. They had come southward with the ice and now that the wind had gone down and the sun was out (this day had been exceptionally clear and summer-like for the Arctic) they were sleeping on the ice and making the most of the good weather. It was too near nightfall to go after our specimens so we spent the night hove-to near by. In the morning the animals had moved off, seemingly to the westward, and thither the schooner followed.

The animals were relocated on the ice on August 30 and, although the wind was rising and blowing on to the ice, so that we were on what is termed the weather edge, not a nice place to be with low-powered craft, the launch was put overside and an attempt made to complete our group. Mr. and Mrs. Stoll had the good fortune to make a perfect stalk on two splendid, big, bull walrus asleep on a small pan of ice. McCracken and I took photographs as the launch crept up to the pair, and when the shots were fired and both animals collapsed before they could move off the ice, we hurried to get a closer view to ascertain if they had tusks as large as we had hoped for. Our long search was well repaid, for the bulls were far finer than the average, and one in particular had ex-

ceptionally large and well-shaped tusks. The weight of these bulls taxed our tackle to the utmost and stalled the winch. Even the skins were so heavy it required three or four men with block and tackle to move them. When these animals are mounted and the completed group occupies one of the large cases in the Hall of Ocean Life, the full and adequate representation of the Pacific walrus will be the sole result of Mr. Stoll's determination, in the face of obstacles and discouragements, to secure a satisfactory group, if the expedition did nothing else all summer.

As a matter of fact, the securing of the group did exhaust the short Arctic season, and after a brief and fruitless attempt to get several more bull walrus as personal trophies, the schooner left the ice on September 3 and began the long run southward. It was a cause of great regret in leaving the Arctic Ocean that not even one polar bear had been sighted. On the other hand, the season was said to be an unusual one, the ice had closed in very early, one schooner had been driven ashore by ice near Point Barrow, and one or two other vessels were trapped by ice along the Siberian side. Under the circumstances we might count ourselves fortunate in having accomplished our major purpose without any undue mishap.



A BALD EAGLE COMING IN TO ITS NEST

Bald eagles are abundant in southern Alaska and out along the Alaskan Peninsula. They are remarkably fearless and fly close to man, failing to recognize him as a potential danger. Their nests are found on every high or detached spire of rock



"THE LONG BROWN
PATH"

HOW NATURE PLANTS HER FLOWERS

The Many Ways That Flowers and Trees Scatter Their Seeds—How the Wind
Aids Some—How Birds and Animals Carry Others—The Extraordinary
Diversity of These Natural Methods

By CLYDE FISHER

Curator of Visual Instruction, American Museum
PHOTOGRAPHS BY THE AUTHOR

*Flower in the crannied wall,
I pluck you out of the crannies;—
I hold you here, root and all, in my hand,
Little flower—but if I could understand
What you are, root and all, and all in all,
I should know what God and man is.*

—TENNYSON.

THE love of beauty seems to be innate. There seems to have been born in every human mind a love of the beautiful in one form or another, and surely in most persons this embraces our wild flowers in their great variety of form and color and fragrance. Some of these flowers are to be looked for along roadsides and in cultivated meadows, others in marshes and bogs, others in shady woods, and still others on mountain tops. Some plants grow only in acid soil, while others are to be found only in limestone regions. But wherever they occur, they attract our attention because of their beauty.

For some reason, perhaps not easy to explain, our early associations strongly

influence our appreciation of wild flowers and birds and other objects of nature. This significant fact is a plea for arousing and cultivating an interest in the outdoors at an early age. Burroughs speaks of the "memory-stirring" note of the meadow-lark.

Plants live as animals live. Many lower forms have powers of locomotion highly developed. Some plants, for example the wheat-rust, a parasite, seem to migrate in a way analagous to the seasonal migration of animals. The insectivorous plants entrap insects and digest them as some animals do. Here belong the pitcher-plants, the sundews, the butterworts, the bladderworts, and Venus's fly-trap. Some plants, like the



DANDELION'S SPHERE OF PARACHUTES

After the flowers fade and while the seeds are ripening, the hollow stalk grows longer, thus lifting the ball of seeds with their parachutes so that they may be more effectively wafted away on the breeze

slime molds or myxomycetes, have a plant phase and an animal phase. In fact, some biologists consider these organisms animals and call them mycetozoa. This recalls a fascinating essay by Huxley on the borderland between the vegetable and animal kingdoms.

Many of our conspicuous flowering plants have extended their range, have traveled far in historic time. Most of the so-called weeds of our roadsides and cultivated fields in eastern United States have been introduced from the Old World. This is true of yarrow, dandelion, daisy, bouncing Bet, butter-and-eggs, corn-cockle, shepherd's-purse, Queen-Anne's lace, viper's bugloss, and many others. Occasionally one has come from the western United States, as black-eyed or brown-eyed Susan, and occasionally one comes from South America, as *Galinsoga*, a small weed with inconspicuous, composite flowers.

This habit of traveling, which is universal among plants, is obviously an advantage to the individual species, for if all the seeds produced by a given plant would fall straight down to the ground and were allowed to remain and to germinate there, the resultant overcrowding can easily be imagined. Of course, this does not occur in any absolute sense, although there are some approaches to it. In practically all cases, however, there are means of scattering the seeds far and wide. In many instances clever devices astonishing in their effectiveness have been developed by the plants themselves. In other cases there seem to be no special devices. It is doubtful whether it is generally appreciated that myriads of seeds are moved, and to long distances in the aggregate, by the water that falls as rain, while it is flowing over the surface of the earth before it has collected into the recognized brooks and larger streams.

One of the commonest and most frequently observed methods of seed-dispersal is that dependent upon the wind, and there are at least three different devices for the accomplishment of this. First, are those with *flying-hairs*, for example, the dandelion. Every one is familiar with the wonderful little parachutes, one attached to each seed, and all arranged in a ball on the scape that previously bore the head of flowers, which is known to the child as the dandelion flower.

*"The dandelion's coin of gold
Anew is minted on the lawn."*

But how many of us have observed that the scape or stalk of the dandelion grows much longer between the time of flowering and the ripening of the seed? This lengthening serves to lift the head of fruits or the ball of seeds with the parachutes up above the grass and other surrounding plants, so that the wind may waft them away more effectively.

Similar to the dandelion's flying appendages are those of colt's-foot, and

perhaps most astonishingly complex and beautiful of all flying devices of the dandelion type are those of goat's-beard and salsify.

We find flying-hairs of a different type in willows, milkweeds, goldenrods, asters, thistles, and very greatly developed in cotton. The lint or fibers of cotton, which are woven into cloth, are the flying-hairs from the cotton-seeds.

Just as dependent upon the wind is a great group of plants whose fruits or seeds have *wings*. Examples of these are the maples, the elms, the ashes, trumpet-flower, cross-vine, and ailanthus. One has only to toss up a handful of maple seeds or ailanthus seeds when a breeze is blowing to observe how the wings function.

The *tumble-weeds* and tumble-grasses constitute a third group of plants which depend upon the wind to scatter their seeds. All of the tumble-weeds are more or less globular in shape, and have the habit, when the seeds are nearly ripe, of



TROUT-LILY BESIDE THE BROOK

John Burroughs referred to this spring flower as the trout-lily or fawn-lily, because of the mottled or spotted leaves. An additional reason for the former name is its frequent habit of growing along trout streams



TWIN-FLOWER OF THE NORTH WOODS

The European form of this flower, *Linnæa borealis*, was named for the great Swedish botanist, Linnæus. He admired its modest, retiring habits, and its delicate fragrance



A BEAUTIFUL MEMBER OF THE CAMELLIA OR TEA FAMILY

Mountain Stewartia, a shrub whose large, showy flowers with cream-colored petals attract attention along the mountain streams from Kentucky to Georgia



GRAY SQUIRREL BURYING A NUT

The seeds of many of our nut-bearing forest trees are without doubt transported and planted by mice, chipmunks, and squirrels



WATER-HYACINTH

This floating plant is often blown about on lakes or slow-moving streams in Florida, where it has been a nuisance to navigation



TOUCH-ME-NOT OR JEWEL-WEED

The touch-me-not has explosive fruits, the turgid capsules bursting open and the valves curling up with sufficient energy to throw the seeds a considerable distance

breaking loose from the ground. These light, rolling masses are then blown across the prairies or fields by the wind. Not all the seed-capsules are opened at once, but they are opened gradually, thus scattering the seeds as the plant tumbles along. Besides the common western tumble-weed, there are several close relatives, such as the ghost-plant or white pig-weed. A relative of the Indian-turnip of the Great Plains, and the Russian thistle, and several grasses are tumble-weeds that scatter their seeds in this way.

The coconut, which is cultivated around the world in the tropical regions, is a classical example of a *water-borne* seed. The outer fibrous husk with a water-proof coat on the outside makes this possible. So often this tree overhangs the water along the borders of islands or other tropical shores, and this habit makes the method a practicable one in nature. Many of our local aquatic plants, such as arrow-head, and the white water-lily, have their seeds transported by water. We do not include the many plants whose seeds

are washed considerable distances by rain-water, as mentioned above.

Some plants depend upon both the *wind* and the *water* in an interesting way. Examples are the Egyptian lotus and the native American lotus. In the lotus the flower is borne on a stiff stem that projects a foot or so above the water. The seeds, which resemble acorns, develop in depressions in the flat upper face of an enlarged top-shaped receptacle. The flower-stalk later supports this receptacle, holding it firmly above the water. The seeds cannot fall out of the receptacle because the cavities open upward, and they are only released when the wind blows hard enough, with the aid of the waves it causes, to shake the receptacle violently enough to throw the seeds out. In this way it works like a certain type of boy's sling-shot, and the seeds are thrown quite a distance.

Many plants have *explosive fruits*, and there is great variety in the ways in which this is accomplished. In the witch-hazel the seed-capsule bursts open and the two seeds are thrown some distance. In the

Virginia knotweed there is a cushion of elastic cells at the base of each fruit, which throw the ripe fruit or seed a distance of several feet when the hook, formed by the dried style of the flower, is pressed. In the squirting cucumber the fruit becomes very turgid upon ripening, and finally the pressure is great enough to push the stem out, leaving a hole through the rind. The seeds, which are held in suspension in the liquid contents of the fruit, are squirted out with the liquid through the hole at the stem-end of the cucumber.

The violets, the wild geraniums or crane's-bills, and many members of the bean family have explosive fruits, and for different reasons.

Plants, whose seeds are *carried by animals*, may be divided into several groups.

FIRST: Fruits or seeds with hooks, as in burdock, cockle-bur, stick-tights, Spanish-needles, tick-trefoil, hoarhound, sand-bur, and many others. Everyone is familiar with the way these burs or hooked fruits are carried on the clothing of human animals, in the mane and foretops of horses, in the wool of sheep, and on the coats of fur-bearing animals.

SECOND: Seeds of plants are carried long distances on the toes of migrating waterfowl, as Darwin proved in an experiment which he described.

THIRD: Fleshy fruits containing seeds, which are indigestible, are eaten by birds and animals, and transported far from the parent plants. Probably many of the wild black

cherry trees which spring up along our fences, came from seeds carried in this way. Robins and starlings carry not only cherry-seeds but also the seeds of the flowering dogwood, and other trees and shrubs.

FOURTH: Certain birds store away or hide seeds,—for example the blue-jay hides or puts away acorns in various places, sometimes in abandoned birds' nests; the tufted titmouse hides or places pine seeds in the chinks of bark of trees; the California woodpecker regularly stores acorns in holes which it drills in tree-trunks or in posts. In many cases these seeds are eaten by the birds, but there is no doubt that some of them reach the soil, perhaps by being washed down by rain, and germinate.

FIFTH: Many rodents store up nuts for



BUMBLEBEE ASLEEP IN THE FLOWER OF A HOLLYHOCK
Photographed on an autumn morning before the sun had warmed the
bee into activity



BROWN-EYED SUSAN

The brown-eyed Susan, or black-eyed Susan, has been introduced from the western United States



QUEEN-ANNE'S LACE

The flat-topped umbel of Queen-Anne's lace or wild carrot usually has in the center an aborted flower, brown in color. By the time the seeds are ripe the umbel has become concave and dense, closely resembling a bird's nest





PARTRIDGE BERRY

This may be called the Siamese twins among flowers, for two flowers develop into one berry having one stem and two blossom-scars



WIND-BLOWN PODS OF THE MILKWEED

The seeds of the milkweed are scattered by the wind



food in positions well adapted to lead to planting. One of the best examples is the gray squirrel which buries many nuts each autumn,—one nut at a place. After a gray squirrel has buried fifty or one hundred nuts, let us suppose that the squirrel comes to some tragic end,—he may be shot by a hunter or killed by a dog. Then what is likely to happen to the buried nuts? They are in excellent position for germination. In case the squirrel

were not killed, it is altogether possible that it would not find and dig up all the nuts it has buried. Those not found would be in fine position to grow.

It is believed that squirrels and mice have a great deal to do with transporting and planting the seeds (nuts) of forest trees.

In this brief article only a few of nature's methods of scattering seeds can be mentioned or described. There are many others, and every one is interesting.

"Happy is he who understands the causes of things."



A PARENT CEDAR AND ITS CHILDREN

The overcrowding due to the lack of efficient means of scattering the seeds is well illustrated by this old red cedar and its offspring



Royal Flame Trees Silhouetted Against a Tropical Sunset

NEW CALEDONIA

A MODERN FRAGMENT OF THE ANCIENT WORLD

An Island in the South Pacific Ocean so Isolated for Ages that Its Plants and Animals and Landscapes Carry One Back to a Past Geological Age—A Setting Almost Like That of a Different Planet

By WILMATTE PORTER COCKERELL

THE silhouettes of flamboyant trees will always be associated in our minds with the island of New Caledonia. This tree, well called the royal flame tree, and voted by many plant lovers the most beautiful tree in the world, is a native of Madagascar, but has been planted all over the tropics, and in New Caledonia the French have planted hundreds—planted them in long avenues, in groups in gardens, or perhaps just single trees near a lake or pool so placed that the lovely shadow may be reflected in the water.

When Professor Cockerell and I were deciding upon an island to explore, we chose New Caledonia because, having many forms, both plants and animals, peculiar to the island, it is of the greatest interest to naturalists. Island areas often throw great light on the history of this old world of ours, and though New Cal-

edonia has been pretty well explored, we hoped there might be some new things in our special field, the solitary bees, and the snails, but we went rather as students than collectors. Some of the questions over which we pondered were: Why are there no mammals in the island except bats, no snakes except sea snakes, no amphibians except the frogs that the French have introduced, few bees, few butterflies, but many species of grasshopper-like insects? The island is continental, the geologists tell us, but the continent of which it was a part must have been broken up in early geological times, though there were connections later with parts of this old continent. Well, it was all tremendously interesting!

I must confess that before we reached Australia, New Caledonia was little more than a name to me, although it is the second largest of the Pacific Islands,



A HUT AT ST. LOUIS, NEW CALEDONIA

Many laborers have been imported from Java and French Indo China and these perform most of the work on the island. Huts such as this, made largely of grass, are almost universal among these people

New Zealand being first. I had learned in my geography years ago that New Caledonia belonged to the French and that it was used as a penal settlement, and later, when I read the life of that intrepid explorer, Captain Cook, I found that it was he who discovered and named the island, calling it New Caledonia because of its physical resemblance to Scotland.

Like the largest of the Madeira Islands, New Caledonia was not discovered until years after the smaller islands of the archipelago (New Caledonia and outliers and the Loyalties) were known. De Bougainville, sailing south from the New Hebrides, noticed coconuts and branches floating in the sea around him, and this he told to Cook who landed at Balade on the northeast coast September 4, 1774. The name of Bougainville is well known to plant lovers because of the beautiful plants belonging to the genus *Bougainvillea*, vines grown in the North as pot plants in the greenhouses, and giving a riot of color over trees, or as hedges and fences in tropical and subtropical countries. It was a delight to see the bougain-

villeas in New Caledonia, and to remember that, though the plant is South American, even in this far-away island which Bougainville was the first to picture in imagination though not actually to discover, his name is linked with one of the common garden plants.

The history of New Caledonia is full of interest through its period of discovery and exploration; through the period of missionary activity beginning about 1840; the period when the island was a French penal settlement; and the last thirty years, which might be called the period of commercial development.

Since 1853 New Caledonia has been a French colony, although almost immediately after its discovery the French missionaries began their work, and its annexation to France was largely due to their influence. The natural history of the island owes much to these early missionaries. One of them, Father Montrouzier, made extensive collections and described and named many insects and snails—in fact was a sort of Linnæus of the island and its outliers. We visited

the church where he worked for many years, and our friends tried to get permission to copy his photograph, and to record something of his life at St. Louis for this article, but the resident fathers were more interested in piety than in Montrouzier's biological pursuits.

The plants of the island are quite as interesting as the animals, and carry us even farther back in the making of land areas. Hardly fifteen years ago Compton from England spent three years on the island studying the plant life. He made a collection of 830 flowering plants, of which 230 were new species with 10 new genera. In the discussion of Compton's report, Doctor Seward, of Cambridge, said that the plants of New Caledonia carry us further back in the history of plant life than the plants of any other region of the earth's surface. We found that wandering through the "scrub" was like being on a different planet or being carried back into a past geological age, so like was the landscape to pictures

of other ages that one sees in geologies.

A superficial survey of plant forms is interesting, but gives little idea of the strangeness of parts of the "bush" of New Caledonia, a "bush" most like that of the Mountains of the Moon in Africa.

A coniferous tree that has been of great interest since the discovery of the island, is *Araucaria cookii*, named for Captain Cook. It grows to a height of more than 200 feet with very straight and imposing shafts. On the approach of Captain Cook's vessel to the Isle of Pines, these trees were mistaken for columns of basalt, so different is their form from that of ordinary trees. Even Banks and Solander, the naturalists of the expedition, insisted that the columns were mineral, after other members of the expedition, among them the great Captain, had conceded that the curious columns must be trees. And although we were quite familiar with the historical account, and had even seen pictures of this remarkable tree, we had the same



A GARDEN AT A RAILWAY STATION

These flame trees, two of which are shown here, are said by many to be among the most beautiful trees in the world. They have been introduced from Madagascar

illusion that they must be mineral columns, when we saw them for the first time.

The island has a native *Cycas*, a very beautiful species which we saw in the bush near Bourail; fourteen kinds of *Casuarina* trees; no *Eucalyptus* trees, but great forests of the beautiful niaouli trees which are near relatives of the eucalyptus though probably more primitive in their characters; four kinds of endemic palms and several species of endemic mosses, and since mosses are so widespread, this is rather specially significant. There are many species of ferns and orchids so that in places the bush looks very like one of the great hot-houses of Kew. These are only a few of the ways in which the native plants interest the traveler, and give ideas about

the history of the world to the naturalist.

As in Australia, the introduced plants have completely changed the landscape in places—guavas and oranges grow wild in such numbers that it is hoped to make them of commercial value. The introduced grasses have become such a pest that sheep raising is no longer profitable, since the seeds of the grasses get into the wool and make it almost impossible to clean. Many species of introduced weeds flourish; we saw the common dandelion which is such a pest in Colorado. There were places where the lantanas were almost as thick as in the Hawaiian Islands.

The principal crops are coffee, coconuts, and rice, and though we saw a few very good fields of sugar cane, we were told that the weather made cane growing



A NATIVE OF NEW CALEDONIA

European colonists have often found that the natives of colonized lands have not lent themselves to the white man's ways. This is true of these natives. They are not, in the European's eyes, "good workers," and the French of New Caledonia have been forced to obtain the laborers they require from other East Indian lands



A CHARACTERISTIC SCENE IN THE INTERIOR

The huts shown in this photograph were occupied by Indo Chinese imported to New Caledonia. The "niaoli" trees and the "bush" shown are typical of the island

difficult and that the fields we saw were grown for the purpose of making rum.

The climate is variable, and instead of having wet and dry seasons, New Caledonia has wet and dry years. In places plants for irrigation have been installed, but often the same land that is irrigated one year must be drained the next, making all agricultural work uncertain and costly. Some of the coastal islands have valuable deposits of guano.

The greatest wealth of the island is in its mines of chrome, nickel, cobalt, copper, lead, and there is some silver and gold. The chrome mines are said to be the largest in the world. Some profitable timber cutting is carried on, and we found a timber company from Australia taking out the valuable Kauri pine trees from the high country. This company has a small railroad running up to the region of their concession, and as we were very anxious to get into the hill regions, we tried to get permission to travel on this road. Unfortunately, we could only go by courtesy of the manager of the sawmill, Mr. Howard Ross, but he always

pleaded that he was too busy, though we felt that his occupations should have left some time for giving help to a visiting naturalist. We received so much help everywhere that Mr. Ross's attitude was very disappointing, for in the high forests we should certainly have found new forms of the splendid *Placostylus* (the fine land snails abounding in the island) and just possibly have seen the wonder bird of the island, the world-famous kagu.

We found some of the residents interested in natural history, particularly in corals, shellfish, fish, and birds, and our host, M. Paul Bloc at Plum Farm, was a very efficient collector and a delightful guide. Dr. Jean Risbec was the only naturalist we met. He was formerly a teacher but is now employed by the government to investigate sea life. He is the author of a very beautiful book on sea slugs or nudibranchs, and we had a delightful afternoon with him looking over his drawings and discussing the distribution of these very fascinating little sea animals. He told us that he

had collected and described about seventy new species from the reefs of New Caledonia and outliers, and hoped to find many more. The beautiful nautilus shells along the shore were a delight to us. We also found the cuttle bones of two species of squid, which proved to be of especial interest to Mr. Iredale of the Sydney Museum. We visited the factory where pearl disks were being cut from

the *Trocas* shells. Tons of these disks are sent to France, where the process of turning them into pearl buttons is completed. Mr. Levin, a young American, who came as a visitor to the islands but who was staying to install the machinery for making jelly from the wild guavas and marmalade from the wild oranges, took us about in his car and gave us help in many ways.



Photograph by D. Seth-Smith

KAGUS IN CAPTIVITY

These rare birds have been known to live a dozen years or more in confinement, and their voices have been compared to the sounds made by puppies. Though the external appearance is heron-like, anatomical studies have shown them to be more nearly allied to cranes. They are flightless birds about the size of small chickens, and though their long legs make it possible for them to run rapidly, they seldom do so

All along the coast and on the near-by islands there are species of the large land snails belonging to the genus *Placostylus*. These snails are esteemed as delicacies both by the natives and the French, so it was easy to get good series of the different forms. Snails are perhaps the best animals to show the history of land building, since they have such limited powers of locomotion.

The native people are of two very easily recognized groups, although in recent years there has been much intermarriage. We thought the Kanaka children delightful. In many ways it is much easier to be a child in a primitive cultural group, for reasons quite apparent even to a casual observer. Like our Indians, the Kanakas are seldom good workers, so that the French import Javanese and Tonkinese to do the work of the island.

There were many interesting birds. Among them were the honey



THE REEF-PROTECTED BEACH OF NEW CALEDONIA

The coral reef surrounding the island of New Caledonia is second in size only to the Great Australian Barrier Reef

eaters which take the place of the humming birds of the Americas. These were especially attractive, both with their bright colors and active movements as they visited the flowers of shrubs and trees, and took their part in the evening bird chorus as I stayed in the first darkness among the niaoli trees near Plum Farm. What a sight must be the large wide-spreading trees with sheets of crimson flowers alive with active, noisy lorikeets and beautiful honey eaters! Sarasin and Roux, celebrated Swiss naturalists, whose reports on the fauna of the island are classical, list seven species of these delightful little birds, and Doctor Leach, a recent ornithological visitor from Australia, recognized five of these species.

Along the shore we saw several species of plovers, and it seemed very amazing that many of them had come from their breeding grounds in Siberia. The long trek of bird migrants always stirs one's appreciation and wonder, but a trek from Siberia to the far-away New Caledonia is almost beyond belief!

The most famous bird of New Caledonia is the unique kagu, a bird with

beautiful wide-spreading wings, though flightless, and long legs which it seldom uses for running. When attacked by an enemy, it settles in the bush and covers its body with its wings and erects its splendid crest. Of course it is an easy prey for dogs or hunters.

Besides the usual dogs kept as pets, many dogs are kept to hunt deer, an Indian stag introduced several years ago and now considered one of the worst of pests, though we found that venison was much appreciated as food and is even canned for export. So it would seem that the success of the deer is likely to cause the extinction of the kagu, so long one of the wonders of New Caledonia. The bird was even given a place on the stamps of the country a few years ago.

The kagu is an ancient, generalized type, and is confined to this bit of the old southern continent which some naturalists call Gondwanaland. Three such birds are known: the kagu, the sun bitterns of South America, and the peculiar *Mesites* of Madagascar. At one time these birds were grouped together, but

now the Madagascar bird is placed with the scratchers. The real systematic place of these aberrant types is still the subject of much speculation.

The kagu is a delicate blue-gray, with its feathers very loosely webbed, giving the crest a flower-like appearance. The bill and legs are red-orange. The bird is about the size of a small hen, though the body has quite a different shape, and the legs are long. We despaired of seeing the bird in its wild state, for the hunters have driven it back into the mountain areas, but fortunately people sometimes keep kagus as pets, and we went to see the two belonging to Mrs. Jackson. Their owner was not at home, but the black servant took great pride in showing us the birds. This she said was Monsieur Kagu and that was his wife Madame Kagu. When asked if they would breed in captivity she said: "Oui, oui, and that is the eldest son, young Monsieur Kagu," pointing to a small gray heron wandering

about the yard (a bird of quite a different group). Only one egg is laid and probably only one young is raised each year, though the natives have an amusing myth of the hen bird leaving an egg behind for the jealous cock when she scuttles into the bush with her newly hatched chick.

A. J. Campbell of Sydney, Australia, has had a chick hatched in confinement, the period of incubation being thirty-six days. The young is described as a fluffy ball with a big heavy head, the color being dark brown with light fawn markings.

Reluctantly we left this old corner of the broken-up continent Gondwanaland, but felt that it had come to be a very real continent to us. Much work must be done with all groups of animals and plants, as well as with fossils and with structural geology, before we can define the boundaries of Gondwanaland or even picture in imagination the vicissitudes through which it must have passed.



"THE PERCHED ROCK" NEAR BOURAIL

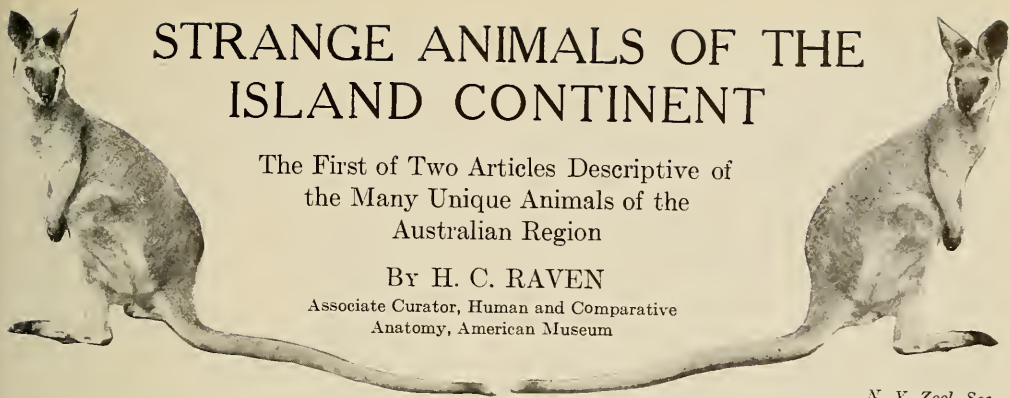
Many swallows, locally called "swiftlets," nest about this rock and in the arch of the cave from which this photograph was taken

STRANGE ANIMALS OF THE ISLAND CONTINENT

The First of Two Articles Descriptive of
the Many Unique Animals of the
Australian Region

By H. C. RAVEN

Associate Curator, Human and Comparative
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N. Y. Zool. Soc.

CAMPED high in the mountains of Central Celebes, I was sitting with my three Malayan companions close to a fire built on the floor of a palm-thatched hut. We heard an animal up in a treetop in the dense mist and darkness outside, give and repeat its faint call—"tuc-tuc-tuc-tuc----tuc-tuc-tuc-tuc."

In the low country of this East Indian island after dark, the buzzing and humming of the insects of the jungle would probably have made it impossible to hear such a faint call; not so, however, in this cool, moss-covered forest between six and seven thousand feet altitude. One of my natives was a Toradja boy about ten or eleven years old, and it was he, speaking in the Malay he had learned during the three months he had been with us, who said the voice we heard was that of the "timpausu," an animal which climbed about in the treetops, ate leaves and fruits, and carried its young in a pocket.

A few days later, while we were eating our midday meal, one of the boys glanced down the steep slope of the mountain and chanced to see something moving about in a treetop about a hundred yards away. The small boy, Sempa, was sent to see what was there. He stalked quietly under cover of the dense vegetation and then called back that the animal was a timpausu, the largest he had ever seen. I went immediately to the spot and found that this nocturnal animal was apparently

foregoing his usual daily sleep in order to feed on the fruit of a tall forest tree.

I told Sempa to climb the tree and drive the timpausu down where we might capture it, but I was surprised when, after a little persuasion on my part, Sempa began to fasten his feet together for the climb up the smooth trunk. He was clad only in a loin cloth, but of course carried his *parang* in a wooden sheath that was always fastened about his waist. When he reached the branch on which the timpausu rested, the animal hissed at him and backed out on the branch, away from the trunk. Sempa carried several pieces of rattan with which to attempt to snare the timpausu, but it was not a very easy matter for him to get the noose over its head and still more difficult to draw it taut, for as soon as the animal felt the rattan he scratched it off. Finally, however, Sempa with a wonderful display of agility managed to snare the beast by the head, body, and feet, so that it was completely helpless. It was then lowered to us.

This marsupial proved to be of a species new to science and was named *Phalanger furrus* by Miller and Hollister. It was the third species to be described from Celebes and is the largest living phalanger. The other two species are fairly common in some parts of the island. The natives have for centuries killed them for food, and until comparatively recent times, for their scent or musk glands, that are like similar glands in the civet. These



HUNTING FOR PHALANGERS

The Australian aboriginal, or Black fellow, climbs trees with the aid of a piece of bark or a vine that he loops about the trunk. He hunts for the phalangers in holes in the trunk and in the branches



A FOREST CAMP

The expedition made short trips into the dense "scrub" between the top of the escarpment and the coast. Here they collected marsupials not found in the open eucalyptus forest





AUSTRALIAN ABORIGINAL HUTS

These crude dwellings are covered with eucalyptus bark and grass. The natives who occupy them live upon wild fruits and grass seeds and with the aid of dingoes, or wild dogs which they have domesticated, hunt various marsupials



FELLING A BIG TREE IN ORDER TO CATCH A SMALL ANIMAL

Trees three feet or more in diameter were felled in the search for the pygmy flying phalanger—a creature so tiny that a whole family can be held in the palm of one's hand



have found their way into the hands of Buginese, Arab, and Chinese traders on the coast just as wild beeswax, copal, rattan, and other products from the jungle have done.

Usually the natives secured the phalangers by shooting them with poisoned darts from their long bamboo blowpipes, or else by snaring the simple-minded creatures with a rattan noose, or with a still stronger noose made from the root of the sugar palm (*Arenga saccharifera*) set on the branches of trees frequented by the animals.

Several years after my experiences with phalangers in Celebes I was collecting zoölogical material in Australia, the homeland of a wonderful assortment of pouched mammals. The pygmy flying phalanger (*Acrobates pygmaeus*) was one of the chief desiderata and was very difficult to secure. I was therefore delighted to get advice from Mr. Harry Burrell, a famous Austra-

lian naturalist, as to the best manner of hunting it. According to him the equipment required was a "half-axe" (an axeman) and a pair of binoculars. A search must then be made for trees with holes suitable for nesting sites for the mouselike creatures. If the binocular reveals tiny claw marks and scratches about the entrance to the hole, simply cut down the tree and take out the phalanger.

It was winter in the highlands of northern New South Wales when we wandered about through the beautiful open forest composed mostly of trees known locally as "stringy barks" (*Eucalyptus obliqua*) and "white gums" (*Eucalyptus hæmastoma*). Many of these were great tall trees and all had rather sparse foliage on their peculiarly gnarled and twisted branches. Scattered among them were a few smaller trees, the most remarkable being the peculiar "bottle brush" tree (*Banksia*). The ground beneath them was



THE PYGMY FLYING PHALANGER

This phalanger (*Acrobates pygmaeus*) is also called the "feather tail," because its tail has short hair on the upper and lower surfaces and long hair on the sides



A DIMINUTIVE MOTHER

This tiny flying phalanger (the same specimen as shown on the opposite page) the size of a mouse, was found hibernating. In its pouch were four young ones, each the size of a small bean

covered with a very fine-leafed grass, now pale buff and dry and strewn with strips of eucalyptus bark and branches.

High on the side of the bole of a towering eucalypt I saw a "spout" where a branch, years before, had broken off. Decay had followed back the course of the branch in its growth and burrowed deep into the side of the tree. The growing wood about the entrance to this cavity now formed a heavy protruding fold that in time would close the wound. The opening, however, still appeared to be three or four inches in diameter and there were undoubtedly little scratches on the smooth light-colored bark about the entrance.

It seemed a shame to cut such a fine tree but here it really made no difference, for all the trees at this particular place were doomed to be either cut or ringbarked so that better grass might grow beneath for the pasturage of cattle.

As soon as it was decided that the "spout" looked promising, my "half-axe" companion set to work to fell the tree, which was about three feet in diameter. When I asked him which way it would fall, he replied that he could fell it in any direction I wished—and he did.

In an hour or less the tree was down. The hole in the "spout" was not as big as it had looked, not even large enough to permit my hand to enter. Besides, the entrance was covered with ice in which were bits of leaves and bark. There was evidently a nest inside. It was therefore necessary to chop through the side of the "spout," but when a small hole was made, the presence of the nest became a certainty and the "spout" had to be chopped off completely, an awkward job for any but a skilled axe-man. Then the nest was opened. On the outside were the long lanceolate leaves of the eucalypt and inside was its finely shredded bark,



Courtesy of N. Y. Zoological Society

AUSTRALIAN OPOSSUM

The common vulpine phalanger (*Trichosurus vulpecula*) gets its name from its foxlike visage. It is the Australian opossum of the fur trade and the commonest of the Australian fur bearers



Courtesy of N. Y. Zoological Society

THE MEDIUM-SIZED FLYING PHALANGER

This creature (*Petaurus*) is commonly called a squirrel in Australia, for it closely parallels the American flying squirrel in size, color, and habits, though in fundamental characters it is not related to this rodent but belongs in the same group with the kangaroos



A RING-TAILED PHALANGER

The habitat of this creature (*Pseudochirus lemuroides*) is the limited area of tropical rain forest along the coast of North Queensland. Another species ranges over the greater part of the forested area of the continent



A CAPTIVE AUSTRALIAN OPOSSUM

Courtesy of N. Y. Zoological Society

This animal is one of the most generalized phalangers and is often found wandering on the ground. It varies in color from pale silvery gray to a deep reddish-brown

forming a dry covering for a beautiful little animal not larger than a mouse, with the form and almost the coloring of our American flying squirrel.

At first we thought it was dead but we soon learned that it was only hibernating. After being taken back to camp and kept in a warm place for an hour or more, it roused. We then examined it carefully and found it to be a female with four minute young ones in its pouch, each the size of a small bean, naked, blind, and all hibernating, too.

Besides the phalangers already mentioned and many others related to them, there live in the same locality many more pouched mammals, foremost among them and largest, the kangaroo.

Kangaroos are hunted by stalking them on foot after the manner practiced in hunting deer. Many professional kangaroo hunters hunt on horseback and

shoot from the saddle, or slip to the ground to shoot. The best sport, however, is to chase the kangaroo on horseback with a couple of "kangaroo dogs" or greyhounds. I found this great sport but by no means a sure way to secure the kangaroo.

When pursued through the tall grass, the great gray kangaroo bounds away with amazing speed and ease. At a little distance the greyhounds cannot be seen, only the kangaroo bobbing up and down and dodging from side to side. Apparently the kangaroo hops high enough to see the logs and gullies in time to avoid or jump them, but several times I have seen dogs stopped or hurt by running into a hidden log. This reminds me of the following passages taken from the account by Captain James Cook of his voyage of exploration to the east coast of Australia. He writes:



Courtesy of N. Y. Zoological Society

RIDING IN ITS MOTHER'S POUCH

Young wallabies and kangaroos lean out of their mothers' pouches and learn to feed on vegetation before being finally turned out into the cold world

Botany Bay, May 1, 1770.

. . . We had a transient and imperfect view of a quadruped about as big as a rabbit [a rat kangaroo]. Mr. Bank's greyhound, which was with us, got sight of it and would probably have caught it, but the moment he set off he lamed himself against a stump which lay concealed in the long grass.

And further, when the kangaroo was first seen, near the mouth of the Endeavour River:

June 24, 1770, . . . I saw myself one of the animals which had been so often described: it was of a light mouse colour, and in size and shape very much resembling a greyhound; it had a long tail also, which it carried like a greyhound; and I should have taken it for a wild dog, if instead of running, it had not leapt like a hare or deer; its legs were said to be very slender, and the print of its foot like that of a goat; but where I saw it the grass was so high that the legs were concealed, and the ground was too hard to receive the track.

July 8, 1770, . . . they saw four animals of the same kind, two of which Mr. Bank's greyhound fairly chased, but they threw him out at a great distance, by leaping over the long grass, which prevented his running: this animal was observed not to run upon four legs, but to bound or hop forward upon two, like the *Jerbua*, or *Jaculus*.

These extracts are from the original description of the kangaroo. It is interesting to note that this description led European naturalists of the time to consider the kangaroo a sort of giant pouched rodent related to jumping mice and jerboas on the one hand, and on the other to the American opossum, which was the first marsupial ever known to Europeans.

One of the most interesting things about marsupials is their condition at birth and their subsequent development.



NATURE'S CONTRASTS

Figures drawn to scale to show the proportional differences in head and body length between the adult and young at birth, of man and the kangaroo. A—adult man; B—new born child; C—adult kangaroo; D—new-born kangaroo

When a kangaroo is born, its crown-rump length is less than one inch. In this immature condition it emerges from the cloaca of its mother and immediately starts crawling upward through the hair to the pouch. At this stage the forelimbs of the young kangaroo are actually larger than the hind limbs and are provided with tiny claws. With overhand strokes the young one makes its way unassisted into the pouch, where it locates one of the four teats.¹ The teat is more easily received into the mouth of the young one, for as part of the maternal preparation for this occasion, it has become pointed and turgid. Within a short time after the young animal has seized the teat, this swells out at the tip

¹It has been claimed that the mother kangaroo takes the young at birth and places it on the teat in the pouch. The clumsy paws of a kangaroo are suitable for digging out grass roots, for awkwardly holding grass, and for scratching, but certainly not fitted for picking up or handling the delicate newborn young.



Courtesy of N. Y. Zoological Society

A LITTLE NIGHT PROWLER

The doormouse phalanger (*Dromicia*), is a seclusive mouselike creature whose prehensile tail is doubtless a safety factor during nightly rambles in the treetops, in search of herbivorous and insectivorous food



Courtesy of N. Y. Zoological Society

ON THE DEFENSIVE

In order to strike with the hind foot, or to get a better view of the surrounding country, kangaroos stand on their toes and use their tails as props



Courtesy of N. Y. Zoological Society

A RELATIVE OF THE KANGAROO

The bettong (*Bettongia*) is one of the rat kangaroos which might be mistaken for a phalanger if it were not for his greatly elongated hind feet



FAVORED BY FORTUNE

The most abundant of the Australian marsupials is the large flying phalanger (*Petauroides volans*), for it has a worthless skin and thus escapes the fur hunter

to fill the mouth cavity, so that the young is practically buttoned to its parent, with its mouth representing the button-hole.

In the field the young are often found by hunters and trappers at this stage in the pouch of the slain female, and of course when the tiny creature is pulled from the teat, its lips are ruptured and they bleed. This undoubtedly gave rise to the widely spread belief among Australian hunters that the marsupial young originate and grow on the teat of the mother.

In the colder parts of Australia the young kangaroos are born at the beginning of the Australian winter (about April). They remain in the pouch until spring (October), then run with the mother during the summer and frequently longer.

The Australian marsupials are hunted and trapped almost entirely for their skins, though the flesh of all the kangaroos is very good to eat. Naturally they are taken mostly during the Australian winter, when the fur is at its best. This unfortunately necessitates killing a pouch young with every adult female, since every normal adult female has a helpless young one in its pouch at that time.

Some Australian marsupials have already become extinct and the ranks of those that are still obtainable are yearly being thinned by trappers for the fur trade. As the ranks of the best grade of fur-bearers are decimated, related animals somewhat less desirable are also exploited. Thus for a few years the annual decrease in the number of skins is not

alarming; however, the inevitable result is not very distant, provided the destruction is allowed to continue.

Several years ago when Prof. William K. Gregory and I were in Australia in the interests of the American Museum of Natural History, he expressed through the Australian papers the great zoölogic interest of the Australian fauna and the hope that it would be adequately protected for posterity. Many of our Australian scientific friends were already deeply interested in the protection of their fauna and have encouraged the enactment of protective measures.

The greatest number of marsupial skins at present undoubtedly come from Queensland, but the following figures from the little island state of Tasmania are characteristic. In their book *The Vertebrate Animals of Tasmania*, published in 1924, Messrs. Lord and Scott state that

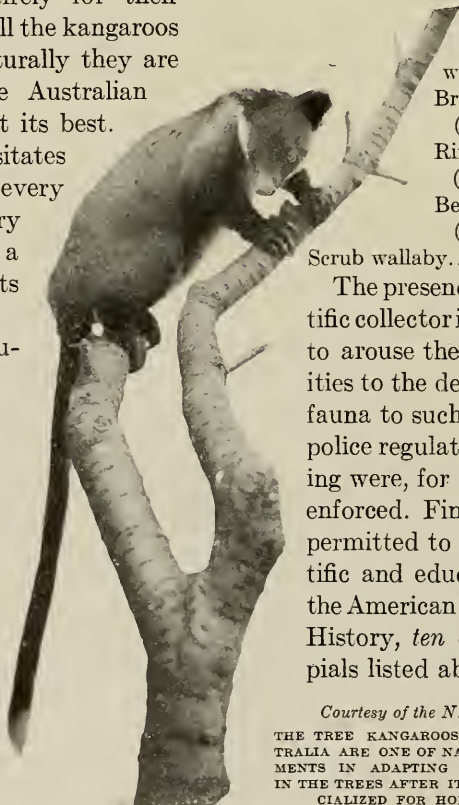
"... during the last open season the following furred animals were trapped:

Brush phalangers	
("opossums")	105,968
Ringtail phalangers	
("opossums")	587,179
Bennett's wallaby	
("kangaroo")	146,236
Scrub wallaby	201,365

The presence of a foreign scientific collector in their midst seemed to arouse the Tasmanian authorities to the defense of their native fauna to such an extent that the police regulations against collecting were, for once at least, rigidly enforced. Finally, however, I was permitted to collect for the scientific and educational purposes of the American Museum of Natural History, *ten each* of the marsupials listed above.

Courtesy of the N. Y. Zoological Society

THE TREE KANGAROOS OF NEW GUINEA AND AUSTRALIA ARE ONE OF NATURE'S SUCCESSFUL EXPERIMENTS IN ADAPTING AN ANIMAL AGAIN TO LIFE IN THE TREES AFTER IT HAD BECOME HIGHLY SPECIALIZED FOR HOPPING ON THE GROUND





A BIT OF
THE GREAT SMOKIES.

SALAMANDERS OF THE GREAT SMOKIES

Grubbing for Spring Lizards in the Brooks and Mountains of Northern Tennessee

By WILLIAM G. HASSLER

Department of Reptiles and Amphibians, American Museum

SALAMANDERS are "spring lizards" to our southern mountaineers, who use them as bait for fishing, but these people certainly would never think of going hundreds of miles to collect a trunkfull. I am sure that to some of the mountain folk living in one small community of the Great Smokies along the Tennessee - North Carolina border, I seemed "quare," (queer).

The small, cold-blooded animals called salamanders form a large branch of the class Amphibia, and are closely allied to the frogs. Though they have a tail and four small legs, their skin is unprotected and often slimy, a character that separates them from the true lizards, which have dry, scaly skins. Cold mountain brooks splashing along their stony beds, spring trickles seeping over mossy rocks and under old logs, boggy places and slow-moving streams, all have their peculiar forms of salamanders. Some of these are wholly aquatic, others only partially so. Still others are terrestrial and are found living under stones and rotting logs.

A large series of living salamanders were desired for experimental work in the laboratories of the American Museum. It was also expedient to secure information on certain species in the field, particularly the habits and probable relationship of a reddish-cheeked, semi-aquatic salamander. This color phase has been found in the Great Smoky Mountains, and it therefore became my good fortune to spend a few days collecting in these, the most beautiful and interesting of our southern mountains.

Wiley Oakley, of Gatlinburg, Tennessee, was my helper and guide for the first two days. Self-styled "Roaming Man of the Mountains," he not only knew of all the likely streams and springs, but could also tell many stories of the mountaineers. Sometimes, while working up a stream he would remark,

"Perhaps they're makin' likker up thar in the holler."

A piece of stove or other rusty iron in the stream would bear evidence that moonshine had been secretly made near by.



RETURNING HOME WITH THE DAY'S CATCH

Woodrow and Orville Oakley helped collect on several days and this particular afternoon the party returned with about 140 spring lizards. Orville also had some snakes, but these he preferred to carry at arm's length



GAUDY IN BRIGHT YELLOW AND BLACK

Six long-tailed salamanders (*Eurycea longicauda*) were the most brilliant of the captures. Their slender yellow and black bodies were in sharp contrast to the dark brown mud under the stones where they hid



WHERE LIZARDS MAKE THEMSELVES AT HOME

Fence lizards and skinks were often seen basking in the sun on old buildings, fences, and stone piles, so the expedition stopped to look for them on this unoccupied mountain house near "Pant'er Creek"



A "GROUND PUPPY" IS DISCOVERED

Popular names of reptiles and amphibians differ with each locality. "Red Puppy" was another name for this salamander which the party sought in every stony stream, and which, as though to mock them, would as often be found in dry situations

Snow covering the tops of LeConte and showing white between the balsams made collecting useless in the higher reaches the first day after I arrived. So Wiley and I investigated the streams in the valleys near by. We each carried a knapsack containing several nests of cans, our lunch, and a cloth bag or two for reptiles, also a mattock with which to overturn stones and to rip off bark and moss. The streams were swollen from recent rains, but some specimens were found in the headwaters and in springs and their overflows. Large, dark brown, mottled salamanders were the first found. They are known as *Desmognathus phoca*, and live under stones and logs in the water. A smaller species (*Desmognathus fuscus carolinensis*), is usually found in slightly drier situations. These were much more common along small trickles of water.

A swath of loose and overturned stones marked our wake. Along the banks of a brook it wound, ever upward among the rhododendron thickets, and the cry "Here's another, and it's one of those big reddish ones," would proclaim that Wiley had caught a purple salamander. Hastily the animal would be dropped into a collecting can, and the search would go on under the stones for more.

From Gatlinburg a stream led us to some property of Wiley's, where, on a clearing, a little log barn stood surrounded by old stumps. Here on the gray, rough

building, two kinds of true lizards basked in the sun. The fence lizards were almost exactly the color of the logs, and discernable only with difficulty. They would

dart squirrel-like to the other side of the log when we approached. By working from opposite directions we were able to capture several. The other kind were skinks, or "scorpions" as they are called all over the South. Wiley took my word that they were not "pizen," and we tried hard to catch some, but they were much more wary and fast than the fence lizards.



Photograph by Edna L. Simms

SET FOR BIGGER GAME THAN SALAMANDERS

An ardent lover of his native mountains, Wiley Oakley always had some story in store about the Smokies, their forests, wild life, and people

One day just before lunch I caught a three-foot house snake. It was a beautiful reptile, much like our eastern milk snake. Its habits and food are similar, and it is often found near houses, where it preys on mice. Wiley, however, did not appreciate it, and insisted that I carry the bag it was in.

Under some flat stones in the grass-grown outlet of a well-like spring not far from Panther Creek, we found six bright yellow and black salamanders. As we had been finding only drab-colored *Desmognathus*, those attractive ones were a most welcome change, and, as it proved later, were the only ones collected on the whole trip.

A terribly rough auto ride over a new road that was being constructed through the "sugarlands" and over Indian Gap brought us to a number of little streams flowing into Alum Cave Creek below. We were more than 3500 feet

above sea level, and high enough to find the red-cheeked "spring lizards" that I particularly wanted to study and collect.

After searching vainly for perhaps an hour, we were nearly discouraged, when both of us suddenly discovered specimens at almost the same time. All the trickles from then on yielded some, and collecting for the day ended under a beautiful falls tumbling off the cliffs of Fort Harry Mountain, a spur of Le Conte.

One afternoon, while investigating the streams around Elkmont, we went to see the gold mine of "Uncle Levi Trenham," who is often called the "Prophet of the Great Smokies." Mrs. Edna L. Simms, who took me over in her auto, and Will Ramsay, another guide at Gatlinburg, showed me the peculiar stone that, according to an Indian legend, points to gold. This huge stone has carved deep on its face the imprint of a man's hand, a bear's foot, and two eyes. It was lost for many years, then rediscovered on "Uncle Levi's" farm. So far no great amount of gold has been found, though small quantities have been dug out, but Uncle Levi hopes that some day he will find the real deposit.

Two of Wiley Oakley's boys helped me on several trips. They enjoyed collecting and worked hard at it. May 12 was devoted to a trip up Le Conte. Mill Creek flows down the side of this mountain and here I hoped to find a goodly number of salamanders. I was disappointed in this, however, probably because the snow had not yet melted completely, and the water

was icy cold. Under stones along the trail a number of black salamanders with red cheeks were found. These were a terrestrial form, and different from the ones we had previously caught.

The trail up Le Conte is difficult but most interesting. Large outcroppings of rock forced us to climb continuously along the lower portions of it. About half way up, Mill Creek takes a beautiful plunge of some sixty or eighty feet off a ledge. Orville, the younger of the two boys, was with me that day, and told me stories of the mountain wildcats that cried at night near the house where he used to live, of "bars" (bears) and other wild life. At the top we had a snowball fight just to prove that the climb had not tired us. From the ledge where we ate our lunch, above a sheer drop of hundreds of feet, we could see for miles over the thick green mountain-tops that stretched below us. A young eagle cried every now and then from the wilderness below, and we could hear faintly the tinkling of Little Pigeon River, hidden in the valley.

The following day was my last in Gatlinburg, and 570 living salamanders and a number of snakes had to be repacked for shipment to New York. We put fresh moss around the salamanders, placed them in perforated containers, and then made them all snug in a trunk. The trip to New York seemed to agree with them, for they were all alive and well when opened at the American Museum.



Photograph by Edna L. Simms

THE PROPHET OF
THE GREAT SMOKIES

ROALD AMUNDSEN

By LINCOLN ELLSWORTH

IT seems the irony of fate that Roald Amundsen's life work should have ended somewhere near where it began—in the Norwegian Sea, off the coast of his native land where, as a lad of fifteen he started out before the mast on a career of great adventure. But the finding of bits of wreckage of his plane in which he with five companions sailed away in succor of former comrades lost somewhere in the Polar wastes, leaves little hope that this supreme adventurer who so often tempted fate in quest of the unknown, and who always came back, has at last paid the supreme sacrifice and journeyed into the unknown—that Great Unknown—from which no man ever returns.

But the end, no doubt, was as he himself would have wished it, for Amundsen often told me that he wanted to die in action. He could bear the thought of no other way.

Life's friendships are transient things. Silently, like shadows in the night, they come—and are gone away. With the loss of this devoted friend—for Roald Amundsen and I had much in common together—goes the last of my boyhood heroes. (Roosevelt and Peary were the others.)

Beyond the last frontier—beyond even the outermost rim of discovery, toward that huge tract in the Polar Sea marked “unexplored” lay my dreams! But how was I to get to that land of far horizons?

The dreams of youth are long, long dreams, and I am certain that they never could have found realization had not chance—or was it fate—brought us together? This was in October, 1924, and the two years of our close intimacy never dulled—it only served to enhance—the hero worship in which I held him. Such was the magic spell that this man's personality wove about me. Just why or how would be difficult to explain.



ROALD AMUNDSEN

The last photograph of the great Polar explorer taken just before he started on the historic flight in the “Norge” in 1926

Although years of battling in regions of eternal ice had bred in Amundsen something that carried outward, visible signs—that indelible stamp of the Arctic—underneath the man of cold reserve lingered much of the spirit and enthusiasm of a boy. “Do you know,” he said to me, on his arrival in America the last time, “I have adopted many of your ways. I have learned to smoke my pipe in bed of evenings and have written to Montreal for fifty pounds of that French-Canadian tobacco you smoke, and I eat only two meals a day now. I

never have that tight feeling around the belt any more."

With the passing of this pictureque viking of an old school, whose strong weather-beaten face with its steadfast eye, hearty handclasp, ease of bearing, and innate modesty, captivated all those with whom he came in contact, goes a certain something that has to do with romance, with youth, with the dreams of life, for Amundsen's attainment of the South Pole closed the chapter of that romantic history of Polar exploration by men using ships and dogs as a means of transport. "Their place now," he says in his memoirs, "though forever glorious, is in the museum and the history books. Aircraft has supplanted the dog." Strangely enough Amundsen was himself one of the first to foresee the possibilities of, and to participate in, this new method of exploration. But it wasn't his game, he told me,—guessed he was too old to learn. Certain it is that, with the passing of the dog and sledge, exploration has been robbed of much of its early romance and glamour, born of the age when, out of the sheer urge for bodily effort, men traveled forth to explore the yet untrodden.

Modern progress moves so swiftly that fact often transcends fancy. The dreams of one age become the realities of the next, and today, as we wing our way in comparative comfort, cutting the years to hours in our swift flight over the unknown, the stories of hardships and sufferings endured by those travelers of yesterday seem as remote as lessons taken from the Old Testament.

But in the ages to come, the navigation of the northwest passage, the attainment of both Poles and the first crossing of the Polar Sea by Roald Amundsen, will ever remain a monument to an heroic effort—a symbol of devotion to an idea: "To seek, to strive, to find and not to yield." Whatever its value to civilization, the

effort was not in vain. Of such stuff are heroes made, the world needs them. They are the salt of youth, and out of the salt of youth comes the iron that makes for mature manhood.

Amundsen would have been fifty-six years old last July 16 had he lived, for he was born in 1872. He had attained all the major Geographic prizes left to the Twentieth Century, but he was not a happy man. No idealist ever is. "Whatever remains to man unknown in this world of ours," he says in his memoirs in speaking of the "good" of Polar exploration, "is by so much a burden on the spirits of all men. It remains a something that man has not yet conquered—a continuing evidence of his weakness, an unmet challenge of his mastery over nature. By the same token, every mystery made plain, every unknown land explored, exalts the spirit of the whole human race—strengthens its courage and exalts its spirit permanently. The trail breaker is an indispensable ally of the spiritual values which advance and sustain civilization." And so, accustomed all his life to the thrill of great adventure, he suddenly found himself, at the age of fifty-four with nothing left to do, for he had lived to see the old method of "going exploring" become obsolete, and the new way wasn't his.

His whole life had been one long, uphill struggle in the face of terrific odds—mental as well as physical. Lack of funds had forced him to rent a bakeshop and with his own hands prepare all the pemmican used on his South Pole expedition. On one of his Arctic voyages, he told me, he had to "turn to" as cook for his men in order to keep up the morale. But where there is a will there is a way, and Amundsen always found the way with that courage born of the right, which, through life, held him ever true to his ideals.

Of such stuff was the man Roald

Amundsen. He had acquired a philosophy of life that taught him to accept, with equal equanimity, whatever the day brought forth. I cannot see him other than the great leader he was,—a man inspired by the highest ideals and responsive to all the finer and nobler things of life, beloved and admired by all those with whom he came in contact. His supreme effort, while it cannot be measured in terms of human lives saved, will go down through the ages as one of the finest examples of self-sacrifice ever made. He gave of his best, and God grant that in so doing he may receive of the best.

Could I, who have been made better by his influence and example, give adequate expression to the tribute due him, it would be "as a fadeless garland in which the laurel of victory is entwined with the roses of love."

So "SKOAL"! Roald Amundsen.

"The winter's cold, that lately froze our blood,
Now were it so extreme might do this good,
As make these tears bright pearls, which I
would lay

Tomb'd safely with you till doom's fatal day;
That in thy solitary place, where none
May ever come to breathe a sigh or groan,
Some remnant might be extant of the true
And faithful love I shall ever bear for you."

BASHFORD DEAN

By HENRY FAIRFIELD OSBORN

President, American Museum of Natural History

ON December 7 word was received at the American Museum of Natural History of the death on December 6 of Honorary Curator Bashford Dean, who has been connected with the Museum in the department of fishes since 1897, receiving his first appointment in the Museum not long after receiving his degree of Doctor of Philosophy at Columbia University.

Dean was the most brilliant and promising student of John S. Newberry, a distinguished professor of geology and palæontology in the strong School of Mines faculty of that day, and Dean fell heir to Newberry's remarkable collection of extinct Devonian fishes, which is now in the American Museum. He soon became master of this collection and began a very remarkable series of restorations of the Devonian fishes of Scotland and North America. This established his fame as an ichthyologist.

In the American Museum Dean rose year by year until in July, 1909, he achieved the rank of curator of ichthy-

ology and herpetology. After many years of delay and disappointment his labors were crowned by the construction of the hall of fishes on the first floor of the new Asiatic wing of the Museum. With Mrs. Dean, he was expected as the guest of honor at the opening of this hall on Wednesday, December 5, for which occasion thousands of invitations were sent to all the members of the Museum. On the morning of the opening of the hall, Professor Osborn received a beautiful letter from Doctor Dean expressing his deep regret that he could not be present, for about a fortnight before he had left for the Battle Creek Sanitarium. Not one of his colleagues in the Museum was prepared for the sudden announcement of his death, which was due to a serious operation.

His career in the Metropolitan Museum of Art was no less distinguished and influential. Because of his life-long interest in armor and the armored fishes of the Devonian period, his native sense of form and of beauty had developed rapidly and is superbly expressed in the great armor

hall of the Metropolitan Museum. He rose to the first rank as a leading authority on armor not only in America but in Europe, where his name was a household word among connoisseurs. He frequented museums and private collections in Europe and was absolutely familiar with the very last of the *rarissima* in the field of armor. With his consummate knowledge, taste, and authority, he combined a sense of evolution of design and of mechanism so that it may be said that in our great museum he laid the foundations of the evolution of fishes, and in the great sister museum across the Park the cognate evolution of armor.

His third activity, which occupied the early years of his professional life, was first as assistant, and then as full professor of vertebrate zoology at Columbia University, beginning in the year 1904. Here he became the master of several now famous ichthyologists and comparative anatomists, including especially Professor William K. Gregory, who has continued Professor Dean's researches in the series of publications covering the whole field of recent and extinct fishes.

Throughout his entire career he had a very strong phylogenetic or evolutionary sense, both as to the beginnings of ichthyology and as to the beginnings of armor. This expressed itself in one of his most fundamental undertakings, namely, a catalogue of all details relating to fishes from the earliest classical times. Aided by Dr. E. W. Gudger, this culminated in three monumental volumes,

known as the *Bibliography of Fishes*, for which Professor Dean was awarded the Daniel Giraud Elliot Medal for 1923 by the National Academy of Sciences.

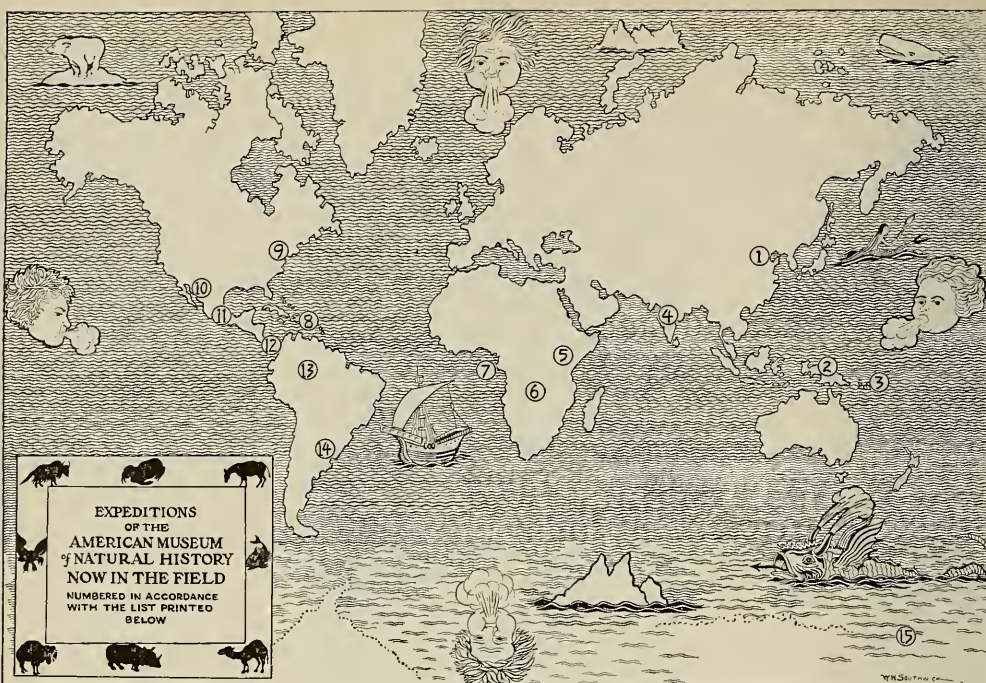
The fourth feature of his life was his career as an explorer in ichthyology, which carried him to the seas of the Far East as well as to the rivers of America, resulting in a superb collection illustrating the embryonic development of fishes to be published in a memorial volume by the American Museum of Natural History.

President Osborn, Professor Gregory, and Dr. E. W. Gudger, lifelong associates of Cura-



BASHFORD DEAN, 1867-1928
In the uniform of a major (of ordnance)
during the Great War

tor Dean in his great works in ichthyology, were shocked and inexpressibly grieved by the news of Doctor Dean's unexpected death. They had been rejoicing with him in his prospect of retirement from his very active life after a service of thirty-eight years in the two great institutions as curator and collector. He had been relieved by both institutions of all administrative duties, and intended to devote his remaining years in his beautiful home at Riverdale-on-the-Hudson to the completion of several volumes on ichthyology and armor, summing up his lifelong researches and describing some of the most remarkable and beautiful of the types which he had been able to collect for the two institutions. To no other man has it been granted to leave such monuments of an intelligent, energetic, and untiring spirit as Doctor Dean leaves in two of the great museums of the modern world, the Metropolitan and the American.



1. Central Asiatic; 2. Beck, New Guinea, for birds; 3. Whitney South Sea, Solomon Islands for birds; 4. Vernay-Faunthorpe for Asiatic mammals; 5. Straus Abyssinian for birds; Sanford-Patterson-Legendre Abyssinian for mammals; 6. Tanganyika for birds and mammals; 7. Sao Thomé for birds (Thorne-Correia); 8. Klingel, Haiti, for birds; 9. Chester A. Reeds, Lake Passaic varves; 10. Sante F⁵ for fossils (Frick-Rak); 11. Vaillant, Mexico, for archaeological finds; 12. Benson, East Panama for birds; Chapman, Barro Colorado for birds; Curran, Panama for insects; Blick, Honduras for fossils; 13. Tyler Duida, Venezuela, for birds and mammals; 14. Southeastern Brazilian (Naumburg-Kaempfer) for fossils; 15. Byrd, Antarctic.

IN THE FIELD OF NATURAL HISTORY

Expeditions — Scientific Research — Conservation
Books — Meetings of Societies

EDITED BY A. KATHERINE BERGER

EXPEDITIONS

CENTRAL ASIATIC EXPEDITION.—Walter Granger and Albert Thomson are spending the winter months at the expedition's headquarters in Peking, busily engaged in preparatory work on the specimens collected during last summer, while J. MacKenzie Young is overhauling motors and equipment for next season's trip. Doctor Andrews will tell of some of the unusual hardships and difficulties of the season of 1928 in the March-April issue of *NATURAL HISTORY*.

THE CARLISLE-CLARK EXPEDITION has been brought to a successful conclusion, and all the material collected, including films and photographs, are now safe in the Museum.

Mr. and Mrs. G. Lister Carlisle, Jr., who very generously financed this expedition on behalf of

African Hall, left New York in April. Mr. Radatz, of the department of preparation, followed shortly after, to make preliminary arrangements. Mr. William R. Leigh, the artist selected to make studies in the field for the painted backgrounds, left in May, and Mr. James L. Clark, departed soon after. All the members met in Nairobi, Kenya Colony, about the middle of June, when final arrangements were made, and in a short time they were headed south in Tanganyika Territory, under the guidance of Mr. Alfred J. Klein, the professional hunter.

Two months were spent in virgin territory where Mr. Clark secured a very fine group of lions. As this country had not been hunted before, there were exceptional opportunities for the selection of fine specimens. Lions were found in the open in daylight, and thus could be care-

fully selected for types and condition. Seven specimens were collected, including a very large fine male. Mr. Klein stated that this was one of the five largest specimens he had ever recorded out of the five or six hundred he had seen shot.

Accessories for the groups, including trees, bushes, soil and rocks were also collected, and careful color notes of the leaves and flowers were taken to insure the finest results in design and detail.

Mr. Clark made a complete miniature scale model of the lion group in the field, which in itself established all the actual and natural records to insure final success. Mr. Carlisle, leader of the expedition, concentrated on wild life motion picture photographs and secured 8000 feet of really remarkable motion pictures of approximately thirteen varieties of big game, including the first pictures of a leopard ever taken and some exceptionally fine ones of lion. These, with Mr. Clark's close-up motion picture of two lions on a kill, are perhaps second to none. Hundreds of still photographs of the country, the people, and details for the group were also secured.

After the lion group had been successfully completed, the expedition moved to another section of Tanganyika, some eighteen miles south of Moshi, where they secured material and background studies for the lesser kudu group. A few odd specimens wanting for the African Hall collections, were taken as opportunity presented. Mr. Clark plans to begin the modeling of the lion group within a very short time, so that it may not be long before the public will see this important acquisition. The motion pictures are now being edited and it is hoped they will be ready for a showing to Museum members within a few weeks.

THE SANFORD-PATTERSON-LEGENDRE ABYSSINIAN EXPEDITION left New York on December 1, for Abyssinia, via Havre and Marseilles. This expedition has for its goal the collecting of a group of nyala, or mountain bushbuck, which will be mounted in the new Akeley Hall of African Mammals. The expenses of the party in the field are generously being met by Miss Gertrude Sanford, Mrs. Grace Patterson, and the Messrs. Sidney and Morris Legendre. Mr. John Sanford, father of Miss Sanford, has shown his great interest in the American Museum by offering to defray the costs of building the group and mounting the animals.

At the time of departure Mrs. Patterson was detained by poor health but hoped to join the party later. Mr. Gordon MacCreagh, who had recently returned from a lengthy sojourn in Abyssinia, was in charge of the expedition, and the

Museum sent as its representative Mr. T. D. Carter of the department of mammals. In addition to the specimens of nyala, the party plans to make as extensive a collection of study specimens as is possible, and to take still and motion pictures. Abyssinia is a region practically unrepresented in the collections of this Museum, and this is an unusual opportunity which the generosity of the Museum's friends has made possible.

TYLER-DUIDA EXPEDITION.—Letters from the Tyler-Duida Expedition have notified the Museum that Mt. Duida has at last been conquered. On October 24 Tyler and Tate managed to reach the summit after a hard struggle. For weeks prior to that time they had been engaged in a systematic campaign collecting at base camps near the foot of the high country, cutting trails, and otherwise preparing for a deeper penetration into this unexplored area. One of the difficulties in the way of the expedition is the fact that this region has never been mapped and the method of attack had to be very largely one of trial and error. The dense tropical forest, which prevented a comprehensive survey of the terrain, and heavy fogs on the mountain also hampered progress.

The ascent of Mt. Duida proved to be steep and arduous. Mr. Tate wrote that a series of ladders would have to be constructed to pass an interval of 900 feet before the main work of the expedition could go on. Following this preliminary reconnaissance, the party will move equipment up to base camps on the top of the elevated plateau and should secure material of great value and interest.

The Tyler-Duida Expedition is a joint undertaking by the department of birds and the department of mammals. The expedition was made possible through the generosity of Mr. Sidney F. Tyler, Jr., who is financing the work as well as taking an active part in it personally. Mt. Duida is situated in a remote section of Venezuela and the region has never been adequately explored by any scientific party. The progress indicated by these letters from the field shows that already the American Museum expedition has accomplished much. The successful conclusion of this undertaking will constitute an outstanding achievement in South American exploration.

THE STRAUS ABYSSINIAN EXPEDITION.—On January 19 the Straus Expedition sailed for a four months' trip to Africa to collect birds for the American Museum. The party, which includes Mrs. Oscar Straus, her grandson Mr. Edward Schafer, and Mr. and Mrs. Rudyard Boulton, plans to go up the Nile, through Uganda by automobile to Nairobi, and spend about two

weeks visiting the big game fields there. Mr. and Mrs. Boulton will then go on to Lake Nyasa to study and collect the birds of that region, and expect to return home by way of South Africa.

The expedition is made possible through the generosity of Mrs. Oscar Straus.

WILLIAM J. MORDEN, field associate in mammalogy, returned from Russia in December, after having visited Moscow, Leningrad, Tiflis, Batum, and Odessa. His purpose in visiting Russia was to obtain information and permits from Soviet scientists and officials in order that he might make his preparations for the Morden North Asiatic Expedition which will operate in Eastern Siberia beginning in 1929. He reports that he received every courtesy, and that the Soviet Government would be glad to assign a representative to accompany the expedition.

The plans for the Morden North Asiatic Expedition are now being prepared and will be announced later in NATURAL HISTORY.

TO HAITI FOR REPTILES.—Mr. Gilbert C. Klingel of Baltimore has organized an expedition to Haiti to study the life histories of reptiles of that island. He has sent many encouraging reports from the field, and has shipped 194 lizard eggs to be hatched out in the laboratories of experimental biology in the American Museum.

BARRO COLORADO ISLAND.—Dr. Frank M. Chapman is continuing his scientific studies of the birds on Barro Colorado Island.

ARTHUR VERNAY sailed recently for Bombay, where he hopes to obtain a pair of Indian lions for the Hall of Asiatic Mammals at the American Museum.

ASTRONOMY

DR. SETH B. NICHOLSON of the Mount Wilson Observatory in California gave a talk on January 2 before the Amateur Astronomers Association, in which he described how he has been measuring the heat from individual stars and planets by means of the thermo-couple. This instrument is so tiny that it is manufactured under a microscope, and when completed, weighs but a tenth of a milligram, or about one one-thousandth the weight of a drop of water.

At the JANUARY 16th MEETING, motion pictures of the planet Jupiter were shown to the members of the Association. These motion pictures, the first of their kind ever made, are the work of Prof. W. H. Wright of the Lick Observatory in California, and Dr. C. E. K. Mees, director of the Research Laboratory of the Eastman Kodak Co.

Many members of the Association took advantage of a wonderful lecture which Dr. Harlow Shapley gave on "The Galaxy of Galaxies" before the A. A. A. S.

ON FEBRUARY 6, Mr. Edward J. Gounod will speak on "Why Is Mars Red?"

ON FEBRUARY 20, Dr. John H. Pitman, professor of astronomy at Swarthmore College, will speak on "The Dimensions of the Stellar Universe."

BIRDS

NEW WOODCREEPER FROM PERU.—Among several new species of birds from Ecuador and Peru recently described by Dr. Frank M. Chapman (*American Museum Novitates* No. 332) is a remarkable woodcreeper from the Rio Ucayali to which he gives the name *Anachilus ucayalæ*. The bird is distinguished by the peculiar shape of the bill, in which the mandible or lower portion is strongly recurved or turned upward at the end. The occurrence of a similar type of bill in two other genera of woodcreepers and in a genus of antbirds, none of which is closely related to the new bird, is believed to indicate that this structure is due to parallelism of development. Whether it is related to the birds' manner of feeding is unknown.

THE NEW HALL OF FISHES AMERICAN MUSEUM

The opening on December 5 of the new Hall of Fishes at the American Museum marks the culmination of many years' work, begun by Dr. Bashford Dean, founder of the department of ichthyology, and continued by Dr. W. K. Gregory, its present curator. Addresses were given by President Osborn, Doctor Gregory, Doctor William Beebe, and Director Sherwood.

The lifelike groups and undersea scenes have been prepared by highly skilled artists and preparators, working under the direction of Doctor Gregory and of James L. Clark, assistant director of the Museum.

The darkened inner hall of undersea life contains a series of seven panels of deep-sea fishes modeled by Dwight Franklin, and represents a descending series of zones of fish life. The original materials and data for these groups were for the most part collected by the "Arcturus" expedition in the Pacific Ocean, in the neighborhood of the Galapagos Islands.

HISTORY OF THE EARTH

CHILDS FRICK TERTIARY-QUATERNARY EXPLORATIONS, 1928.—The search for additional evidence regarding the animal groups of the Late Tertiary-Quaternary, their differentiation, hori-

zons, and distribution, was carried on in six localities, including our widely separated New Mexican and Californian key stations.

The investigation of the difficult Miocene beds to the north of Barstow in the Mojave Desert, California, was continued for the eighth consecutive winter by Mr. Joseph Rak and assistants. The season's collections include particularly important material from the until recently believed non-fossil bearing strata, Joseph Rak Beds, which unconformably underlie the typical Barstow formation.

Work in the Hopi Indian Agency was resumed in the early spring by Mr. John C. Blick, assisted by Messrs. Charles Falkenbach and Joseph Rooney. The great Upper Pliocene pocket discovered there the past season was completely excavated by June first. It has yielded a grand total of forty-one large cases of skulls, jaws, and other remains of the huge extinct camel, *Megacamelus blicki* n.g. and n.sp., (facial fossa marked and $p \frac{2}{3}$ absent). Perfectly preserved skulls testify to a head in the flesh of over a yard in length, and limb elements to an occasional height at the withers in excess of eight and one-half feet. Partial reconstructions of this massive limbed beast and of a widely different and also newly discovered elongate-limbed form, *Altomeryx raki* n.g. and n.sp., from the Lower Pliocene of New Mexico have been temporarily installed in the Museum's camel alcove. This Arizona investigation was undertaken originally through the courtesy of the Department of Indian Affairs and the National Museum, and has been greatly facilitated by the Hopi Reservation's able superintendent, Mr. E. K. Miller. Mr. Blick, at the present writing, is in Central America investigating a reported occurrence of Pliocene mammals.

Researches were carried on in the Miocene, Pliocene, and Pleistocene to the north of Santa Fe, New Mexico, for the fifth full May to November season, the party as usual being under the capable direction of Mr. Rak. Our collections from this area are several times greater in size than collections from any other American Late Tertiary locality. Erosion annually uncovers material but that of the past season was secured only through hard and skillful work. The collections are rich in remains of horses, rhinoceroses, long symphysised mastodons, antelopes, and above all, of camel forms. The latter vary in size from a diminutive to a giant-giraffe-like species, in which the metatarsus (650 mm.) is four times the length of the former. A previously unrecognized uppermost horizon has yielded a widely different, heavy limbed camel suggestive of that of Arizona. The writer and Mrs. Frick

spent three weeks of September with Mr. Rak in study of the fossil occurrences and of interesting problems of local stratigraphy. The great carnivore, *Amphicyon*, seems to have been as rare locally as *Hemicyon* and has for the first time been checked as present. Replicas of the skull and jaw of our single *Hemicyon* have been given to several European and American museums including that of Santa Fe. *Aleurodon* wolves are common in the upper beds. A unique block holding the beautifully preserved, practically complete, and gracefully grouped skeletons of three young Oredonts (*Merychys medius* race *novomexicanus* n. r.) has been recently placed on exhibit in the American Museum.

The Pleistocene exposures along the Niobrara River near Hay Springs, Nebraska, were visited during midsummer by Messrs. Rak and Falkenbach, and subsequently a considerable amount of fragmentary material was obtained there by Mr. Falkenbach. The tapir has been added to the previously known fauna, and the Museum's collections of local camel remains more than quadrupled. On the basis of certain specimens with $p \frac{3}{4}$ typically present, *Camelus americanus* is transferred to a new genus *Prochenia*.

The exploration of beds of Devil's Gulch-Valentine Pliocene affinity, in the vicinity of Ainsworth, Nebraska, was continued for the second summer by Mr. M. F. Skinner, who has sent us additional specimens of rhinoceroses and long-chinned mastodons, dentitions of horses and a half dozen partial camel mandibles of the rare "*P. vera*" type.

Exposures in the neighborhood of Elephant Butte and Benson, Arizona, have for a second time yielded Mr. Rak, while en route to California, a small but useful collection of Late Tertiary and Pleistocene remains. Mr. Falkenbach will spend the coming months in further investigation of this southern Benson phase, where Dr. J. W. Gidley several winters past was so successful in obtaining *Stegomastodon* and *Glyptodon*. For the good reason that the handling, figuring, and preparation of material demand both time and skill, our little staff, Miss D. G. Tagert, Miss H. de Berard, Mr. Charles Hoffman, and Mr. Joseph Rooney, have been constantly occupied.

These explorations, originally undertaken for the purpose of obtaining through adequate collections from definite horizons a more exact knowledge of the history of the horses, have continued (as noted above) to yield a surprising number of camel specimens, which both in number and variety exceed the horses. Eventually the camels should afford a most valuable guide and check in the interpretation of fossil

evidence as to conditions existing in the American Late-Tertiary-Quaternary—including continental changes and the coming and going of animal forms. On the completion of the preliminary descriptions of the new camel species and the reclassification of the group, it is planned to exhibit the more striking of these forms in a new and much enlarged alcove in the Hall of Tertiary Mammals, so that the entrance to this hall will be flanked on right and left respectively by instructive series of the extinct American fore-runners of man's two most doughty helpmates—the camel and the horse.—CHILDS FRICK.

HONORS

DR. FRANK E. LUTZ, curator of insect life at the American Museum, has been made a member of the Committee on Experimental Animals and Plants recently appointed by the National Research Council. The functions of the committee are to make arrangements for central supplies of animals and plants of known value in experimental biology and to test hitherto unused species of promise.

MR. H. E. ANTHONY, curator of the department of mammalogy in this Museum, has been elected a fellow of the New York Zoological Society, a class of membership the qualifications for which rest upon scientific achievement.

CURATOR HERBERT P. WHITLOCK of the department of minerals and gems at the American Museum has recently been appointed honorary curator of minerals by the Trustees of the Wadsworth Atheneum at Hartford, Connecticut.

MEETINGS OF SOCIETIES

THE AMERICAN ASSOCIATION FOR ADVANCEMENT OF SCIENCE.—Once every twelve years this Association comes to New York during the Christmas holidays to hold its annual meeting. The fifth New York meeting, and the eighty-fifth in its history, convened from December 27, 1928, to January 2, 1929.

The convention proved to be the largest that has ever occurred in this country, with an attendance of about 5,000 men and women of science, drawn from the whole of English-speaking North America. A brief summary of the notable advances reported in science during 1928 will appear in the next issue of NATURAL HISTORY.

SCIENCE OF MAN

EASTER ISLAND STONE FISH HOOKS.—Easter Island is a land of mystery and romance, and anything that hails from its shores has unusual interest. Recently the department of anthropology received from Charles Nordhoff of Papeete,

Tahiti, a fish hook made of stone used by the natives of this island. The hook is a unique specimen of primitive stone work not heretofore represented in the Museum's collection. It is exquisitely finished and in every way a fine example of Easter Island art. Some time ago Doctor Gudger of the department of fishes made a detailed study of the Museum's collection of fish hooks from the islands of the Pacific Ocean, which appeared in the *Anthropological Papers*. This publication attracted a great deal of attention, especially among students of primitive and prehistoric fishing in the South Sea Islands, and encouraged them to take up new investigations. Mr. Nordhoff is making a detailed study of fishing among the natives of the Society Islands, and coöperating with Doctor Gudger in determining the distribution of fishes in the Pacific Ocean. The Museum is indebted to Mr. Nordhoff, not only for the gift noted above, but for many past courtesies.—C. W.

AFRICAN WOOD CARVINGS FOR THE AMERICAN MUSEUM COLLECTIONS.—Mr. George D. Pratt has presented to the Museum some wooden statuettes and a bronze casting made by the Negroes of west Africa. Native African carving in wood and ivory is recognized as one of the world's most characteristic types of art. While it is true that a certain grotesqueness pervades African carvings, yet there is symmetry and beauty of form. The educated Negroes of America are taking an intelligent interest in this art as a part of the æsthetic heritage of their race. The Museum now has collections from the Congo and adjacent parts of Africa in which wood carving is well represented.—C. W.

THE MUSEUM ACQUIRES IMPORTANT SERIES OF ESKIMO HAIR SAMPLES.—Among other interesting materials brought back by Mr. Edward M. Weyer, Jr., archæologist on the Stoll-McCracken Expedition, are a series of measurements of one hundred Eskimo men. In addition he was equipped with a set of Binet tests by which their mental rating could be made. This is probably the first attempt to apply a series of such tests to an adult Eskimo. That Mr. Weyer is a diplomat when among such people is further indicated by a complete collection of hair samples. According to Eskimo belief, giving away a lock of one's hair puts one in the power of the recipient. Consequently, asking an Eskimo for a lock of hair is about the equivalent of asking him for his life. Nevertheless, Mr. Weyer convinced them that he could be trusted and so came away with a full series of hair samples. These samples are an important addition to the Museum's collection, in which is

to be found authentic hair samples from different races of the world. Such a collection is important, because hair is one of the outstanding racial characteristics, a character in which there is the least variation and, therefore, one of the best characters by which to make classifications of racial types.—C. W.

MASKS MADE OF WHALE BONES DISCOVERED ON THE ALASKAN PENINSULA.—The recently returned Stoll-McCracken Alaskan Expedition brought two unique masks carved from bones of whales. These masks were found by Edward M. Weyer, Jr., archæologist of the expedition, while digging in a shell-heap on the Alaskan Peninsula. No masks made of whale bones have been reported, and while it seems likely that these were made by an Eskimo people, they were in a deep deposit and so of considerable age. They also show a high degree of workmanship and unusual symmetry of form.—C. W.

ALEUTIAN BURIALS.—In a recent number of *NATURAL HISTORY* appeared an article on the Aleut of the Aleutian Islands in which, among other information about their daily lives, was an account of the peculiar way in which they used to prepare their dead for burial. The Stoll-McCracken Expedition discovered such a burial on a small rocky island of the Aleutian chain. The tomb was constructed with logs carefully fitted together and enclosing three bodies. Two of the bodies are well preserved like mummies enclosed in wrappings. Most unique of all is the head of one body found in a fine condition, fully equal to that of the best Egyptian mummies. These Aleutian mummies have been placed on exhibition in the Museum and the discovery of this tomb is important in that it gives us complete information as to the mode of burial formerly practiced by these natives. Also, the costumes and other objects accompanying the mummies will give data as to the weaving and tailoring arts of the Aleutians. The idea of the Aleuts was to keep the dead with them as long as possible, so the bodies were preserved as well as they knew how. The procedure in brief outline was to open the abdomen, remove the viscera, close the body, and then wrap the whole in skins. Prepared in this way, the flesh dries hard and a true mummy results. Ultimately, these bundle bodies were placed in dry caves in the rocks or in tombs built of logs, as was the case in this instance.—C. W.

CHARLES SHELDON

In the death of Charles Sheldon, on the 23d of September, 1928, the country loses one of its

foremost conservationists and the Boone and Crockett Club one of its most active members.

Charles Sheldon, after graduating from Yale in 1890, spent four years in Mexico in the railroad business. During this time he made many hunting trips into the least known parts of that country and acquired an extensive first-hand knowledge of its wild life. Returning to the United States, he decided to devote his time to exploration and hunting in Alaska and Mexico, with especial reference to the distribution of the various species of mountain sheep. He first went to Alaska in 1902 and in the following years explored the mountains of southeastern Alaska and the adjoining parts of British Columbia, where he hunted in the Cassiar Mountains and the ranges lying to the north. In pursuit of his favorite study of the big horn sheep, he passed an entire winter on the northern slopes of Mt. McKinley, and he later hunted in company with Frederick Courtney Selous in the headwaters of the Lewes and Hootalinqua Rivers.

The specimens he secured in these hunting trips he forwarded to the National Museum at Washington, where he worked in close coöperation with C. Hart Merriam and E. W. Nelson. The results of all these expeditions to Alaska and British Columbia have been embodied in a series of books, the best known of which were entitled, *The Wilderness of the Upper Yukon* and *The Wilderness of the North Pacific Coast Islands*, 1912.

After his marriage in 1909 to Miss Louise Gulliver, he settled down in Washington, D. C., spending his summers in Nova Scotia and making occasional trips to his old hunting grounds. He devoted himself to the interests of the Boone and Crockett Club, of which he was First Vice-President at the time of his death. For many years he represented the interests of this club at Washington.

He developed the laws of game conservation along the European ideas of administration of game. In this matter he was in advance of his countrymen, since, as yet, few of them realize the necessity of "administrating" game as it is done in Europe. The reckless depletion of our game supply will soon force all Americans to accept his views on this subject.

Much of Mr. Sheldon's time in recent years has been devoted to the collection of a library which is absolutely unique in the field of hunting and conservation. This collection of books represents a large outlay and should be kept as a unit. Efforts to accomplish this end are being made by his friends.

Mr. Sheldon's death occurred suddenly in his camp in Nova Scotia.—MADISON GRANT.

PETER SUSHKIN

THE ACADEMY OF SCIENCES in Leningrad announces the sad news of the death of Prof. Peter Sushkin on September 17, 1928, at Kislovodsk, Caucasus. A special celebration had previously been planned for October in honor of Professor Sushkin's fortieth year of scientific research and educational activity. The American Museum of Natural History shares in the deep sorrow at the passing of this eminent ornithologist and palæontologist.

CHARLES H. GARDNER

In the death, on December 7, of Charles H. Gardner, a Vice-President and Manager of the 79th Street Branch of the Colonial Bank, American Museum employees have lost a friend who for more than twenty-five years gave them his most helpful assistance, and the Corporation has lost one ever willing to serve it. No appeal for his experienced judgment was ever denied and none ever found him other than considerate and courteous.

Mr. Gardner's kindly attitude and genial personality made for him a large circle of friends who greatly deplore his sudden and unexpected death.

LOUIS AGASSIZ FUERTES
IN MEMORIAM

February 7, 1929, marks the 55th birthday anniversary of Louis Agassiz Fuertes, whose untimely death by accident at a railroad crossing near Unadilla, New York, on August 22, 1927, brought to a close an unusual career as one of the leading bird-life painters of the world.

He has created well, since we partake
Of countless treasures here that bear his mark.
For him there is no terror in the dark:
Where soon the throbbing, golden dawn will break.
His feathered friends that with tomorrow wake
And sing their hearts away:—the meadow-lark,
The thrush, the chickadee, with song embark
Upon their journey, though their throats must ache
With dismal longing, since he hears them not.
Grant that he rest within some silent spot
Beloved by him, when evening shadows fall:
A garden filled with flowers, moss, and grass,
Where he can hear the autumn winds that pass
And spattered rain upon an ivied wall.
So will he dreamless sleep, and well-content,—
With bird and tree for earthly monument.

—MARGUERITE JANVRIN ADAMS.

BOOK REVIEWS

Coming of Age in Samoa, by Margaret Mead, Ph.D. William Morrow, New York City, 1928.

Dr. Margaret Mead, associate curator of ethnology in the American Museum, is now on her way to the South Pacific to continue her studies of adolescent girls among the native populations. Recently she brought out a book *Coming of Age in Samoa*, presenting some aspects of her earlier studies along this line among the Samoans. Some thirty or more years ago, the

late G. Stanley Hall led a movement in this country for the study of adolescence as the critical transition period in life. According to the conception of the time, the adolescent period was regarded as the critical stage in the individual's development, especially with respect to morals, religion, and general social adjustments. From that time to this our own youth have been studied intensively, more intensively than in any other country. So far, however, little attention has been paid to the comparative study of adolescence among other types of civilization and among primitive peoples. Doctor Mead's book is therefore a welcome contribution, since it gives us for the first time a picture of adolescence in a primitive tribe. The author presents clearly and directly the main features in the life of the adolescent girl in Samoa, as well as the social setting in which she must find her way. The author sees a sharp contrast between the situation confronting the Samoan adolescent girl and that confronting our own children, a situation due in large part to the simple, easy-going life of the Samoan. Doctor Mead believes that the adolescent who has trouble in adjusting herself to Samoan society is the exceptional girl who is ambitious to be recognized by her elders and to achieve something worth while, whereas the ideal of Samoan civilization seems to be an easy-going, complacent life, accepting conditions as they come. In our own society, the author believes that the reverse is true, that the adolescent who is so complacent that nothing much matters is the one that gets into trouble and develops a case of maladjustment. However this may be, the thoughtful adult will find the book provocative of reflection upon the more intimate aspects of life.—CLARK WISSLER.

"BLAZING THE TRAIL TO THE
DISTANT PAST"

The cover design for this number of NATURAL HISTORY is reproduced from another painting by Mr. Arthur A. Jansson of the American Museum staff, and represents a party of palæontologists uncovering a fossil skull of the dinosaur *Tyrannosaurus*. In the distance, outlined against the sky, is the artist's conception of what these scientists are able to visualize as they struggle with the huge fossil skull. *Tyrannosaurus* was, during the Cretaceous period, the most terrible of all the "terrible lizards"—a beast of prey before whom even *Triceratops*, the greatest of the horned dinosaurs, probably fell. *Tyrannosaurus* attained a length of about thirty-five feet, and was surpassed in size by other creatures, but no other dinosaur yet discovered had such powerful jaws and teeth.

OUR CONTRIBUTORS

Young aspirants to the art of paleontology will be interested to know that in the year 1876 **Henry Fairfield Osborn**, the author of "The Revival of Central Asiatic Life," began hunting invertebrate fossils in the Paleozoic beyond the Catskill Mountains; in 1877 and 1878 he was chosen leader of a party of Princeton students in a hunt for fossil vertebrates in Wyoming, and between these two expeditions he worked very hard cleaning and preparing and illustrating fossils. In 1890 after several years' research in comparative anatomy, he resumed fossil cleaning and preparing and describing in the top of an old elevator shaft of the American Museum with Doctor Wortman, and thus with a handful of fossils from the Wasatch Mountains was established the Department of Vertebrate Paleontology which, with the cooperation of a series of great fossil explorers—Wortman, Granger, Brown, Peterson, Gidley, Kaisen, Olsen—is filling the six great exhibition halls of our Museum and rewriting the paleontological history of the world. Meanwhile hundreds of pamphlets, bulletins, and volumes were issued describing these fossils, including in 1890 a prediction regarding the ancient fossil life of Central Asia, which has been brilliantly verified by Andrews and Granger as partly described in the present article.

Henry Field, author of "Early Man in North Arabia," is one of the most promising recruits in the younger school of American archaeologists who are specializing in the Old Stone Age of western Europe. Beginning his original archaeological studies in England, France, and Spain, he is now extending his work into the Near East, Palestine, and Syria, which promise to form the connecting half-way point between the European and Central Asiatic archaeology of the Stone Age. The Field Museum of Chicago, now under the acting direction of Stanley Field, has entrusted to Henry Field the design and arrangement of the entirely unique exhibition hall in which the various phases of the Stone Age are shown somewhat after the manner of the habitat groups of zoologists. *NATURAL HISTORY* is indebted to the Field Museum for the opportunity of publishing the present narrative of Henry Field's reconnaissance in Syria.

H. E. Anthony, who tells of the quest of the Schooner "Morissey" to the Arctic for walrus, and how, homeward bound, she beat the ice packs crowding down from the Polar Seas, has traveled more than 100,000 miles on expeditions in North, South, and Central America, the West Indies, Africa and the Arctic. Mr. Anthony began collecting mammals while he was still in high school, and he had more than 1500 specimens before his association with museums left him no further time for private collecting. His first trip for the American Museum took him to Lower California with Dr. C. H. Townsend in 1911. Since that time he has been a member of the department of mammals of the world at the American Museum. He is the author of *A Field Book of North American Mammals*, as well as a frequent contributor to *NATURAL HISTORY*.

Dr. Chester A. Reeds is familiar to the readers of *NATURAL HISTORY*, through the many fascinating and instructive articles on geology and fossil invertebrates that he has contributed for many years. "When Winter Comes" is cramful of information about such everyday things as how snow, ice, sleet, hail, and frost are formed.

Wilmatte Porter Cockerell has accompanied her husband, Prof. T. D. A. Cockerell of Boulder, Colorado, on

countless expeditions through many strange lands, and her experiences have been presented to the public in lectures and articles. She has done much original research work in botany and with Prof. Cockerell, developed a new species of sunflower in her sunflower garden at Boulder in 1910. Her article in this issue of *NATURAL HISTORY* entitled "New Caledonia—A Fragment of the Ancient World" will interest many of our readers who like to study every angle of the history of this old world of ours.

Dr. Clyde Fisher's practical experience in the schools of Ohio and Florida, his training at Johns Hopkins University where he received his doctorate in botany, together with his enthusiasm as a teacher, have developed to a high degree his natural, rare talent of stimulating interest, and imparting knowledge to young people. He has been a member of the education department of the American Museum for fourteen years, and has rendered exceptional service in promoting the growth of the Museum's methods of visual instruction. His article "How Nature Plants Her Flowers" is a charming example of his method of sharing his wealth of botanical knowledge.

The group of insects which includes flies and mosquitoes and which contains more than twice as many species as there are vertebrates, including birds and fishes, has been a subject for particular research on the part of **C. H. Curran**, assistant curator in charge of Diptera, at the American Museum. He tells in "Mosquitoes and Other Flies" of some of the strange habits of these common insects, as well as of the remarkable forms and beauty with which they are sometimes endowed. Mr. Curran came to the Museum from the entomological branch of the Department of Agriculture, Ottawa.

Observations made during eight years in the Indo-Australian region form the basis of the present article on "Strange Animals of the Island Continent" and of other articles which **Henry C. Raven** has contributed to *NATURAL HISTORY*. Mr. Raven, who is associate curator of the department of comparative and human anatomy at the American Museum, has done extensive zoological field work in the Dutch East Indies, Africa, Australia, and Greenland.

Of all the gallant companions of Roald Amundsen on that now historic airplane flight to the Pole in 1925, and the Transpolar Flight of the dirigible Norge in 1926, from Spitzbergen to Alaska, no one held a deeper or more lasting friendship for the great Explorer than did **Lincoln Ellsworth**. His tribute to the sterling qualities of this heroic personality of the world's famous polar explorations appears in this issue under the title "Roald Amundsen."

William G. Hassler, a new contributor to *NATURAL HISTORY*, originally planned to perfect himself in electrical engineering. He spent his summers at the Boy Scout Camp at Bear Mountain, and became so interested in studying the reptiles and amphibians of that region that his knowledge of these creatures soon fitted him for a position on the camp staff. Later he was invited to affiliate himself with the department of herpetology and experimental biology at the American Museum, where the care of the live reptile material is his responsibility, together with the preservation and supervision of the study collections of that department. Some of his experiences in hunting salamanders are told in "Salamanders of the Great Smokies."

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The increased facilities of the new School Service Building make it possible to greatly augment the Museum's work not only in New York City schools but also throughout the country. Fourteen million contacts were made during 1928 with boys and girls in the public schools of New York and the vicinity alone. Inquiries from all over the United States, and even from many foreign countries are constantly coming to the School Service Department. Information is supplied to, and thousands of lantern slides are prepared at cost for distant educational institutions, and the American Museum, because of this and other phases of its work, can properly be considered not a local, but a national—even an international—institution. Through its loan collections, or "traveling museums," which are circulated locally, 557 schools were reached last year, and 72,282,192 direct contacts were made with the pupils. More than a million lantern slides were lent to the New York City schools, and 4,851 reels of the Museum's motion pictures were shown in 223 public schools and other educational institutions in Greater New York, reaching 1,576,249 children.

Lecture courses, some exclusively for members of the Museum and their children, and others for schools, colleges, and the general public, are delivered both at the Museum and at outside educational institutions.

For those interested in scientific research or study on natural history subjects, the Library, containing 115,000 volumes, is available, and for the accommodation of those who wish to use this storehouse of knowledge, an attractive reading room is provided.

Many publications, both popular and scientific, come from the Museum Press, which is housed within the Museum itself. In addition to *NATURAL HISTORY*, the journal of the Museum, the popular publications include many handbooks, which deal with subjects illustrated by the collections, and guide leaflets, which describe individual exhibits or series of exhibits that are of especial interest or importance. These are all available at purely nominal cost to anyone who cares for them.

The scientific publications of the Museum, based on its explorations and the study of its collections, comprise the *Memoirs*, devoted to monographs requiring large or fine illustrations and exhaustive treatment: the *Bulletin*, issued in octavo form since 1881, dealing with the scientific activities of the departments, aside from Anthropology; the *Anthropological Papers*, which record the work of the Department of Anthropology; and *Novitates*, which are devoted to the publication of preliminary scientific announcements, descriptions of new forms, and similar matters. The Librarian of the Museum, who may be addressed in care of the Museum, may be called upon for detailed lists of both the popular and the scientific publications with their prices.

Expeditions from the American Museum are constantly in the field, gathering information in many odd corners of the world. During 1928 thirty-four expeditions visited scores of different spots in North, South, and Central America, Asia, Africa, and Polynesia, and nearly as many are now in the field continuing last year's work or beginning new studies.

From these adventuring scientists, as well as from other members of the Museum staff and from observers and scientists connected with other institutions, *NATURAL HISTORY MAGAZINE* obtains the articles that it publishes. Thus it is able to present to the constantly enlarging membership of the American Museum the most fascinating and dramatic of the facts that are being added to the Museum's knowledge, or are deposited in this great institution.

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The Journal of The American Museum of Natural History

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THE CENTRAL ASIATIC EXPEDITION IN THE SHADOW OF THE GREAT WALL
The expedition's motor cars stop while the members have lunch on the way to the Gobi Desert
See "Further Adventures of the American Men of the Dragon Bones," Page 115.

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XXIX

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FURTHER ADVENTURES OF THE AMERICAN MEN OF THE DRAGON BONES

An Account of the Activities of the Fourth of the Central Asiatic Expeditions
in Their Work of Reconstructing the Pre-history of the Vast and Arid
Region Which Includes the Gobi Desert. Further Proof that Central
Asia Was One of the Chief Centers from Which the Reptilian and
Mammalian Life of Europe, Africa, and America Radiated

BY ROY CHAPMAN ANDREWS

Leader of the Central Asiatic Expeditions
and Curator-in-Chief of Asiatic Exploration and Research, American Museum

PANIC among the foreign population of China is rare. In fact I had never seen anything approaching a panic there until I reached Peking in April, 1927. Then I found most of the foreigners thoroughly scared. Even the year before, when the gates of Peking were closed and sand-bagged, and Chang Tso-lin's wild Manchu hordes were looting and burning the country-side, few foreigners in the capital were even nervous. Dinners and dances, polo and tennis went on as gayly as before.

But in the winter of 1926-27 the Han-kow and Nanking outrages had been perpetrated. I need not enlarge upon the details. It is a disgraceful page in China's modern history. The result was to inflame the anti-foreign feeling which exists

in the hearts of most Chinese. The murder of white residents and mysterious disappearances of others happened frequently. All legations had ordered their nationals to the seacoast. Every ship that left China was packed to the rails with missionaries, merchants, and others who had resided for years in a country which had suddenly gone mad as though smitten with an attack of the rabies.

Such was the situation when I arrived in Peking in early April. It was a pretty hopeless outlook for continuing the work of the Central Asiatic Expedition in Mongolia. Even had we been able to get the expedition away from China, the American Minister would have prohibited our leaving. Common sense dictated that policy. Still, it was rather disheartening



THE EXPEDITION LEAVES FOR THE GOBI

Escorted by a troop of fifty Chinese cavalrymen, the expedition starts across the plain beyond Kalgan to the foot of the pass near Wan Chuan Hsien



THE LEADER OF THE CAMEL TRAIN REPORTS

Doctor Andrews greets the leader of the camel train, which, because camels are slow-moving beasts, has been on the trail for many weeks longer than the automobiles



THE CAMEL TRAIN ARRIVES

Doctor Andrews and Tserin, the leader of the camel caravan, go out to meet the newcomers who are arriving with the all important supplies



TRANSFERRING SUPPLIES

The camel train having arrived with supplies, the goods are checked and repacked for transportation in the cars and for use in camp



A LINK WITH CIVILIZATION

A telegraph operator of Northern China and his family, with their sole means of transport

to face another season of inaction, for heavy fighting about Peking had prevented us from going the previous year.

It looked very much as though everyone would have to leave China, and we proceeded to liquidate certain immovable effects of the expedition, to put others in a place of comparative safety, and to reduce current expenses to the minimum. I decided to hang on during the summer and winter, hoping that one of those sudden changes that so frequently happen in Chinese politics would give some encouragement for an expedition in 1928. The hoped for happened. Chang Tso-lin raided the Soviet Embassy in Peking and disclosed world-wide plots. North China quieted almost in a day. Still it was months before foreigners were allowed to return to the interior. Then they began to trickle into the back country without the official sanction of their legations.

I had promised to cable the Museum by the first of February if the staff were

to come out for the spring expedition. At Christmas it looked bad. By mid-January there were slight signs of improvement. It all depended upon whether I had guessed right as to what would happen. Anyway, I decided to gamble and wired for the staff to come.

It would take too long to describe the delicate diplomatic negotiations which had to be carried on to get the expedition away. It is enough to say that they were successful. We slipped out during the month of comparative calm which I had anticipated would precede the usual spring offensive.

For 120 miles north of Kalgan the plateau swarmed with bandits, all soldier deserters. Nothing could pass unmolested without an arrangement with the brigands. We made such an arrangement. The brigand transit tax cost me two dollars and a half each camel. The regular price was five dollars, but we got cut rates because the bandit chief was an



A SHRINE IN THE DESERT

This Mongol shrine is situated in the vast expanse of the Gobi at a spot called Lybaghrin Gol



DESERT ENTERTAINMENT

For the amusement of these native callers, the electric victrola played the latest tunes from America



"THE TREE"

This lone tree was the first seen by the expedition in Mongolia, and advantage was taken of its shade at lunch time



"NAVIGATING" IN THE DESERT

Hill and Granger, with the aid of a Gurley transit, determine the position of the expedition by taking the elevation of the sun. As it is being used here in the desert, the transit takes the place of the sextant, which is used at sea



GATHERING DATA FOR A MAP OF THE DESERT

Throughout most of the country traversed, the expeditions have made maps as they have advanced, thus adding exact topographical knowledge to their great fund of palæontological information



NEW USES FOR AUTOMOBILE TIRES

In the Gobi even the camels sometimes travel "on tires." A cameleer is shown here sewing a section of the tread of a tire over a wound in a camel's foot. It is no more painful to the animal than is the process of shoeing a horse, and the cut is thus protected



THE FURIOUS WINDS OF THE GOBI

No photograph can even vaguely suggest the force of the desert wind. This straining tent, torn by the wind, illustrates an important phase of desert conditions

old friend and he knew that our camels carried nothing that his men could use or dispose of. But we refused to pay the one hundred dollars fee for each of our eight motor cars which the brigands demanded. I felt sure that we could protect ourselves against several hundred robbers. The American Minister, Mr. J. V. A. MacMurray, with his wife and sister, accompanied us to the top of the plateau when we left Kalgan on April 16. His presence was an enormous help to us in our departure. We owe him and all the legation staff our sincerest thanks for the splendid support they have given all our expeditions.

The first day's run through the bandit country was interesting, for we expected to be attacked at every village. But the brigands were afraid to meet us in open fight even though there were some three hundred in the vicinity. They tried to trick us into stopping at a fortified village, but the plan did not work. We knew the habits of the species too well!

Our first working camp was at Shara

Murun about three hundred miles northwest of Kalgan. We had discovered the locality the previous year and had done some prospecting there. It was Eocene and very rich. All our plans had been made to explore Inner Mongolia westward to Turkestan. Sven Hedin, the famous Swedish explorer of Tibet, had gone that way, but our work was somewhat different than his and we hoped to find a new route.

While Granger carried on palæontological studies at Shara Murun, I went with some others to hunt a western trail. We found that the one Hedin had followed was the only possible route unless we crossed into Outer Mongolia. That we could not do, as we had no permits. Still it seemed wise to go west and we sent the camels forward.

On May 5, while hunting antelope, I sustained an accidental wound in the left leg from my heavy .38 caliber revolver. The bullet entered in the middle of the thigh, ranged downward, and emerged below the knee. By a miracle it did not



SCANNING THE DESERT FOR SIGNS OF A TRAIL

In the vast expanse of the Gobi there are few trails and the possible routes are difficult. Doctor Andrews is shown here as he attempts to lay out a route for the expedition to follow



THE LEADER OF THE CENTRAL ASIATIC EXPEDITIONS

Roy Chapman Andrews, in camp at Urtyn Obo, takes time to feed two pet eaglets captured in the desert. Appropriately enough, he is using chopsticks with which to feed these Mongolian birds



COOLIES BRINGING IN A FOSSIL

This is the first step, after excavation, that the fossils take on their journey half way around the world to the halls and workshops of the American Museum



THE CAMELS SUPPLY PACKING FOR THE FOSSILS

Fortunately, the camels begin to shed just as the expedition needs material in which to pack the fossil treasures. The great bunches of camel hair, ready to fall off, are consequently carefully garnered in order to protect the fragile fossils



THE DESOLATION OF THE GOBI

This difficult bit of terrain is a portion of the badlands at Urtyn Obo

smash the joint; otherwise I should have had a stiff leg for life. Doctor Perez, our surgeon, did a splendid job in getting me fit again.

The accident delayed us nearly a month, during which the members of the staff were busy whenever the sand storms gave them an opportunity to work. The fossil deposits proved to be moderately good and the archæological stations interesting. Therefore no time was lost except through the weather. For six weeks we had just one terrific sand storm after another. Never have I seen such continuous bad weather. Many days it was impossible to work at all, and the nerves of all the men became strained to the breaking point. We were glad enough to leave as soon as I was able to travel.

The western trip proved to be bitterly disappointing. Not only did we find no fossil deposits but the country was so blanketed with loose sand that motor travel was impossible. It is really an extension of the northern edge of the Ordos and Alashan deserts and is quite

unlike the Gobi that we knew in Outer Mongolia. There the terrain is largely gravel, and motors can go almost anywhere. But toward Turkestan great areas of shifting sand and huge dunes make the country a desolate yellow waste, impassable for anything but camels. The archæologist, geologist, and topographer did find some things to interest them but it was a land of utter desolation. Thus the first two months of the expedition were a dismal failure.

The only thing to do was to turn back. It is hard for any explorer to do that. Still the pill was not so bitter, because there was a great area in Eastern Mongolia still unexplored. In fact it was less known than the country which we were in. We had intended to explore it next season. We would do it now, instead, and leave the west to Sven Hedin.

It proved to be a wise decision. Back-tracking by forced marches to the Shara Murun, we stopped near Hospital Camp while five of us went off to make a reconnaissance of the eastern country. After



EXCAVATING A TITANOTHERE SKULL

This find was made in the lower white beds of the formation at Urtyn Obo

we had gone, Granger and Thomson made a great discovery of one of the richest fossil deposits in all Mongolia. Pond also found an enormous residence site of the Mesolithic and Neolithic Dune Dwellers, a culture discovered by Mr. N. C. Nelson, our chief archæologist in 1923. On our part, we learned that the east was well worth an extended exploration. New geological horizons were discovered containing a new fossil fauna.

Before we started eastward, the expedition remained for two weeks at Urtyn Obo, Granger's locality. It yielded a series of amazing mammals. Most spectacular of all is a giant beast allied to the *Baluchitherium*. It is certainly a new genus and is probably larger than the *Baluchitherium grangeri*, a skull of which we discovered in 1923. We obtained many parts of the skeleton, from several individuals. Also Shackelford discovered a skeleton which we judge to be more or

less complete. It is in such difficult matrix that much time and special preparation will be required for its removal. We therefore had to leave it for next year.

An extraordinary titanothere, unlike any other known form, rhinoceroses of new types, carnivores, and parts of the giant piglike animal *Entelodon* came out of the red and white badlands at Urtyn Obo. The deposit was merely scratched during our two weeks' stay, but we hope to prospect it thoroughly next season. Last summer the expedition's staff was organized for reconnaissance and we could not settle down to intensive palæontological work without keeping many men idle.

The eastern exploration proved to be well worth while. A vast area of Pliocene deposits was discovered. Strata of this age is almost non-existent in the region of our previous explorations. In fossils, it yielded an extraordinary mastodon with



A RHINOCEROS OF THE GOBI

This photograph is of a prehistoric skeleton found at Gur Lung Khara



A FOSSIL FIND

Alonzo W. Pond, of the Central Asiatic Expeditions, is shown in this photograph at work excavating the skeleton of a primitive man in the Sha Kang Usu country

a shovel-like jaw which is one of the most amazing adaptations in the animal kingdom; also many other less spectacular but hardly less important specimens. Our topographer mapped thousands of square miles of uncharted country; the archæologist discovered more than a hundred stations of the Dune Dweller culture, giving a very clear idea of the life story of these primitive people. To me an interesting fact is that without doubt Mongolia 20,000 years ago was much more densely populated than it is today.

The summer of 1928 proved to be the hottest that any of us have ever known in Mongolia. For two weeks the temperature stood at 110° F in the tents and 140° F in the sun. At night the thermometer dropped to 70° F. This extraordinary change of 70° between night and day temperature worked havoc with our gasoline. Although we had devoted more care and thought to the packing of our gas than during any previous year, the loss was enormous. Out of 4000 gallons we lost nearly 1000 gallons. This was due to

the great expansion and contraction of the tins in the sun-heat and cool nights.

As a result our expedition ended two weeks earlier than we had intended. Nevertheless, we accomplished most of what there was to be done in the way of new exploration. When we were forced to return to Kalgan, we looked back over the results of the expedition with great satisfaction. There were 87 cases of fossils, containing some of the most extraordinary and important specimens that we have ever found in Mongolia; there were 15,000 artifacts in the archæologist's collections, giving the story of the Dune Dwellers in most of its phases. The topographer had mapped 3000 miles of virtually unknown country; the photographer had a superb collection of photographs and motion-picture film; the geologist had filled in many gaps in the geological column of Mongolia and elucidated the continental structure of thousands of miles. It was a good season's work, taken all in all, and we were well pleased.



DIFFICULTIES OF DESERT AUTOMOBILING

This car of the Central Asiatic Expedition has bogged down unexpectedly in a wet spot while on a scouting expedition to the west of the expedition's camp



Incubating king penguins of South Georgia, with Lucas Glacier in the background. Detail of the American Museum's now dismantled group

AT THE EDGE OF THE ANTARCTIC ICE

The Animals and Birds that Live Along the Perpetually Frozen
Shores of the Antarctic Continent,—Whales and Seals,
Sea Leopards, Penguins, and Others

By JOHN T. NICHOLS

Curator of Recent Fishes, American Museum

TO dwellers in north temperate latitudes, the Arctic is comparatively close at hand and holds little in the way of wild life that is outlandish, new, or strange. Periodically blizzards come whistling down out of the northwest and bury us in snow. Shore birds that nest on the far northern tundras pass regularly north and south along our beaches and marshes in the spring and autumn. The cool touch of the Labrador Current permits the same kind of white whale that Amundsen and Ellsworth saw from the dirigible "Norge," when the creature showed itself in an open lead near the North Pole, to disport for the edification of summer tourists in the Gulf of St. Lawrence; and along the Atlantic steamship lanes in winter the identical dovebies, or little auks, whose arrival will mark the return of spring for the Eskimos, are sometimes to be seen, flying about in

the air, or swimming under the water (with their wings as their chief means of locomotion).

But the Antarctic is different. That June is midwinter there is not its only contrast with the north. Instead of being an intangible point on a living, drifting ice pack which covers a wide, deep sea, the South Pole is situated on and surrounded by a high, more or less mountainous land mass. This Antarctic Continent has been buried under ice and snow for so many ages that such life as it may have had at some time in the distant past has ceased to exist. It is essentially dead year in and year out. No polar bear, no musk ox, no fox, or wolf, or hare, leaves its tracks across the frigid deserts of never melting snow and ice. No redpolls or snow buntings come flitting back with the low sun during that travesty of spring that comes in September and October to the far



Photograph by R. C. Andrews

FLUKES OF A HUMPBACK WHALE

This photograph of a diving whale was taken in the North Pacific, but the same kind of whale is also to be found along the edges of the Antarctic Continent

southern continent. No shore birds or wild fowl nest on the frigid slopes, which never, even for the shortest of seasons, thaw out. There is nothing in all Antarctica to compare with these creatures of the north.

On the other hand, this barren continent of snow and ice is surrounded by a comparatively ice-free Southern Ocean fairly teeming with life, which, for the most part—as regards the higher animals—is quite unlike that of the cold northern seas.

It is interesting to note that the area of the Antarctic Continent is almost the same as the area of the Arctic Ocean. Where, in the north, explorers make their bases on the edge of the land masses that extend toward the south, and turn northward to cross the floating ice pack, explorers in the south do the reverse. Their bases must be at the shore line of the

southern sea, from which they turn away in order to penetrate an ice-covered continent that extends to and around the pole.

Any Antarctic expedition, then, must have its base at or near the southern shore of the Southern Ocean, the northern boundary of which is climatological rather than physiographical, and may be said to lie along the northern edge of the Westerly Winds—that is to say, somewhat south of the thirtieth parallel of south latitude. The southern shores of Australia, of South America south of Valparaíso on the west and of Buenos Aires on the east, and the Cape region of Africa, all border on this ocean. It is the characteristic life of this Southern Ocean that Antarctic explorers encounter, and of which they tell us.

To begin with fishes, several kinds of sculpins are plentiful in the far northern



A SCHOOL OF KILLER WHALES

Drawing by Lynn Bogue Hunt

These ferocious mammals, which reach a length of about thirty feet, are common in Antarctic waters. They congregate in small schools and often attack whales much larger than themselves, tearing and devouring pieces from these great mammals



Photograph by R. C. Murphy

A SEA LEOPARD OF SOUTH GEORGIA

Napping contentedly on ice floes at the foot of Grace Glacier. His mouth is wide open in a comfortable yawn, and the flippers are crossed on the breast. This particular animal was shot by Dr. Robert Cushman Murphy. When dissected, it had in its stomach the remains of four king penguins with a total weight of 136 pounds

seas, and not dissimilar appearing species in the south were at one time classed with these. We know now, however, that the resemblances are superficial, and the southern forms belong to the family *Nototheniidæ*, peculiar to those waters.

Various whales, on the other hand, are like the northern whales, or show only slight differences which may or may not have been described. Photographs of humpback whales taken by Dr. Roy Chapman Andrews on the northwest coast of North America will serve equally well for southern waters.

The killer whale is apt to be very plentiful along the edge of the southern ice. Here also it is peculiarly dangerous, for it has developed the habit of bumping seals and penguins off the ice pans where they have taken refuge from this wolf of the seas. With such a habit well developed, the killer, which, naturally enough, does not differentiate between seals and men, might readily enough bump some careless explorer from an ice pan into the sea,

there to serve as the *pièce de resistance* for this fierce and always hungry diner. The killer seems to be the only whale that has the habit of deliberately raising its head out of the water and looking around—a highly disconcerting and apparently un-whale-like maneuver.

These killer whales, or orcas, remain throughout the year as far south as open water can be found. They are prone to keep together in schools of varying size, and it is said that they often break up heavy sea ice in their search for food.

Sperm whales are rarely to be seen in the cold waters of the far southern sea, although occasionally one is captured by the whaling stations of South Georgia, in the sub-Antarctic. Humpback whales (*Megaptera*) and fin whales of several species (*Balænoptera*) are common, however, even in the very shadow of the great Ice Barrier.

Far southern seals are of species unlike those in the corresponding north. The widely distributed sea leopard is a partic-



Photograph from the Australasian-Antarctic Expedition

AN ICE RAVINE IN ADÉLIE LAND

During the great Ice Age some 50,000 years ago, northern Europe may have presented scenes similar to this



Photograph by J. Innes Wilson

ROARING HIS DEFIANCE

Male sea elephant, surrounded by his wives at Cumberland Bay, South Georgia. These sea elephants are typically sub-Antarctic animals



Photograph by R. C. Murphy

A SEA ELEPHANT "PUP" OF SOUTH GEORGIA

The "pup" is pictured engaged in its principal occupation—sleeping. These animals grow to great size, sometimes weighing as much as two tons



Photograph by R. C. Murphy

SOUTH GEORGIAN TERN SITTING ON ITS SINGLE EGG

The bird permitted itself to be touched while on the nest because a snowstorm was in progress. In fair weather the terns are inclined to be shy



Photograph by R. C. Murphy

A MALE SOOTY ALBATROSS AND ITS OFFSPRING

The perch is a narrow ledge of a cliff at South Georgia. A broken ring of white feathers behind the eye of this finest of flyers gives it a perpetually astonished expression



Photograph from the Australasian- Antarctic Expedition

BELOW ZERO, AND AN EIGHTY-MILE GALE

Life in the Antarctic presents extreme perils and discomforts, as is shown by the above picture of a blizzard in Adélie Land

ularly interesting solitary and predacious species. The primary food of this creature is penguins, which, being numerous and unable to fly, fall readily enough before the attack of the active, spotted seal.

The great sea elephant, too, is a southern form. It has a cousin that is found north of the equator, but that branch of the family is presumably of southern origin. This ungainly beast does not live on the Antarctic Continent itself, but is common on certain of the sub-Antarctic islands that lie outside the zone of the ice packs.

The Southern Ocean is alive with birds—birds whose life and whose living are at sea. All of these, however, must, at some time during the year, repair to the land to lay their eggs and raise their young.

Perhaps the most dramatic of all these is the majestic wandering albatross—bird of the Ancient Mariner. Its narrow, bladelike wings, which may measure eleven feet or more from tip to tip, are beautifully adapted to its perennial task of riding the prevailing westerly gales. Only occasionally is this master of flight com-

pelled to flap its wings, even for a few strokes, and, helped not hindered by the strength of the wind, it sails serenely on, leaning far to one side or the other as its curving course takes it through the cold air. Sometimes the tip of a wing may cut knifelike through the water, before the bird tilts the other way and sails gracefully and powerfully away on the other tack.

Various smaller albatrosses are also plentiful. Among these, the dark-gray sooty albatross, with its long, pointed tail, is peculiarly graceful in the air.

The heavier-bodied giant fulmar, despite its relatively short wings, soars with equal ease and control in high winds. Spotted Cape pigeons, looking for all the world like real pigeons, except that they have the same sailing flight characteristic of the petrel-like birds of these stormy seas, follow the few ships in flocks in order to pick up scraps from the galley that are tossed overboard by the cook or the observer bent on attracting them. The more windy the weather, it seems, the more certain these birds are to be about



Photograph from the Australasian-Antarctic Expedition

SUB-ANTARCTIC CORMORANTS AT HASSELBOROUGH BAY

The brilliantly white breast and neck of this far southern cormorant distinguish it from the northern cormorants, which are generally dark



Photograph by R. C. Murphy

A GIANT FULMAR GUARDING ITS NESTLING

The cold blue eye and terrible beak of the parent are not its worst threats. It is capable of ejecting the contents of its stomach at an intruder, and its food is mainly carrion



Photograph by R. C. Murphy

A PAIR OF WANDERING ALBATROSSES

The male is tamping down the partly constructed nest with his huge webbed feet, while his mate sits serenely beside him



Photograph by R. C. Murphy

A JOHNNY PENGUIN AND ITS TWO CORPULENT YOUNGSTERS

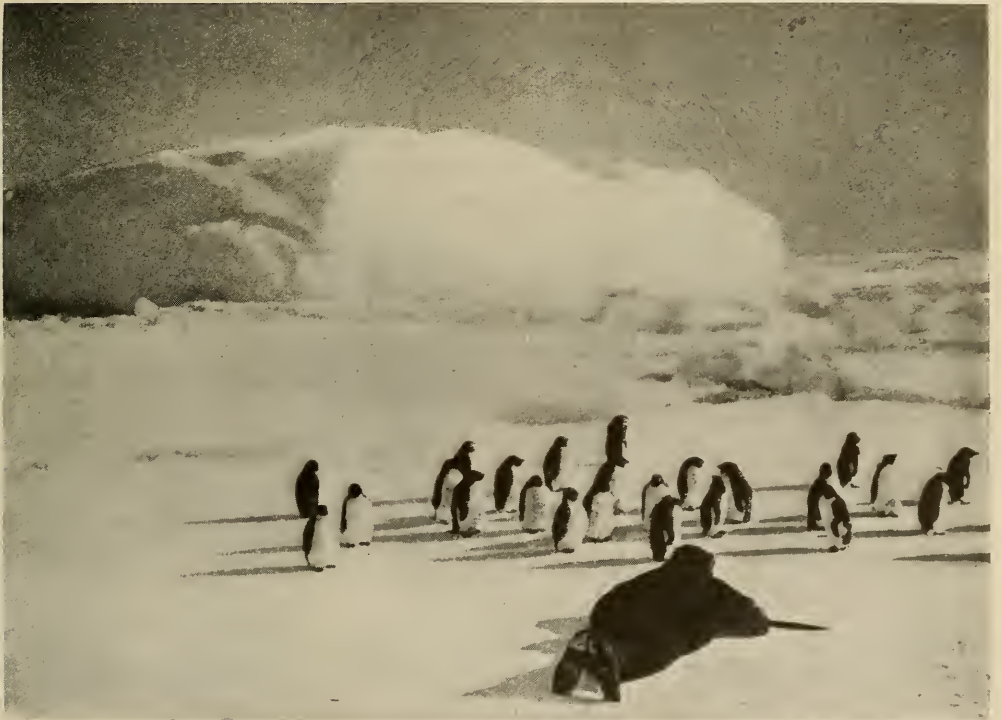
The Johnny penguins are roly-poly, interested in everything, and quite remind one of small boys. The chicks are anchored to the nest by the weight of their stomachs



Photograph by R. C. Murphy

A DASH INTO THE SEA

These three king penguins are entering the water from the beach of South Georgia. Bands frequently come out of the sea during the warmer part of the day to sun themselves on the beach



ADÉLIE PENGUINS IN THE ANTARCTIC ICE

These birds are quite fearless and courageous, and a human can easily come up close to them, but if they are mistreated, they are likely to become shy and hard to approach



Photograph by R. C. Murphy

A GIANT FULMAR'S NEST IN THE SNOW

Even when such birds are buried by snow, they do not leave the egg

any ship that may be voyaging in those tempestuous waters.

The silver-gray petrel (*Priocella*), Antarctic petrel (*Thalassæca*), and pure white snow petrel (*Pagodroma*) are similar in habits to the Cape pigeon, and the last two are seldom seen even so far north as the latitude of Cape Horn. The little blue-gray whale birds, which skim close to the water in the troughs of the waves, are in some places excessively abundant. Their peculiar color gives them an intangible appearance against the sea background, and was studied for low visibility by United States camouflage experts during the World War. A northerner is apt to think of comorants or shags as being—as a rule—almost as black as crows, but, in the Southern Ocean, species with glistening white lower parts are common.

Penguins are probably the most interesting and peculiar animals of the Southern Ocean. I once heard an intelligent ship's officer, who had long been familiar with them, express surprise and incredulity that they were birds at all. They were not seals, he realized, and they were certainly not fish or porpoises, but why call them

birds? However, penguins are true birds, though completely flightless and essentially adapted for a life in the sea comparable with that of seals. Their wings have degenerated into flippers, covered all over with small scalelike feathers and used only for swimming. They travel for considerable distances below the surface with brief periods of emergence for breathing. Some species, when traveling swiftly, leap or "roll" as porpoises do, and in general, when at the surface, they swim and behave much like seals. Most species can leap out of water to a height of three or four feet to land on an ice floe or a rock. They nest on desolate coasts or shore ice, sometimes in large close-ranked colonies. Animals that associate in flocks usually maneuver with a certain coördination and precision, that, in the case of this peculiar and almost wingless fowl, which stands more or less erect on feet placed close under its tail, give the illusion of ranks of trained soldiers.

The emperor penguin, which is quite the largest, stands about four feet high. It "nests," strangely enough, during the long Antarctic night (July to September) on the ice barrier on the coast of Ant-



Photograph from the Australasian-Antarctic Expedition

ON "THE NUGGETS" BEACH, MACQUARIE LAND

From rookeries on the hills, royal penguins come down in long processions each day to fish from the beach

arctica. During the period of incubation, the egg—of which there is but one—is carefully held on the bird's feet where it is covered by a fold of loose skin between the legs. This, on a little thought, will be seen to be an almost essential arrangement, for an egg placed on ice might be expected to go into permanent cold storage. Furthermore, the male and female take turns in thus brooding the egg, for, in the frigid temperatures of the Antarctic winter, even a short period during which the egg remained unprotected, would almost certainly be enough to freeze the contents of the shell.

The second largest, or king penguin, bears a close resemblance to the emperor, but is smaller—about three feet—and is sub-Antarctic in distribution. It has been studied and photographed at South Georgia by Dr. Robert Cushman Murphy, some of whose photographs have been used as illustrations in this article. There are other species of penguins, the smallest of which are about one half the size of the king.

As I have said, the higher forms of life in the far south are, for the most part, peculiar to it. Yet there are certain birds of northern origin to be found there. Furthermore, there are a few that actually migrate from the Arctic to high southern latitudes and return. The Arctic tern, after nesting in the far north, migrates south and crosses the equator. Just how plentiful it is in far southern

latitudes it is difficult to say because of the difficulty of differentiating it at sea from similar terns which breed in the south. The Arctic tern, of course, returns to northern regions with the sun to nest in the ensuing year, but perhaps these other terns, which nest on sub-Antarctic islands, are descendants of stragglers from such migrants, that failed to find their way back to their northern homes.

There are other birds to be found in the far south that are, undoubtedly, of northern origin. Among these are several species of the big robber gull, or skua,—birds with great powers of flight. One of these, observed by Sir Douglas Mawson on the Antarctic Continent 125 miles from the coast, may lay claim to being the most southerly of all birds. It is even conceivable that such a skua might cross the South Pole itself, flying from sea to sea, and who shall say that this has not been done—that birds, the most remarkable of migrants—are entirely without the true explorer's instinct?



Photograph by R. C. Murphy

King penguin of South Georgia tucking the egg into warm storage between its thighs after receiving it from its mate

Desolate and devoid of life the Antarctic Continent certainly is. But on its ice-encrusted shores and in the seas that break ceaselessly upon its titanic fringe of ice, Nature has made possible a wide range of unique and fascinating creatures, with which, as further exploration of the Antarctic is carried out, we shall become increasingly familiar.



A LANE
NEAR MARAGHA

FOSSIL BONES IN A PERSIAN GARDEN

Remains of Animals Caught by Streams and Buried in Their Deposits Fifteen
Million Years Ago Come to Light Amid the Fruits and Flowers of Persia

BY OTIS BARTON

This expedition was organized in the summer of 1928 by Messrs. Otis Barton and Eugene Callaghan, in connection with their studies in geology at Columbia University. The fossil remains of Pliocene mammals collected by the expedition were presented to the American Museum.—THE EDITORS.

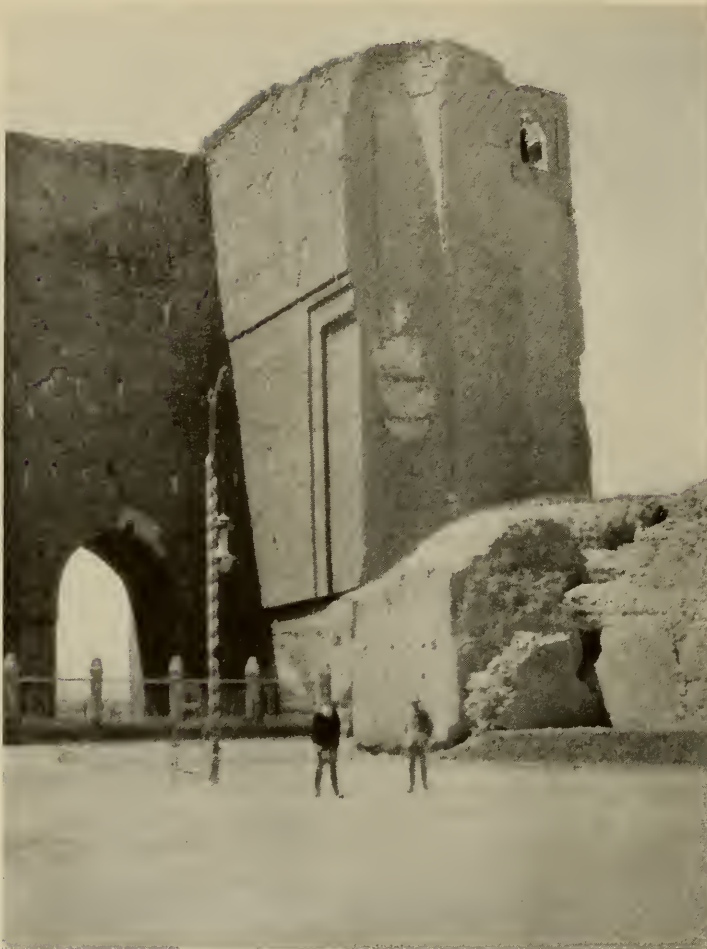
LANDING at Batum last summer, we found the Soviet officials courteous and eager to help an enterprise on behalf of the American Museum. The officers of the Near East Relief helped us with our baggage. But soon we were in trouble. I had forgotten to declare a Colt revolver, a very serious offense, for firearms may not enter Soviet territory, even in bond. Accordingly our boxes were ransacked, and we had to send our entire armament back to New York. Neither were cameras allowed, but ours were taken by the railroad in bond.

English-speaking guides not only helped us at the station, but they always refused to accept any tip, saying that their government did not allow it.

Our hopes of going to Western Turkistan to look for fossils were dashed on finding that no automobiles could be

obtained in that region, nor would we be allowed to import one, for in Russia automobiles are still an infant industry. At present the cost of construction is higher than in America.

We heard that there were rich fossil beds in Northern Persia, so we finally decided to turn our steps in that direction. Nor was the Persian border difficult to reach on the excellent state railroad. Leaving the squalid Asiatic town of Tiflis in the evening, we awoke next morning to find the train rolling over fertile green plains, with snow-capped Ararat ruling the western horizon. At the border the regulations of the U.S.S.R. again proved troublesome. Paper money may not be taken from Russia, and since no bureau of change was open, we were obliged to take a receipt for 80 rubles. This could only be cashed by returning



THE "ARC" IN TABRIZ

The origin of this ruin is unknown, but it was the only thing left standing after the great earthquake that completely destroyed Tabriz. In the old days, it is said, women who were found to be unfaithful to their husbands were hurled from the top of the tower

our way about with great difficulty, for the mud walls around the houses and gardens made the crooked streets look so much alike that we had difficulty in identifying them.

Our consul, Mr. A. W. Ferrin, took us to call on the governor. The day of our visit happened to be a sacred one. Passing through the bazaar, we saw throngs of young Moslems beating themselves on their bare backs with chains. The blows resounded in time to a dismal dirge, and each blow left a bloody streak. This ceremony is a chastisement for the murder of Husein some twelve hundred years ago.

His Excellency was exceedingly gracious. He gave us a letter to the police in

over the same route. Our baggage was again searched at length, so that it was with no small feeling of relief that we carried our iron boxes over the bridge into Persian Joulfa. Here automobiles were obtained, and under a full moon we swept southward through the Persian night.

Northern Persia is the greatest carpet market of the world. Even stables and garages have carpets on their floors, that elsewhere would grace a palace. The streets of the great bazaar at Tabriz are covered with carpets. Here we found

Maragha, where we wished to search for fossil bones, and offered every possible assistance.

Not often does the palæontologist fare as well as we did after reaching Maragha. It is set in the midst of gardens and orchards and is the fruit center of Persia. We were able to obtain five different kinds of grapes, watermelons at two for five cents, and walnuts at about a cent a pound. Chickens cost five cents each, and the bread came in great flat sheets from the mud ovens. It was the kind used



A BIRD'S-EYE VIEW OF TABRIZ

Looking west across the Armenian section toward the plains of Urmia



A VIEW FROM THE TOP OF THE "ARC"

This garden, which has long been a prominent landmark in Tabriz, is now turned into an open-air restaurant every evening in summer. Beneath it is an elaborate system from which water is dipped to irrigate the flowers and bushes



THE INTERIOR OF A LARGE CARAVANSERAI

Built originally to accommodate camel caravans, it now caters to modern automobile traffic

by the Romans and helped very much to piece out our supply of canned goods.

We pitched our tent in a shady stream bed, a day's pack ride with donkeys east of Maragha. Our equipment was carried in four iron cases. These rode well on mud guard, donkey, or camel, and in camp their handles could be padlocked together, thus making it impossible for a thief to make away with the whole chain of heavy cases. For rent we promised our army filter pump.

Fifteen miles to the north, Mount Sehend loomed serene and hazy, quite otherwise than in the early Pliocene when this range blazed in a line of volcanoes. At that time several rivers flowed down past the present site of our camp into a sea to the south. Of this sea Lake Urumiah is a remnant.

The surrounding country is today a rolling desert. The hills are of yellow marls and conglomerates deposited in the

Pliocene by the rivers from the north. But now the small streams are used by the poor folk of the mud villages to irrigate their fruit trees. These people are peaceable and docile, if one leaves their mosques and their women alone. We employed an old man, formerly with a German expedition, three workmen, a water boy, and a donkey, for less than three dollars a day. For this they arrived at our tent at dawn and worked till dark.

At first we searched the various dry stream beds and draws. Here and there weathered bones were noticed in the dry bare banks. We marked the best places for preliminary surveys. One of the hardest tasks, especially when time is limited, is to determine at exactly what spot to expend the effort of digging. After a few days of exploring, however, we chopped down the bank in two or three places. Our steel pick cut the soft sediment and laid bare the hard white bones. We

usually hacked away at random until a jaw or tooth was exposed by which we could identify the animal. A large block was then cut out and carefully trimmed down. The crumbling bones were covered with shellac, and finally strips of burlap, soaked in flour paste, were wrapped about the block. By the next day the whole would be a compact mass, ready to ship. Rhinos, giraffes, horses, pigs, antelopes, and deer of fifteen million years ago had been caught by the streams and buried in their deposits. Most of these animals differed but little from their living relatives. One tooth puzzled us. It has since turned out to be *Sivatherium*, a gigantic animal looking like a bull moose, but related by its teeth to the giraffe. Not once did we find a skeleton completely intact. But in less than three weeks we

had all the skulls and jaws that a Chevrolet truck could carry.

Our second search for bones proved less successful, however. South of Maragha is a large cave in a cliff of Cretaceous limestone. In this, it was said, were many pitfalls, which we hoped might have caught some of the animals or even dawn-men of late Tertiary time. We investigated with ropes and lanterns. The first chamber was a veritable blue grotto. Here many pigeons made their nests. From it we passed into a smaller and darker cave, where bats swooped above us, and then down a slanting passage. Soon the first pitfall gaped before us. It extended nearly across the entire passage. Only along the left wall was it possible to pass on deeper into the mountain. Its edges sloped off gradually at first and were



THE EAST GATE OF MARAGHA

Several native members of the expedition are about to pass through the wall, which is built of sun-baked brick



A COUNTRY ESTATE NEAR MARAGHA

This estate belonged to four wealthy Persian brothers. Beautiful pools are common in Persian gardens, and are usually connected with the irrigation system



THRESHING GRAIN

This method of threshing has been in use since ancient times. The runners of the apparatus drawn by the oxen, and the trampling beasts, break the grain from the husks



NATIVE SHOP IN MARAGHA

At the right, dressed in his best to say good-bye to the expedition, is the head man who superintended the search for fossils



IN AN ORCHARD AT MARAGHA

Here fruit is washed and softened in water that has been boiled in buckets over an underground oven. The fruit is then dried and treated for shipment



LOOKING OUT FROM THE BLUE GROTTA

This is the entrance to a series of passages and sink holes which probably extend down to the floor of the cañon

smooth and slippery. This was the place we sought. One rope was tied about my waist. With the other a lantern was lowered into the pit, which proved to be about fifteen meters deep. Both ropes were held fast at the upper end by our Armenian companions. I let myself down hand over hand on the second rope, while the first was kept taut at my waist. Twice I was able to rest on projecting terraces before reaching the bottom. Several of the Armenians followed me down into the pit in the same way. We

scratched in the loose débris at the bottom but soon struck hard rock. Farther out we found the hat and staff of a worthy Sunday School teacher, who, four years before, when leading a class of boys through the cave, had ventured too near the treacherous edge and fallen to the first terrace. This discovery nearly caused a panic among the Armenians. Apparently a supernatural return of the deceased seemed to be feared. Further investigation showed that the limestone had been re-cemented, probably in the Pleistocene, so that it was impossible to dig for bones in the hard rock.

Persia, however, presents other difficulties for the fossil hunter. The head of the customs at Tabriz consulted his list of "antiquities," of which no one is allowed to despoil the country. We stood before him, explaining that antiquities were works of man, and that our collection antedated *Homo sapiens*. Alas, "*os mummifié*" was one of the

items on his list. So there was nothing for it but to take them over the long road to Teheran, where our minister, Mr. Phillip, could intercede on our behalf.

The first night the boys wished to stop at the bizarre and lurid desert town of Mianne. But we had been warned of an insect of this locality whose bite brings eight months' fever, and we refused to leave the truck. Eventually, we camped farther on by the side of the road—too close, in fact, as I found when awakened by a gigantic and heavily-laden camel

stepping close to my face. Breakfast was taken in a caravanserai. I always hesitated to enter these filthy places, and finally sat down outside.

Near Teheran we were interested to see some Persian women with uncovered faces. It has been the custom for all females of this country to wear a long, black cloak with a hood over the head. To show more than one eye in public was considered a sacrilege, but the new Shah has succeeded in abolishing this time-honored restriction locally.

At the capital the fossils were eventually declared by the Persian ministry of education to be antiques, but of no historical value. (I am informed by Doctor Simpson of the American Museum that the converse of this decision is actually the truth.) We were then asked to evaluate our collection in order that

the export tax of 3 per cent might be levied. I named the sum of fifty dollars, which seemed to be unsatisfactory to the ministry. A consultation followed, and at last the assistant minister returned and reported the findings of his colleagues. The bones, he was sorry to inform us, were found to be worth one hundred and fifty dollars.

After shipping our cases we were free to take the government airway from Teheran. Flying is at its best in these regions. The desert air is still, and there is no fog. A landing can be made almost anywhere, so that landing fields and hangars are unnecessary. The Junkers plane took off at five in the morning, and soon we were sailing over deserts and ancient cities, and through the gorges of the limestone mountains. This is a vast and miserably poor country, bare of vege-



MR. BARTON WITH A FOSSIL FIND

The skulls of several animals were contained in this block. A wolf skull, apparently complete, together with remains of rhinoceros, deer, and others, was contained in it



ON THE ROAD FROM TABRIZ TO TEHERAN

The car at the right belonged to the expedition. The others are trucks for freight and passengers going to the capital



THE MEMBERS OF THE EXPEDITION IN CAMP

This photograph, taken in camp near Kijave Village, shows, from left to right, Barur Serunian, the interpreter, Eugene Callaghan, and Otis Barton



THE WESTERN GATE TO TEHERAN

The city wall is pierced by many gates, each individual in its decoration and design. Through Kasvin Gate, shown above, passes the road from Tabriz, one of the most traveled roads in Persia



THE BAS-RELIEF AT THE SPRING EAST OF RAY

The carvings originally represented Darius the Great and his court, who evidently visited the spring to "take the cure." About 1500 the warlike Fat Ali Shab carved his own portrait over that of Darius

tation except along the few streams which come down from the ranges.

At Bagdad we changed to the Imperial Airways. This trip was better than that of the famous flying carpet. First, the date palms of the "Garden of Eden" passed beneath us. At its further edge the Euphrates wound like a silver snake. Here was the site of Babylon. Beyond stretched the great Arabian desert. We landed for breakfast at a fort on the "Beau Gest" plan near the oasis called Rutba Wells. In the afternoon we flew

over the Jordan and saw Jerusalem in the distance. About six we were over the Suez Canal, when the mechanic sent us back a note: "Passengers for the Rajputana: see your boat in the Canal." Finally, at sunset we came down close to the pyramids.

During these flights we photographed many geological formations from the air with a view to locating by this means, if possible, new fossil beds. Even so erudite a field as vertebrate palæontology may, therefore, be subject to aerial exploitation.



THE JORDAN RIVER AND THE DEAD SEA

The expedition, in flying from Rutba Wells to Gaga, passed this well known Biblical spot. From the air, Jerusalem could be seen in the distance as the plane passed the mouth of the Jordan

THE ANGLER GENERALLY LIES ON THE BOTTOM IN COMPARATIVELY SHALLOW WATER IN WAIT FOR FISHES. IF A DIVING BIRD APPROACHES NEAR ENOUGH, THE SUDDEN OPENING OF THE FISH'S MOUTH WILL CAUSE IT TO BE ENGULFED



WIDE-GAB, THE ANGLER FISH

How the All-mouth (*Lophius piscatorius*) Sometimes Attempts More Than It Can Accomplish. Instances in Which It Has Tried to Swallow Geese and Sea Gulls

By E. W. GUDGER

Bibliographer and Associate in the Department of Fishes, American Museum

WITH THREE DRAWINGS BY LYNN BOGUE HUNT

THE "angler" is so called because he has on top of the head two or more spinelike tentacles with fleshy lobes or lappets at the ends. Since the days of Aristotle this fish has been credited with dangling the tentacles in front of his mouth to entice fishes to approach, and when close enough, the victims are forthwith engulfed by the rapid opening and closing of the angler's mouth. This alleged habit has recently been established as a fact by a competent observer. As may be seen in the figures, the angler does have a very "open countenance," and on this account two of his characteristic common names are "wide-gab" in Scotland and "all-mouth" in America.

Another common name is "goosefish," given because it is believed that he swallows whole, geese, ducks, and such other aquatic birds as he can lay hold of. Nevertheless, however common and widespread is this belief, the supporting evidence is scanty. Hence I welcome the opportunity to present the following case,

for the facts about which I am indebted to Mr. Feodor Deguyieff Polevoy of 100 Ridgewood Place, Staten Island.

On November 19, Mr. Polevoy came to my office carrying a gunny sac having in it a rather large, weighty, and flexible object, which he said was a fish of a kind unknown to him. This sack when emptied gave up a goosefish, which measured 3 feet, 1½ inches long "over all," 15 inches wide over the head, 13½ inches wide just in front of the pectoral fins, and 3¼ inches between the inner edges of the eyes. The huge mouth was 10 inches wide straight across from angle to angle, with a vertical gape of 6 inches.

In both jaws the long, straight, conical teeth are so hinged as to be depressible only in a backward direction. Further, around the entrance to the gullet on the supra- and infra-pharyngeals are patches of backwardly-pointing teeth arranged quadrant-fashion. These are hooked or sickle-shaped and also hinged so as to be depressible backward toward the throat. A pull on any one of both lots of



THE ALL-MOUTH ABOUT TO SWALLOW A SEA GULL

The sleeping gull floating on the surface has its head tucked under its wing, making it easy for the wide-mouthed fish to gulp it in

teeth simply brings it to or (in the case of the pharyngeal teeth) toward the perpendicular. Such teeth readily grasp and hold objects, are easily depressed to permit the inward passage of food, but absolutely prevent any "backing out" on the part of any live object of prey. Furthermore, since the bones and cartilages of both jaws and pharyngeals are freely moveable, it seems that this fish might be able, by working the sets alternately, to "hitch" its prey steadily backward into the gullet.

The fish in question had been caught under the following circumstances. On the morning of November 18, 1928, Mr. Polevoy and some companions had gone out duck-shooting long before day on Raritan Bay, New Jersey, in a rowboat covered with rushes for a blind. In the half light of the early morning (about six o'clock) when some five miles off shore,

they saw about one hundred feet away a rather large object threshing around at the surface of the water. In the poor light they were unable to make out what it was. Conjecturing that it might be a shark, a dolphin, or an octopus, they cautiously rowed around it several times, getting always closer. Presently they recognized the object as a large fish with a bunch of feathers protruding from its wide mouth.

The fish threshed about at the surface, seemingly unable to sink. The men then drew the boat alongside, caught the fish with their hands, and hauled it aboard for examination. Whereupon they found that this (to them) unknown fish had a good-sized sea gull so stuck in its throat that it seemed equally powerless to swallow or disgorge it. Just why the fish seemed unable to sink is not clear, but it may be that, in seizing the bird, it had gulped in and passed down into the

stomach, as its relatives the pufferfishes do, a quantity of air sufficient to float it like them at the surface of the water. In this case the bird, caught by the teeth set around the pharynx, could not be expelled, and for some reason could not be swallowed, hence it acted as a plug to retain this air. Once an aquarium pet of mine, a minute pufferfish about the size of a 45-caliber bullet, while distended, got a bit of oyster lodged in its throat, could not descend despite violent efforts, and nearly choked to death.

Such then is the account of the capture of this goosefish. It hardly seems likely that the fish could have caught the bird close inshore and have brought it in its mouth five miles off shore—the sea gull must have been taken while it was floating on the surface of the water, which on this morning was perfectly calm and quiet. This conjecture is supported by

the fact that when the bird was carefully extracted from the throat of the fish, its head was found tucked under one wing—it *had been asleep when captured*. Unfortunately the bird itself was not brought in.

Now, lest the reader think this a not unusual case, let us examine the all too scanty literature dealing with the food and feeding habits of the angler. The most extensive investigation ever made on the food of *Lophius* is reported by T. Wemyss Fulton in a paper on "The Distribution, Growth, and Food of the Angler" published in the 21st Annual Report of the Fishery Board for Scotland (Edinburgh, 1903, pages 186-217). In this able article, Fulton records the examination of the stomachs of 541 anglers without finding a single bird in any of them. However, he did find whole fish or fish remains in half of them (269), and concludes that the goosefish is almost



GOOSEFISH AND LOON

Goosefish have often been known to swallow birds of various kinds. The text describes an attempt on the part of an angler fish to swallow a loon, but the powerful bird, though caught, kept the fish at the surface where the struggle was witnessed by a fisherman

wholly a piscivorous beast, as its specific name *piscatorius* implies.

Nevertheless, the goosefish does, at any rate occasionally, eat birds, as our case plainly shows. The few reported instances make a background for Mr. Polevoy's interesting experience. The most definite, and likewise the earliest one known to me, is contained in a short note entitled "Voracity of the Angler (*Lophius piscatorius*)" found in the English journal *The Zoologist* for 1865 (p. 9470). This was written from Dublin, Ireland, under date of December 20, 1864.

The author, Mr. H. Blake-Knox, tells us that there was once brought to him an angler (Irish, *mullagoon*) with a cormorant in its throat. The fish had seized the bird with its portmanteau-like mouth and had swallowed it as far as the shoulders. However, the cormorant was so strong and its feathers were so light, that it had raised both itself and the fish to the surface, where they were caught while struggling—an exact parallel to Mr. Polevoy's case. The bird was rescued from the fish, but was so badly wounded by the fish's long sharp teeth, that it died in a few days.

Mr. Blake-Knox adds that he had personally known of a number of cases where anglers had devoured such diving birds as guillemots and razorbills, and that in one instance he had taken the remains of a great northern diver from the stomach of a *mullagoon*. He had heard of two or three other instances where these birds had been killed by the angler.

Jonathan Couch's *History of the Fishes of the British Islands* (London, 1869) is full of interesting natural history matters. In Volume II, page 209, he describes an incident that almost exactly parallels the two already given. A struggle was once perceived going on at the surface of the water some distance away. As the boat drew near, it was seen that a goosefish was trying to swallow a gull which it evidently

had laid hold of while the latter was floating on the surface. The three-foot long fish had gotten the body of the gull (which was 4 feet 6 inches across its spread wings) down into its gullet and stomach, but (here also) the tail, feet, and the hinder ends of the wings projected from the fish's mouth. It could neither swallow the bird further nor let it go, so both became the prize of the boatman and were sent to a local museum. Couch then concludes with another account of an angler that tried to swallow a great northern diver. Their struggles were so great that they also attracted a fisherman who captured them both.

Francis Day, another English ichthyologist, in his *Fishes of Great Britain and Ireland* (London, 1880, Vol. I, p. 75) quotes the account of Couch just given and supplements it as follows. At Belfast (Irish anglers seem especially fond of sea birds) an entire and perfectly fresh widgeon was once extracted from an angler. At Youghal, another, while still alive, was once cut out of a goosefish. Further cases were reported to Day of anglers devouring guillemots and razorbills, and the author expresses the belief that they would probably swallow any bird which they could capture.

Coming now to our own United States, Dr. G. Brown Goode will be quoted from his "Fisheries and Fisheries Industries of the United States, Section I, Text—The Natural History of Useful Aquatic Animals," published at Washington in 1884. On page 169 he accounts for the name "goosefish" because it has been known to take in live geese. A fisherman once reported that, on investigating a struggle going on in the water, he found an angler that had swallowed the head and neck of a good-sized loon. The loon actively resisted any further swallowing and in its efforts to escape kept the fish at the surface. Goode wrote further that he had "an authentic record that seven wild

ducks had been taken from the stomach of one angler"—surely the grandfather of his tribe!

Last of all, Dr. Henry B. Bigelow in the "Fishes of the Gulf of Maine," published by himself and W. W. Welsh in the *Bulletin of the United States Bureau of Fisheries* for 1924 (Washington, 1925, Vol. 40, pp. 526-527), discusses at some length the food of the common angler. He names more than twenty-seven kinds of fishes that have been taken from its stomach, and then goes on to discuss the kinds of birds that have also been found therein. He affirms that, as its name goosefish infers, it feeds on birds, and says that "cormorants, herring gulls, widgeons, scoters, loons, guillemots, and razor-billed auks are all on its recorded dietary." In Pamlico Sound, North Carolina, Doctor Bigelow himself had found grebes and various diving birds, as scaup ducks and

mergansers, in goosefish. However, he doubts, and in this he is backed up by the local fishermen there, whether a large goosefish could pull down and swallow a live wild goose, no matter how frequent the opportunity due to the great abundance of wild geese in Pamlico Sound.

Here then is the evidence that *Lophius*, the goosefish, does feed on birds, and an interesting story it makes. And interesting, too, it would be to enumerate the kinds and quantities of fishes (some as long as itself) found in it—together with the story of how one angler tried to swallow another. Then again, there are interesting accounts of how they swallow such inanimate objects as the wooden buoys of lobster pots and sink nets, seine corks, stones used for anchors, and in two cases anchors themselves. But all this, as Mr. Kipling says, is "another story."



THE OPEN COUNTENANCE OF THE ANGLER

Showing the teeth in the jaws and on the floor of the mouth. On the latter, birds are sometimes caught, and are held there to the discomfiture of the fish

EXPERIMENTS WITH "WONDER CREATURES"

Insects Existed Before Man Appeared on Earth, Have Invaded Most of the Livable World, Can Withstand Conditions that Humans Cannot Possibly Survive, and Are Among Our Worst Enemies and Best Friends

By FRANK E. LUTZ

Curator of Insect Life, American Museum

ON inviting questions at the end of his first American lecture on the "Mechanism of the Muscle," A. V. Hill was indignantly asked by an elderly gentleman, of what use were all the investigations which he had been describing. For a moment Doctor Hill tried stumbingly to explain what practical consequences might be expected to follow from a knowledge of how muscles work. Realizing suddenly how thankless a task it was to prove to his indignant questioner that the work he was doing was useful, Doctor Hill turned to him with a smile, and finished,

"To tell you the truth, we don't do it because it is useful, but because it is amusing."

"And if that is not the best reason why a scientist should do his work," says Doctor Hill, "I want to know what is. Would it be any good to ask a mother what practical use her baby is?"

This article is to give you a peep at some of our "babies," glimpses of some of the experiments we have been trying at the American Museum's Station for the Study of Insects in the Harriman State Park and at the private laboratory of Alfred L. Loomis in Tuxedo. They are "babies" in the additional sense that none of them have gone far enough to mature into a definite scientific report.

THE CRICKETS' CHIRPS

MOST of the more than half a million different kinds of insects live their lives without a sound that we can hear. A few, however, such as the crickets,

katydids, and their relatives, with an originality that is the more striking as we consider the multitude of conservatives, have developed not only rather complicated sound-producing organs, but also apparently satisfactory ears. As is characteristic of insects, they have gone about certain functions in a way and with structures that seem to us strange. An interesting essay could be written on this latter point, telling about such things as that insects take air directly to the blood instead of the rather clumsy human method of taking the blood to inhaled air; and not the least interesting thing about it is that the insects' way seems to work better than our way. An intimation of their success will be found in the last of the experiments discussed here.

Several years ago, in reviewing work on insect sounds, I confessed considerable skepticism concerning the utility of these sounds to the sound producers; but the chirping of crickets gave me considerable trouble both then and after the paper was published. The chirping is done by rubbing together highly modified structures on the front wings which seem "made for that purpose." Furthermore, crickets have ears on their front legs, and definite ears are unusual among insects. Since only males chirp (although both sexes have ears) the conclusion has been that the chirping is a sex call.

Having somewhat questioned that conclusion, it seemed only fair that I should test the matter; but watching a female cricket to see if she goes to a chirping male is a time-consuming business and, so, it

seemed desirable to invent a machine that would do the job as well or better than we could. Consequently we made an automatic "eavesdropper." It will have to be improved and its first reports are not to be taken too seriously.

AN AUTOMATIC EAVESDROPPER

A BOX, broadly U-shaped in its ground plan, was made to contain the females. There was a window at each end of the U and where the two arms joined was food and shelter. Each window communicated with separate boxes containing males. One window was covered tightly with thin celluloid that let through the chirps but kept back odors. (Remember that insects have a keen sense of smell and many clearly find their mates by this sense.) The other window was covered with wire gauze that let through the odors and would have let through the chirps also if there had been any in the box with which it communicated. But there were no chirps in that box, because a simple surgical operation on the wings of the males there had completely "dechirped" them without hurting them more than a girl is hurt by having her hair bobbed—and the effect was much the same in so far as they were made more like the opposite sex. The females in the central box could wander about and go to either window. Would they go more often to the one where there were male chirps but no odor, or to the one where there presumably was male odor but certainly no chirps? This is where the automatic eavesdropper comes in.

On the floor of the females' box, just below each window, was a very delicate treadle. When a female came to either window, she stepped on the treadle there and, her weight depressing it, closed an electric switch that completed the circuit through an electro-magnet. The magnet drew aside a pen that was otherwise tracing a perfectly straight line on a paper

tape moving at a known speed. Each treadle moved its own separate pen. Clearly, all we needed to do was to examine the tape at our leisure and we could tell not only which window was visited but how often the female came, when she came, and how long she stayed.

As I said, the experiment is not finished; many more trials must be made. Also, the apparatus must be improved, because males do not chirp all of the time, and at present our eavesdropper does not tell us whether a male was chirping at the time of a female's visit or whether she merely went there for the sake of some place to go. Undoubtedly we can, but not easily, make the machine record on the same tape the times when males are chirping. In these preliminary experiments we tried to dodge the issue by the rather clumsy device of occasionally offering the females their choice between a blank and something else.

In "chirp but no odor vs. possible odor but no chirp" the females visited the chirp window 290 times and the no-chirp window 307 times. There is practical equality here. When offered a choice between a blank window and one where there were males that could not chirp the score was 170 to 166. Again equality. "Chirp but no odor" won out over "blank" by 63 to 24 but the numbers are rather small and "blank" scored 65 against 48 for a window where there was *both* chirp and possible odor. Males which were offered several of the same choices paid 86 visits to "chirp but no odor" and only 40 to "possible odor but no chirp"; also 80 to "possible odor but no chirp" as contrasted with 44 to a blank window. It seems as though males are more consistently interested in both male chirp and odor than are females, the latter wandering about more or less at random; but that may be a too hasty conclusion.

A few experiments were tried with un-

mated females whose presumed ears had been removed by the simple expedient of cutting off their front legs. There were 27 visits by these virgins to a window where there were both male chirps and possible male odor and none to the other window where there were no males. In another short series of trials where possible odor, but no chirps was opposed to chirps but no odor the score was 14 to 11 in favor of odor, but the numbers are too small to be significant. On the other hand, possible odor but no chirps won out over a rival blank window by the rather startling total of 106 to 1.

One of two conclusions is fairly certain: either female crickets do not get wildly excited over the music of possible mates or there is something wrong with the apparatus. Since the machine practically works itself, once it is started, we shall probably set it going when crickets chirp again, especially if we can get a device that will record the chirps.

TEMPERATURE AND WALKING SPEED

THERE is a very different sort of problem which has greatly interested some physiologists and which may strike rather deeply into the mysteries of animal activities, either muscular or nervous, we are not sure which. For example, Harlow Shapley, an astronomer apparently desirous of improving daylight hours when he could not look at stars, watched ants and noted the speed with which they walked along a path at various temperatures. The warmer it was, the faster they went. A curious thing is that the relation between speed (S_1) at a given temperature (T_1) and the speed (S_2) at another temperature (T_2) closely accords with a complicated formula which represents the speeds of certain chemical reactions at various temperatures:

$$S_2 = S_1 e^{A(\frac{1}{T_1} - \frac{1}{T_2})}$$

where e is 2.7183, the base of "natural logarithms," temperatures are measured

on the "absolute Centigrade" scale ("absolute zero" being about -273°C . or about -459°F .) and A is a constant that is characteristic of the reaction. Some physiologists think that, by a comparison of the "temperature characteristics" of various animal activities (as shown by a curve representing the speeds of these activities at various temperatures) with the "characteristics" of various chemical reactions, we can discover what chemical reactions control these activities. Possibly we can but, at any rate, it is interesting to find out a little more concerning the influence upon insect activities of all the environmental factors, and this seemed to require a new type of apparatus in which the insect could walk straight ahead indefinitely without coming to a wall and in which the environment could be controlled.

AN ENDLESS TRAIL

A DEVICE something like the wheel in an old-fashioned squirrel cage seemed to be what we wanted, but we wished it to be so delicately balanced and so frictionless that even a tiny fruit-fly would easily turn it. However, if we did away entirely, or almost entirely, with friction, the wheel, once it got started, would go on and on even after the insect had stopped walking. Furthermore, while we were at it, we wanted things fixed so that the wheel would automatically record both the speed and the direction of its turning. As I look back, I do not wonder at the kind, solicitous inquiries of friends concerning the "fly-wheel," and I even forgive the less kind intimations as to "wheels" in my head. The list of failures is a long one, but here is what worked and it is quite simple.

The track where the insect walks is something like an automobile tire with the insect inside of it. It is made of exceedingly thin, transparent celluloid, the "valve" being a tiny, sliding celluloid

door for getting the animal in and out. The spokes of the wheel are fine silk threads; the axle, depending on the size of the wheel, is either a needle or the shaft of an almost obsolete thing, a hat pin. Over each end of the axle is an electromagnet whose strength can be quickly and accurately varied by a rheostat conveniently located in the circuit. Now: An insect is put into the wheel, just enough electricity is sent through the magnets to take practically all the weight off of the bearings (a trick suggested to me by Prof. R. C. Wood), and the insect can go as rapidly as it pleases but, like Alice and the Red Queen, it never gets anywhere. If it decides to stop, we can decrease the strength of the electric current; this lets the weight press on the bearings and friction stops the wheel.

Since an observer is usually on hand when the apparatus is being used, there really was not much point in having it self-recording but, compared with getting the wheel to work, that was easy, and there is some satisfaction in finishing what one starts out to do. Accordingly, a disk of opaque paper was fitted to the wheel and a series of openings was made in the disk. A photo-electric cell was put back of the disk and a beam of light was directed against its front. Every time an opening passed the beam of light, as the wheel turned, an electric impulse went through the photo-electric cell and worked a pen on a recording tape much as did the cricket treadle already described. The openings were so arranged that the turning wheel "telegraphed" a code message that told exactly what it was doing.

POOR WALKERS AND GOOD

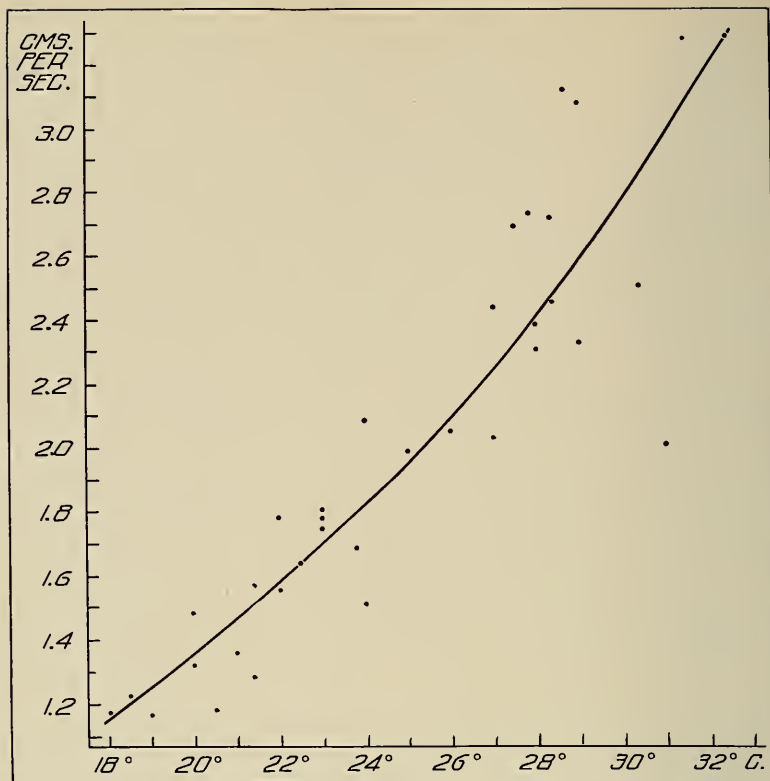
HAVING the apparatus, there was an obligation to use it and, I confess, this was more like work, although interesting. Not every insect is fit to go in such a wheel. Some are what the boys called "Coolidge Bugs," they did not

choose to run but sat calmly, as though thinking about something. Others had the will to walk but got tired, for the inside of a freely turning wheel is a trail that has no end. Thus, a yellow-jacket wasp that, in ordinary life, flies much but walks little, started off with an evident intention of getting somewhere in a hurry. For the first twenty minutes it kept steadily going at an average speed of about 9.5 cms. per second. Then, temperature, light, humidity, and barometric pressure remaining the same, it began slowing up, its average speed in successive five-minute intervals being 8.3; 7.7; 7.4; 7.3; and 6.2 cms. per second. At the end of the three hours and a half it was still at it but going only 3.9 cms. per second, having had the longest walk of its life—about two-thirds of a mile.

Ground beetles (*Carabidæ*) are much more used to walking than are wasps. In fact, they rarely fly. A specimen which Richard Iverson, one of our boys, timed for two hours with the wheel in the open laboratory started off with a speed of 5.3 cms. per second. Its average speeds in nineteen of the twenty five-minute intervals for the last hour of the run were: 5.4; 5.3; 5.1; 4.9; 4.8; 5.9; 6.0; 5.9; (Dick took a five-minute rest); 6.0; 6.2; 5.8; 5.7; 6.2; 6.1; 5.5; 5.6; 6.0; 5.2; and 4.3. Apparently it could keep that up longer than we cared to watch and record. Our automatic disc contraption would have been handy in this case.

The creature that best served our purpose was not, strictly speaking, an insect but *Spirobolus marginatus*, the large brown milliped ("thousand-legger") of the late-summer woods. It is heavy enough to turn the wheel without the help of magnets; it is a consistent walker; and there is an absolute fascination in watching the perfect rhythm of those many legs hour after hour. Let us examine the effect of two environmental factors upon its speed of locomotion.

A *Spirobolus* was started off at a temperature of 32.5° C. (90.5° F.); then the box which contained the wheel was gradually cooled to 18° C. (64.4° F.); and finally warmed again to 30° C. This took about four hours and a half, the creature walking most of the time. Distance traveled, together with elapsed time, was electrically recorded on a rapidly moving tape. If you are used to reading graphs, the accompanying one will clearly tell the story. The dots



THE WARMER, THE FASTER

Diagram showing the relation between temperature and the speed at which a "thousand-legger" walks. This graph is explained in the adjacent text; each dot represents the average of one part of the whole experiment

on the graph indicate the average speed of walking (see left-hand margin) at various temperatures (see bottom margin) and the slightly curved line is that given by the formula noted above when the constants are Speed of Walking (cms. per second) equals

$$2.238 e^{6351 \left(\frac{\text{Temp.} - 300}{300 \times \text{Temp.}} \right)}$$

when temperature is given on the "absolute" centigrade scale. It is quite evident that "the warmer, the faster." What it all means is another question.

AIR PRESSURE AND ALTITUDE

RATHER more startling experiments, perhaps largely because they were in an almost unexplored field, were the effect

of changed air pressures,¹ and this requires a bit of comment on the side. At sea level the air above us weighs so much that it balances the weight of a column of mercury about 760 mm. high; in other words, the barometric pressure is about 760 mm. at sea level. As we go up in a balloon (mountains are not high enough for present purposes) the pressure decreases, but not in simple proportion to the altitude. The balloon in which Gray died reached an altitude of about eight miles, and "sounding balloons," carrying recording barometers but not a human being, have attained thirteen miles above sea level. But even that is not high enough for our

¹An even more unusual type of experiment which we started was the effect of short-length radio waves. If short and strong enough, they kill; but less lethal doses seem to act merely like warming up the creature, although the temperature of the air remains the same.

present purposes. Since we do not know what the air pressure is thirty miles above sea level, about the best we can do is to take a very simple formula which seems to be "in the direction of the truth" even though it is known to be inaccurate. It is that altitude in miles about equals

$$10.33 \log_{10} \left(\frac{760 \text{ mm.}}{\text{Observed Pressure}} \right)$$

It may be simpler to look at the curve on the following page which gives on the bases of known facts and of this formula altitudes in miles for various barometric pressures.

WALKING IN LOW AIR-PRESSURES

FOR this experiment *Spirobolus* was put in a wheel; the wheel was put in a bell-jar; and air was pumped out of or let into the jar according to whether we wished to decrease or increase the atmospheric pressure. It was absurdly easy to give the creature all of the air-pressure thrills of a super-balloon ride to, say, fifteen miles above sea level (air-pressure of about 27 mm.) and return in less than three minutes. Of course, since it is well to investigate one factor at a time, temperature, light, and humidity were kept as nearly constant as possible, and for that reason we can speak here of only the effects of air pressure and decreased oxygen supply.

Suppose a man were being treated in this way. Even if the change were made slowly, his gait would be wobbly and his breathing very labored at a pressure of 400 mm. of mercury, and Gray died, whether accidentally or not, when it was about 150 mm.

Since we wished to time the speed of walking at various pressures, *Spirobolus* was subjected to graded series of them. Observations were made during the first hour at 740, 500, 400, 300, 250, 200, 150, 100, 75, 50, 40, 30, and about 22 mm. pressure in succession. In order to have a constant degree of humidity and also to

prevent drying of the milliped by excessive evaporation, we had water in the jar and, since the vapor pressure of water at ordinary summer temperature is about 22 mm., that was as far as we went, and it seemed far enough for the present. At that, there was practically no air left in the jar. Then we came by rather short stages back to normal; then went to 100 and back to normal; and repeated this "round trip" three more times—all in two hours and a half.

Instead of walking more slowly as the air became rarer, *Spirobolus* increased its speed, all of its many legs functioning in absolute rhythm. This increase kept up on the average until the air was about two-thirds gone, corresponding to pressures at an altitude of, say, six or seven miles; then it began to slow on the average and stopped (but not for good) when there was practically no pressure left except that of water-vapor. As a matter of fact, however, the fastest one-meter dash that it did was at an air-pressure of only 105 mm. (representing, say, an altitude of about nine miles), making the meter in 59 seconds or a rate of about 1.7 cms. per second. Of what stuff are these creatures made, at any rate?

AN AËRIAL ADVENTURE

WE are all familiar with the tiny, red-eyed fruit-flies that come about over-ripe bananas and the like. Ten of these flies were put in a bell-jar with water and the air exhausted to the vapor-pressure of water in ninety seconds. The flies stopped moving. Valves in the apparatus were then opened wide and the pressure almost instantly returned to normal. Within four minutes all ten were walking about as though nothing had happened. The same procedure was repeated again and again. After the eighth trial one fly did not walk within seven minutes and I did not wait for him but went on with the one- to three-minute

PRESSURE TO WHICH FRUIT FLIES WERE SUBJECTED, ALTERNATING WITH NORMAL PRESSURE, 24 TIMES IN 4 HOURS; TWO OUT OF THE TEN FLIES LIVED AND BRED

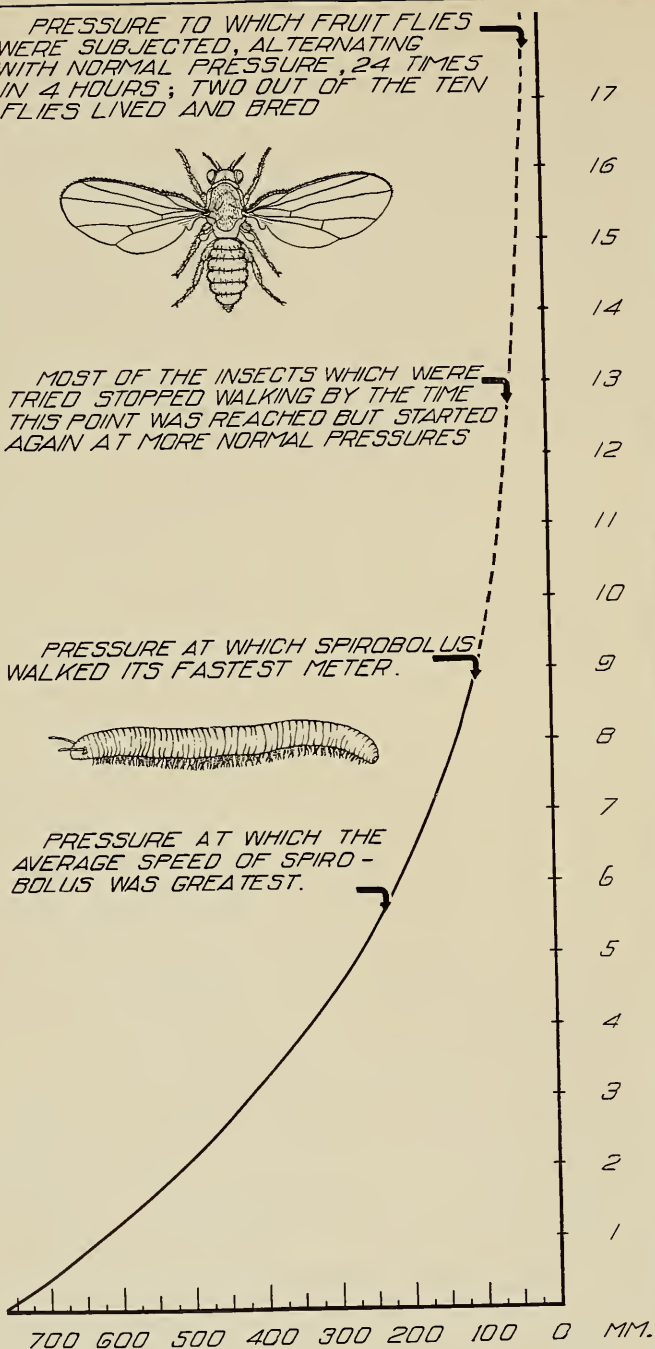


MOST OF THE INSECTS WHICH WERE TRIED STOPPED WALKING BY THE TIME THIS POINT WAS REACHED BUT STARTED AGAIN AT MORE NORMAL PRESSURES

PRESSURE AT WHICH SPIROBOLUS WALKED ITS FASTEST METER.



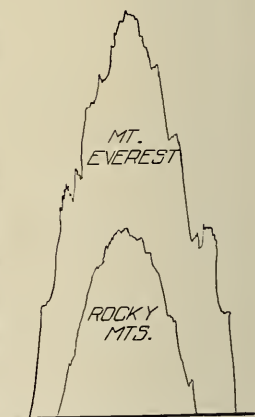
PRESSURE AT WHICH THE AVERAGE SPEED OF SPIROBOLUS WAS GREATEST.



MILES ABOVE SEA LEVEL AT WHICH THERE ARE CORRESPONDING BAROMETRIC PRESSURES

←THE HIGHEST POINT REACHED BY "SOUNDING BALLOONS"

←MAN HAS NOT SURVIVED HIGHER THAN THIS EVEN WITH SPECIAL APPARATUS.



5.

BAROMETRIC PRESSURE

SUMMARIZING CERTAIN EXPERIMENTS WITH REDUCED AIR-PRESSURE

The curved line shows approximately the relation between air-pressure (horizontal scale) and height above sea level (vertical scale) under normal conditions. At the right are human affairs, including diagrammatic representations of the heights of mountains. Entomological facts are given at the left

swings from normal to "none" and back again. After the twentieth trial only six of the ten stalwarts were walking and I took time out for tea. After tea we (the flies and I!) made four more round trips and then only a male and a female of the original ten were still alive. There seemed no point in pushing the experiment to their death and, besides, I wanted to see if they were really as well and hearty as they seemed to be. So, I put them in a cage with a nice ripe banana, where they started breeding the next day. Careful microscopic examination of their children, grandchildren, and great-grandchildren failed to reveal indications that anything unusual in fruit-fly affairs had happened.

Human endurance would fall so far below that of insects in such a test that no comparison can be made. An express elevator in the Woolworth Building or the dropping of a cage in a deep mine are slow coaches going a short block compared to the ride these flies took twenty-four times in four hours, but in what follows we tried to reach the limit of even insect endurance—and failed as far as air-pressure is concerned.

INSECTS AND SUPER-VACUUM

IT is well known that, in order to produce X-rays, the air is almost completely removed from the X-ray tube and then an electric discharge of very high voltage is made to jump the gap between two electrodes in this "vacuum." But the so-called vacuum, while nearly complete, is not entirely so; there are still enough ions left to carry the electricity from one electrode to the other. Furthermore, it is possible, by means of a pump which Mr. Loomis has in his laboratory, to exhaust the tube so completely that the X-ray dies out and even 30,000 volts will not force a discharge across the gap. Instead of an air-pressure of about 760 mm. of mercury, as we have in normal

atmosphere at sea level, the pressure now in the tube is of the order of one ten-thousandth of one millimeter. It is probably lower than the vacuum of interstellar space. What would happen to a "frail" butterfly or bee if subjected to such a vacuum and then suddenly brought back to normal pressures?

The answer is complicated by a factor already mentioned, one which we found was more important than sudden and great changes in air pressure. This factor is that the pump which removes the air also removes the moisture; and insects which are kept in a pressure much less than the vapor pressure of water would quickly dry up and die of desiccation. Water cannot be supplied to them in this apparatus, because some of it would evaporate so quickly that what remains would be frozen to solid ice and, in fact, part of the slowing effect of high vacuum on insects may be due to a marked lowering of their temperature caused by evaporation from their bodies. However, let us see what happened.

Three small bees belonging to two genera of the sort that live a solitary life, instead of in colonies, two mound-building ants, a beetle related to fireflies, and an immature grasshopper were put in a tube and the ends of the tube were melted so that it was welded into the apparatus. (Ordinary joints would not hold.) Since moisture would ruin the pump and since moisture was sure to come from the insects, that part of the tube between the insects and the pump was packed in a mixture of solid carbon dioxide and acetone in order to freeze the water out of the air on its way to the pump.

The pump was started and the next three minutes were busy ones. First the vacuum-tube glow appeared, but before the end of the second minute it had died out, showing that a non-conducting vacuum had been reached. This was held for 60 seconds, a rapidly growing pile of

snow in the chilled connection being the moisture sucked out of these "frail" creatures, and then the glass tube was broken at one blow and the insects were returned to normal conditions from their journey into a "complete vacuum." Not one moved then but two hours later all were active and apparently normal. A little later one of the ants showed some signs of trouble but whether it was due to the vacuum, the drying, or to some more natural cause I do not know. The next day that ant was dead but, when released, the other ant and all of its companions each according to its kind flew, hopped, or walked away.

The same experiment was tried with a bumble-bee and two kinds of butterflies, except that the insects were in a vacuum of less than one millimeter pressure for four minutes and the extreme of $1/10,000$ mm. was kept up for 90 seconds. In about ten minutes after the tube was broken, instantaneously returning them to normal pressures, the bee and one of the butterflies began to show signs of life. Five minutes later both were walking and the other butterfly was feebly moving its legs and mouth-parts. By the next day the bumble-bee was active as ever but the butterflies had died. Possibly they were unable to withstand the conditions of the experiment, including the excessive drying, and possibly they died from other, more natural causes, but it did not seem necessary to try the experiment again. There was no longer room for doubt that insects and their near relatives are creatures that can not only exercise vigorously at air-pressures which no man nor any of the animals related to him could survive; creatures that can not only completely recover within a few minutes from sudden and rapidly repeated transfers from normal pressures to almost none and back again; but they are

creatures that can survive the most complete vacuum that man can produce with exceptionally perfect apparatus. How do they do it; why can they do it?

THE WONDER CREATURES

ALL that we can say is that insects seem to be better made than we are. They have invaded almost every bit of the livable world, including hot springs and the highest mountains, the Arctic and the Tropics, in water and on water, underground and above ground, in plants and animals and on them. Only the ocean is avoided by them. Their structure and mode of living have stood the test of time practically unchanged since the Carboniferous. Possibly Maeterlink was right when he called them "beings so incomparably better armed and endowed than ourselves, concentrations of energy and activity in which we divine our most mysterious foes, the rivals of our last hours and perhaps our successors." On the other hand, as has been pointed out in "The Friendly Insects" (NATURAL HISTORY, Vol. XXVI, p. 147), relatively few kinds of insects seriously injure us and we owe much to many kinds. Possibly, with increased knowledge of insect habits, we may be able to swing the balance still more in our favor.

WHAT good are such experiments as these? Possibly collecting interesting information about the masterpieces of Creation is of no greater value than collecting human masterpieces of art; and possibly writing about Nature is no more useful than writing music; but, until some one is wise enough to be able to predict the worth of any bit of pure (as contrasted with "applied") science, we can at least say that it "amuses" those who do it and interests many who read about it.



ELEVEN WEEKS IN A LION PASTURE

Collecting in Tanganyika for a Superlative Group for the New African Hall
That Is to Be Added to the American Museum

BY G. LISTER CARLISLE, JR.

Leader, Carlisle-Clark African Expedition of the American Museum

The Carlisle-Clark African Expedition of the American Museum was made possible through the generosity of Mr. and Mrs. G. Lister Carlisle, Jr., of Norfolk, Connecticut, and was intended to supply two finished groups for the Museum: a major group of lions and a minor group of suni, the smallest of the world's antelopes. The task of producing a wholly satisfactory lion group requires high talent, and in spite of the press of work, Mr. James L. Clark, Assistant Director, was granted leave of absence to carry out the work. The party consisted of Mr. G. Lister Carlisle, motion-picture photography; Mrs. Carlisle; Mr. Clark, group work; Mr. William R. Leigh, artist; Mr. Richard C. Raddatz, background accessories; and A. L. Klein, "white hunter."

One of the most important objectives of the expedition was to give to the members of the Museum preparatory staff renewed familiarity with the anatomy of African animals and with their habitats, in preparation for the work on the African Hall, and also, in the case of Mr. Clark, the personal knowledge of the White Nile country so necessary for representing that section of Africa. In view of the fact that the expedition was fortunate in having an artist in the party, it was decided to substitute for the small group, paintings for the lesser kudu group, which were needed by the Museum, but were not on the original program. This, however, was in accordance with the plan to render as much general service to the Museum as possible. The party was carefully organized so that complete competency would be available for all of its activities, and the expedition was to be on a non-killing basis, as far as it was humanly possible to achieve this and still succeed in its mission. It was intended to be an idealized museum expedition. The illustrations used in this article are enlargements from motion picture films taken by Mr. Carlisle, and are hardly representative of the best, as it was not desired to cut the film.—THE EDITORS

EACH year we must change our mental picture of Africa and bring it up to date.

Three years ago Mrs. Carlisle and I traveled eleven hundred miles south of Khartoum on the White Nile and found

few animals and no tourists. Now regular tourist steamers are run on the route, and animals are scarce indeed. Mr. Clark reports that he did not see a head of game on his way out from Kenya in 1928, and the distance from Nairobi to Khartoum by



ZEBRAS IN TANGANYIKA

A typical scene along one of the water courses

car and boat is about two thousand miles.

And so I found it in South Africa. In traveling by train from Cape Town to Victoria Falls and out on the east coast at Durban, I saw just two hartebeests.

The old buffalo country around the present site of Nairobi is now given over to coffee plantations and charming country homes. The Rift valley, where Theodore Roosevelt found such great game herds, is now uninteresting, almost desert, or cut up into farms; and so it goes over all Africa.

Tanganyika is the least altered area left to us, and shortly we may expect that it also will lose its wild-life interest. At present and for some years to come it will remain the grandest example left to us of the world as man first knew it. Here it was that we hoped, on our 1928 expedition, peacefully to collect our lion group and yet leave the country as unspoiled as we possibly could for the next man and the next generation.

Animal life does not spread itself evenly over a country. Instead, favoring conditions cause local concentrations, with seasonal changes, to be sure, but with the range of movement quite limited and easy to follow. Our objective in Tanganyika was an area such as this, and it may be the last to be found in Africa. This, I well remember, was Carl Akeley's opinion as we discussed the matter before he left on his last African trip.

From one such area of concentration in Tanganyika, more lions, probably, have been taken than from any other area in the modern world, but in spite of the fact that they are holding on, owing to the present abundance of game, they are doomed, as elsewhere, because the lion is a plains animal, lazy and frequently easy to approach. Before the automobile and the modern high-powered rifle he stands no chance at all.

To my surprise I found that most people without actual experience in a lion coun-

try feel that the lion and leopard may properly be shot out of it; and so they may, if the area really is needed for white settlement, but it is a mistake to kill them off from the waste places, as they are the most interesting animals there. One soon tires of looking for expression and individual interest in an antelope, but the lions are different. Their rule over the animals has continued for so long and has been so absolute that it is reflected in their expression, as in their actions, and if you shoot the lions out of a country it becomes "flat" and uninteresting in comparison with its former proud state.

A few years ago a party of hunters from our middle west went after a record on lions in this area and shot between sixty and sixty-five; and then the British changed their laws. They are rather good lion hunters themselves and are particular to inquire how their lions are shot and how

many are shot by those privileged to shoot over their preserves.

The game commissioners of Kenya are selected from men of a very high type. At present both the commissioner and the assistant commissioner are ex-army officers of standing in the community and they are making an able and gallant uphill fight to preserve the game against the inroads of all unnecessary killing by settlers and of excessive killing by both sportsmen and some museum expeditions. May they be successful!

The world will be the poorer when the last of the great African game herds has passed into history.

These were the thoughts that were uppermost in our minds as we traveled many weary miles south of Nairobi without seeing more wild life than a small zoo might hold.

But at the end of a week, after two



WAITING NEAR A WATER HOLE

African animals are ever waiting and watching for the sudden attack of lions and leopards. Here a group of zebras and wildebeests are facing in all directions and also watching the animals on the other side of the hole. Sometimes they wait for hours before daring to drink



AN EXHAUSTED WATER HOLE

Four days before this picture was taken a flourishing water hole existed here, but in that time the water supply had been exhausted by the thirsty animals and only mud remained

hundred fifty miles had been covered, we arrived in game country, and what a sight! From then on, for three months, game was always in view. At times we saw very little because the game was "out," as is the local saying, or in other words the migration had passed on from the exhausted water holes of the dried-up plains to the lower reaches of the rivers where they empty into Victoria Nyanza. Later, we followed the game down one of the rivers and there found it in its thousands. The herds were concentrated from a vast area of country and an estimate of their numbers would be misleading and harmful, unless reduced to an acreage basis over their whole range, which is impossible.

The expedition established a base camp three hundred miles south of the railroad, and there our work began. It was serious work that we had undertaken, for this was not a sporting event, nor a trophy

hunt, nor an expedition organized for any other purpose than to render service to the Museum, and in so doing to enjoy the picture of unspoiled Africa which lay around us.

The making of a superlative major museum group is an undertaking of size that requires great expertness in execution and hard work, and we at once became the busiest party in Africa, with Mr. Clark directing his departments with energy and ability.

Museum lion groups present a special and difficult problem because of the personality that the lion himself possesses and because of his predominant position among animals. The design and execution of a lion group, therefore, calls for the abilities of an able sculptor, as well as those of an artist and a taxidermist; but all this talent had been provided in our organization and we went prepared for success in our venture.

A present-day expedition to East Africa representing the American Museum of Natural History but follows others which have established a high reputation for the institution among the English residents, and there is a desire on their part to assist in every way possible. My own reaction to this condition was that it was our clear responsibility not to swerve from our intention to kill only the limited number of specimens required for well-defined museum purposes, and just enough of the common varieties of antelope for food. I am glad to report that our expedition lived up to this. Mr. Clark collected for the museum; Mr. Clark and Mr. Klein killed for food; but neither Mrs. Carlisle, Mr. Leigh, Mr. Raddatz, nor I even took out licenses to kill animals. Personally I had a bird license, which I did not need.

The scale model designed by Mr. Clark called for a group of seven lions, headed

by a superlative specimen of a dark-maned male, but where to find him became the all-important problem of the expedition. We ranged the country for fifty miles in every direction and inspected, probably, three hundred lions, but the lion of our dreams was found only on the last day of the last extra week given to the hunt!

We are glad to have him!

Every day we saw from two to twenty lions, but they were mostly females or young, and infrequently males with poor manes. The big fellow we needed appeared to have left the country. As the country we were in has not been shot over to any extent and some of it not at all, we knew that lions there die of old age, and that there must be many big males. But these keep by themselves and during the day lie well hidden in the dongas, or stream beds.



MERELY LAZY

In districts where lions are able to find food readily and where they have not learned to fear the attacks of man, they are often easily approached and photographed. Remarkably enough, they seem to have no fear of motor cars



IMPALLA AND THOMSON'S GAZELLES

Tanganyika still supports great herds of antelopes and other animals on which the lions depend for food. In a land where such herds abound, it is only natural that lions and leopards should be both numerous and well fed

BIRD hunting in the lion country has much to recommend it as an exhilarating outdoor sport. Although I did not kill anything on the trip, I tried on one occasion to collect a few guinea fowl for the pot, but without success.

Mr. Clark and I were out looking for that elusive superlative male and a change of thought from lions seemed wise, so I went after a flock of guinea fowl traveling in Indian file, toward a kopje, a small tree-covered granite island that rose out of the level plain.

As is usual, the tender, young birds were in the lead and the tougher old ones in the rear, and the best I could do was to bounce a few shot from my twenty-gauge shotgun off the tough backs of the old birds as the line disappeared among the rocks, and then go in after them.

My mind was on the birds and I was not thinking of lions as I worked around

one side of a small, high boulder, but as I was about to pass a nice, sunny cleft in the rocks, I heard a tremendous "*whoof*" from around the corner—and then silence. I knew that I had not stepped on him, but doubted whether he was far enough off to allow me to swing my gun on him, if he charged. As I stood there waiting for something to happen, with nothing but the "*whoof*" to work on, I ruminated on the effect of a load of bird shot on a lion's disposition. Finally I decided that it was only a warning. I was not to disturb his dreams of fat zebra, and, having no further intention of doing so, I went on about my business of hunting guinea fowl. The hunting was all right, but just then I recalled that lions are said to come in fives, sevens, and elevens, so, not meeting any more birds and recalling the fact that they were vulturine guinea fowl anyway and

not very good for the pot, I worked back to the motor truck. There I expected to find Mr. Clark dozing at the wheel and the blacks dreaming of still more meat.

On the contrary they were recovering from what appeared to them to have been an unprovoked assault by a lion. I had so frightened the beast behind the rock that he had dashed downhill and out on the plain directly toward the car, which he did not see until he almost ran over it. Then, with a quick swerve, he shot past the rear end and was gone. Personally, I never did see that animal. He was decidedly jumpy and nervous for a lion, but perhaps he mistook me for Al Klein.

Lions are not afraid of cars, if they do not wind them and hear no human voices. They look at an approaching motor car very critically, but if the approach is skillfully made, they evidently decide that it must be an elephant; possibly a new sort of elephant with a rotary drive, but

still an elephant, and so they let it go at that.

A lion is like an old-time gun fighter in our west. He is tremendously able to protect his interests. You can play with him, but not against him. Otherwise you will have to "blot" him, as Al Klein called it, and that spoils the wild-life picture for the next man. Africa without lions and leopards would be devitalized.

Lions add considerable zest to an afternoon stroll, as Mrs. Carlisle found one late afternoon when leaving camp alone for a constitutional on the plain below. Hardly had she started, when two shadowy lion forms passed close in front of her, bound for our camp water hole. They paid no attention to her, but they left a decided impression just the same.

On another occasion we passed through a group of six lions which were leaving the wooded river bed for an evening hunt. These lions were in a very different mood



FROM A MOTION PICTURE FILM

A very rare picture. The leopard is nocturnal and few motion pictures of uncontrolled and unafraid wild leopards have been taken

from those we had previously played with and photographed to our heart's content. They were hungry, hunting, and truculent, and no doubt would have given us trouble if we had troubled them, but we did not need any of them in our collection.

The following night, when near Victoria, we camped three hundred feet away from a closely-packed herd of some five thousand wildebeest, and I passed a wakeful night with their lowing in my ears and my mind occupied with the wilderness life around me.

With the first light I was up to see what I could read of the night's happenings. There were wildebeest closely packed as on the previous evening. Lions had taken their toll during the night, as was evident from the signs surrounding the herd. And then had come the hyenas and the jackals and the birds, and between them all there was nothing left of the kills but

splotches on the grass. We saw seven hyenas slink toward cover in the dawn, with their mid-rib sections hanging low from their meals of wildebeest flesh and bones.

It is fortunate that hyenas are not killers and that they feed only after the lion and leopard, as there are many of them and they have jaws almost as powerful as a lion's.

THE object of our trip down the Blanketti River was to photograph buffalo, and although we secured some good pictures the animals were camera shy, and it was most difficult to drive them into the openings in the thorn bush where the light conditions were favorable. We finally gave it up, as this particular herd of about fifty was not truculent enough for our purpose.

As we neared Victoria Nyanza we



THE ETERNAL TRIANGLE

This lion was gazing wistfully at the two others—a male and a female. The evidence indicated that this was the preferred male, but that the other was older and stronger and had apparently driven this one away.



A FINE CITIZEN OF TANGANYIKA

The opportunity to photograph a male lion in such a setting does not often occur

approached Wanyamwezi settlements and found the country alive with native hunting parties that were taking an incredible death toll of the wild herds there gathered. We passed dozens of groups that were killing wildebeest not for meat, but for their tails only, which they sell for three shillings apiece to the members of the Kavirondo tribe, bordering them on the north, who use them in their dance ceremonies.

Suddenly, when crossing a broad, grassy plain, between mountains, we came on a well-beaten human trail, the first we had seen in two months, and we followed it for several miles to its end. There we got a picture.

The Wanyamwezi were operating a game trap at the base of the mountain and were carving their kill into man-size sections for transportation to their villages near the lake.

Such game traps are village undertak-

ings. Each family provides a line of nooses of about one hundred fifty feet in length, consisting of a single line lightly supported four feet from the ground. To this are fastened and hung single short lariats so arranged that each open noose touches the next.

The rope, about a quarter of an inch in diameter, is made from sansavera fibre found wild in the section. It is incredibly strong, stronger and softer than sisal fibre, and likely in time (when a decorticating machine is invented) to supercede it.

The method of operation is to group these many noose lines on an area of flat land near a hill along which it is easy to steer the game, and then the natives organize a great drive over the surrounding country. In this case the noosed area covered at least ten acres, and the result was a game trap as devilish in its effectiveness as any devised by the mind of man.

It caught practically everything that entered the area, whether they came in singles or hundreds.

Once an animal stampeded into the noose-covered area where the yellow ropes were the same color as the yellow grass, it had no alternative but to try and break through the maze, but few indeed succeed.

We saw tons of meat ready for transport. There were remnants of all the local animals from Thomson's gazelles to zebra, giraffe, and we even counted five striped unborn eland calves.

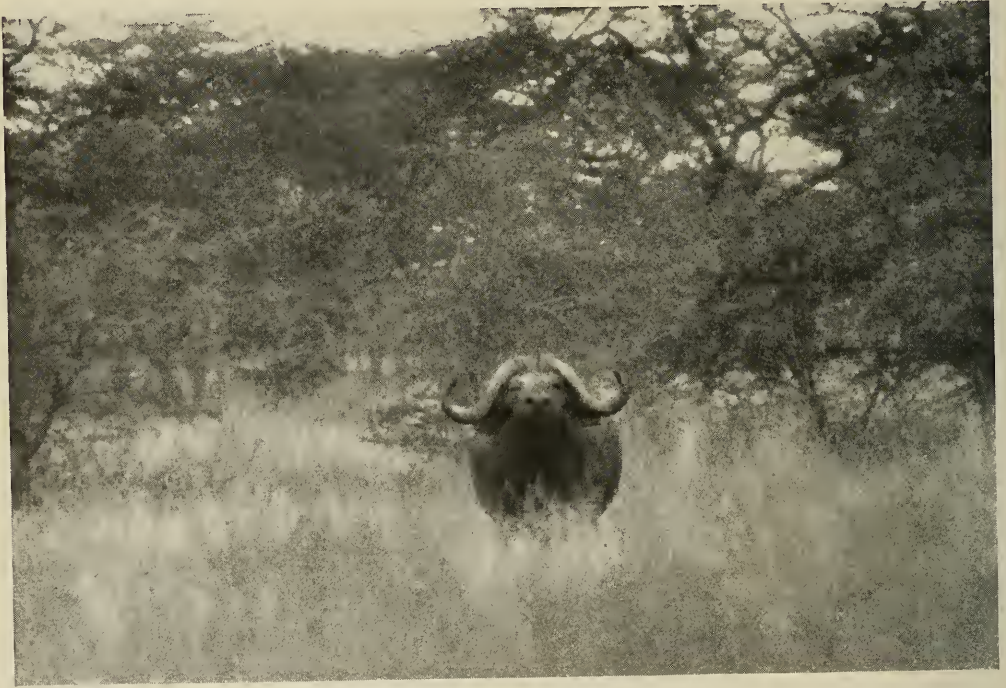
Such slaughter is supposed to be illegal, but game conservation in Tanganyika has not aroused the vital and growing interest that it has in America.

Also, this may have been the first game trap of this character seen by white men, and Al Klein and I debated as to whether we would spend some time in the vicinity in order to photograph the trap in action. We finally decided that the natives would

postpone their next drive until we left the country, or, possibly, make us irresponsible to their affairs with poison arrows, so, as the light was unfavorable, and the pictures of the trap in action, if taken, were likely to be so bloody that they could not be shown to an American audience, we sadly left the scene.

We did no shooting, not even for meat, in that bit of country. We had no heart for it. My estimate of the animal life taken by all these native hunters from the surrounding country then filled with herds on their dry season migration is five hundred per day.

The success of an expedition to Africa depends largely on there being a similarity in the basic ideas of the members regarding killing. Those few who still enjoy the primitive and now out-of-date pleasure of killing animals on the decline, should not be members of parties composed of those who have risen above it. To my



INTERRUPTED

A fine specimen of bull buffalo photographed in the late afternoon when he had come out of a cool creek bed to feed



GIRAFFES ON THE SERANGETTI PLAINS

There are forty giraffes in this herd, but only a part of their number could be recorded by the motion picture camera. Good lion cover can be seen along a stream bed in the middle distance

joy, and rather to my surprise, I found that our able "white hunter," A. L. Klein, had progressed beyond this earlier conception of the subject, and we had some happy days photographing the animal life around us.

Al Klein is a great guide and hunter and also an expert at wild animal photography.

The combination of professional hunter and photographer found in Mr. Klein is rare indeed, and these qualities together with his high spirits, added to our pleasure and success.

Mr. Leigh's study paintings for the background of the lion group are very beautiful, and we are glad that he was selected to do the work. Seeing an artist go about his work with the purpose and concentration of a business man, losing neither time nor light opportunities, was a new experience to me.

If I were asked just what Mr. Raddatz performed as his major duty on the expedition, I would have to stop and think, for he covered a very wide field of usefulness. Mrs. Carlisle and I are grateful to Mr. Clark for making it possible for Mr. Raddatz to accompany us.

Of Mr. Clark's work on the lion group it might be unwise for me, as a layman, to express an opinion, but certainly Mrs. Carlisle and I are in entire sympathy with his conceptions as to design and color, and we look forward with keen anticipation to the completion of the group, which will be his and his associates' from the killing of the lions to the completion of the group on the exhibition floor.

An American mining engineer in Johannesburg, long active in the preservation of the game remaining in the Kruger National Park, rather demurred that we planned to do any killing at all. He has taken probably the greatest series of still photographs of African animals in the world, unless Al Klein has its equal, and he has never had to fire a shot.

I answered that as a conservationist I had considered his point of view and arrived at the conclusion that public interest in conservation can best be aroused by public exhibitions of such beauty and excellence as those being created in the American Museum. A few may properly be sacrificed for the good of the many.

Having acquired the rudiments of a scientific education myself, I desired that

the collecting should be done in the spirit of science and service and not in that of the hunter. I believe that a cut-over forest or a shot-over country has lost its bloom and can never be brought back. Although we all know that the wild life is going or gone, I, for one, do not wish to help push it over the brink. I believe that at least sample areas should be preserved, where the balance of nature is as it was in the beginning. It was not intended that man should completely cut the stream of animal life that has come down to us from the distant time that Professor Osborn portrays with such interest and accuracy, and this expedition was planned to collect with one hand and to preserve with the other. We represented a scientific institution and desired to act in accordance with the responsibility. In America the balance has been destroyed. Some species were exterminated and many nearly so from five to fifty years ago and now there is nothing better

for us to do than to shoot and re-stock and repeat the operation down the years.

But Africa is different. There, with public interest and individual work, sample areas may and should be preserved, so that future generations can enjoy at least an unspoiled part of their entailed wild life estate, instead of the shadowy bankrupt heritage which is all that now promises to be theirs.

Vision and enlightenment must come to more men holding important and potentially influential positions for preserving the great picture of nature; and I am glad to realize that the American Museum and its representatives in the field are at the forefront of the wave of conservation that has swept America.

We look to all of our natural history museums in America to be effective agents for conservation both at home and in the field. They teach the beauty of nature, and, logically, the objective also is to inspire preservation of the beauties of nature.



WANYAMWEZI WOMEN AND CHILDREN

According to the local chief, the Carlisle party were the first white visitors ever to come to his village

Photograph by
J. M. Johnson



"HE CLIMBED
UPON A LOG
AND RESTED
IN THE SUN"

THE ODYSSEY OF A GROUND SQUIRREL

How, after a Winter of Hibernation, a Ground Squirrel Awoke in the Growing Warmth of Spring, How He Found His Mate, Raised His Family, and Met His Dramatic End

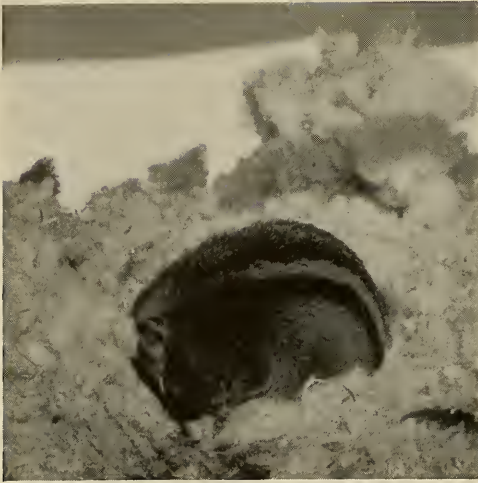
By ROBERT T. HATT

Assistant Curator, Mammals of the World, American Museum

In the following article Mr. Hatt, from his wide experience with rodents, has told the partially imaginary story of an individual golden mantled ground squirrel. Despite the fact, however, that the story is fiction, the reader may accept as absolutely accurate the information it contains, and can be assured that the impression he obtains of these appealing creatures is in every sense faithful to Nature.—THE EDITORS.

THE golden mantled ground squirrel slept heavily. For five months he had been lying thus in his nest. The grassy ball that surrounded him lay at the foot of a short tunnel which he had dug in the crumbling granite high up on the mountain. His nose was held between his legs and his tail curled up over his head. In this way he formed a furry sphere that wasted little heat. Yet to the touch he was cold, insensible, and he was breathing so slowly that the movement of his sides was but faintly perceptible. Heart beats came far apart and seemed about to stop. His body was stiff as though it were paralyzed.

But somewhere near the center of this scarcely living ball must have appeared an uncomfortable sense of hunger, or possibly the self-made drug of sleep had become exhausted. A tremor ran through the numb circle of the little body from head to tail, and the tension lessened in its back. Then the shaking stopped and for an hour the creature remained nearly motionless. This stillness was broken when his head shook violently in all directions. The wakening proceeded slowly backward, affecting first the fore legs, then the trunk and rear legs. Eyes opened, and he stretched out, heavy-headed, dull-eyed. He tried to go to



"THE SQUIRREL SLEPT HEAVILY"

sleep again, but he was cold, and it was damp in his confined chamber. He turned round, and yawned, stretching out his upward curving tongue. Then each leg reached out, the toes spread wide with the exquisite tingling that follows long disuse.

An urge came to find food. In October, when last he had seen the sun, he had been rolling in fat. But now it was April and the fat had disappeared. After struggling to push through the side of his nest, he emerged into a tunnel leading to a store-room. Here were a few frozen berries of the kinnikinnic that grew about his doorway, but nothing more. And here he nibbled a meager breakfast. Autumn's cornucopia had filled the mountain valleys with a wealth of seeds, but few of these were stored in the squirrel's store-room. Sleep occupied so great a part of his winter season that the labor of storing up a hoard of food was not worth while. But autumn days spent basking in the sun must be paid for now by foraging outside, where there was little to find.

The tunnel was in bad repair. Freezing and thawing had caused sections of the roof to fall, and the awakened squirrel had to break these up and kick the gravel

backward towards the nest in order to get out. It was fatiguing to work on an empty stomach, and the long-rested muscles soon grew sore. When he was about ready to give up from fatigue, the last crumbling rock gave way, and before him was a soft white mass that packed down easily with little pressing. Where earth walls ended and he had thought to enter open air, this soft, cold stuff still blocked the way. He pushed his nose into it and struggled on and upward. Soon his nose bumped a harder part, but here the light came strongly in. Excitedly scratching at the hard crust, he broke through into the bright sunshine on the mountain-side.

The fast melting snow lay deep in the hollows and under the trees, but here on the open, southward sloping hillside the ground showed great brown patches touched here and there with the delicate green of newly awakened life. From a



"SNOW WAS YET HEAVY ON THE UPPER SLOPES"

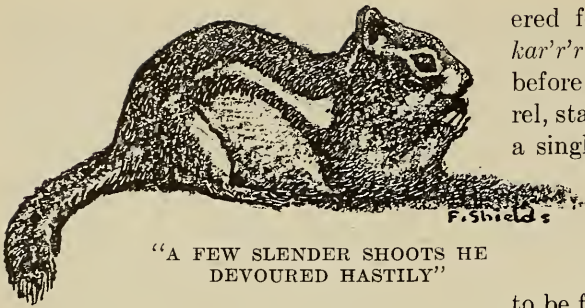
mountain torrent a hundred yards below, arose a roar that smothered every other sound. Squalling, long-crested jays hurled epithets at the brightly striped squirrel as he stood conspicuously on the snow, but because of the roaring water he could not hear them. A golden eagle screamed, poising before the breath-taking drop that might secure a meal for him. The squirrel did not hear the bird, but a rapidly moving shadow appeared near him on the snow. What caused the shadow he did not know, nor did he try to learn. Instead, he dropped abruptly back into the steep tunnel that his hind feet had never left, and a split second later a set of grasping hooks struck the soft snow that overlaid the crust. Such season's greetings from the air struck momentary terror into that timid rodent heart.

But were the nervous systems of the grass-feeding multitudes subject to lasting fear, they would soon die of fright or of starvation. No wonder, then, that in a quarter of an hour a brown, short-furred nose appeared again just where the eagle had struck. Cautiously, with slow, short advances, and shorter, though quicker, retreating movements, the squirrel emerged again and, after surveying the sky and land, dashed over the edge of his small snow bank to the nearest patch of earth. This lay on the slope below a huge rock that caught the sun



"WERE THEY GOOD TO EAT?"

and that shunted off the wind pouring down the valley from the high peak that had not yet awakened to the spring. Already a few tender shoots of the first spring flowers were up and these he nipped and devoured hastily. The branch tips of a spruce brushed the ground near him and he saw the fresh and tender newly formed needles on the twigs. Were they good to eat? He'd try. Yes, when one is hungry they would do, but one soon tires of their strange flavor. There were no seeds about for this "beautiful seed-eater" (*Callospermophilus*, he was dubbed by scientists). All those that had not been



"A FEW SLENDER SHOOTS HE
DEVoured HASTILY"

picked up by the provident chipmunks, the pine squirrels, mice, and birds were now covered over by the movements of the surface soil. Such poor foraging! And being already fatigued, back he went to bed, where he slept for two weeks more.

Spring had come hastily to the mountain-side. The stream was still swollen to the proportions of a small river, for the snow was yet heavy on the upper slopes. But here about the burrow all the snow was gone, and ground patches that before were brown were now green and flecked with the white of blossoms.

The squirrel emerged slowly, with all his senses alert as was the custom and necessity of his kind. Once only in his life had he done otherwise, and then it was through the emergency door so well hidden by the matted bearberry. That time a weasel was close behind him and he did not have time to consider the terrors of the outside world when certain death was at his tail tip.

But on this day he came with caution. When his eyes were just above the level of the ground, he froze all motion and surveyed intently the hill and sky about him. There, on a little flooded meadow along the stream above, a deer was grazing, but that was not alarming. Deer, it was true, often stole the food about his doorway, but in themselves they were not a source of danger. If his eyes had been made far-sighted, he might have seen a small band of mountain sheep on the bare shoulder of the high ridge across the valley.

In the nearest spruce a gray and feath-

ered form moved, and gave a rattling *kar'r'r'r kar'r'r'r* on seeing the squirrel, before gliding to a log near by. The squirrel, startled by the nutcracker, gave forth a single sharp, birdlike chirp. The note

was not, however, intended conversationally. It was given in annoyance at being disturbed

from a careful search for creatures to be feared. No alarming thing was to be seen, and no other ground squirrels were about. He came out and ran up to the top of the nearest boulder. Here he was more exposed to attack, but it was a good point for observation and the sun felt warmer there. For a time he sat as motionless and upright as a stake upon the rock, but as all was tranquil, he settled down and assumed a sphinxlike attitude. An hour of basking made him comfortably warm. There was much to occupy his attention in this hour. The landscape he knew well, but moving, living things must be watched with care.

One thing the squirrel missed, and that was companionship. The others of his brood had disappeared. One had been taken on its first day outside by a lucky coyote. A brother had been



"HE RAN TO THE TOP OF THE
NEAREST BOWLDER"

drowned in his burrow built too near the stream. Two others had moved three hundred yards up the valley to less crowded feeding grounds. In consequence he never again saw them. Was he the only one left of the lively company? He arose and ran down the surface of the rock to search for others. His hasty descent was checked rapidly, for there below him was another rodent, smaller, sharp-nosed, nervous, and heavily striped—a chipmunk, distant cousin of the squirrel. But, the nervous, jerky, little one fled, tail straight up, and the squirrel continued on his way. A trail, much used and quite well worn, hugged the base of a small overhanging bank, where from above the squirrel could not be seen, and this he followed. At one point a jutting root stub just brushed the backs of passing squirrels, though, should they choose, they could avoid it. This stub was, in their social world, a signal center, for each animal in touching it with its hair left a message on the stub. The vocal expressions of the ground squirrels are very few in number, so Nature has done the next best thing and has placed glands in the skin of their backs. From these comes forth a secretion that clings to the hair



"THE NUTCRACKER GLIDED TO A LOG"

and gives off an odor strong to squirrel noses.

Our squirrel came to the stub and was arrested by the information which it bore. One scent stood out clearly over all the others. Some fellow squirrel had left that on the root not an hour before. The newcomer noted that the odor was that of a female and that she had been excited. Possibly the thing that had frightened her had by now caught and made a meal of her. More cautiously he moved forward, stopping once or twice to sniff the air and trail. As the wind was from his back it gave no warning of what lay before him, where, at a fallen log, the protecting bank stopped and he would be in the open. So, on he came, and was two feet from the protection of the rock when there came from what seemed to be a stump just at his right, a sharp "woof." The stump turned into a sitting bear that lunged at the squirrel, but by wheeling sharply and breaking into a mad burst of speed, he reached the protection of the overhanging rock, and dashed under the root stub, quite unconsciously leaving a light odor on it as he passed. In five seconds more he dove into his burrow. The bear arrived a moment later and tore furiously at the



Photograph by J. M. Johnson

"THERE BELOW HIM WAS A SHARP-NOSED SMALL CHIPMUNK"



Photograph by A. E. Butler

"NATURE PLACED A GLAND IN THE
SKIN OF THEIR BACKS"

burrow mouth while the squirrel trembled and uttered a high-pitched querulous whistle. By great good fortune the tunnel had been excavated in a softer filling between two solid rock masses and the bear could only scratch up the surface of the ground about the entrance. Unprofitable work, and so soon ended!

The spring wore on with one adventure crowding itself upon another. The hawks were an ever present source of concern, but spring had brought its pleasures, too. One day, the squirrel again found an odor on the stub where the squirrels left their messages. A strange quality in it excited him and drove him off in search of this member of his tribe, after he, in turn, had arched his back and rubbed it against the root. The morning of

the following day he climbed up the slope to ground he had never visited, and there he came upon the object of his quest. She whistled in excitement, but stood her ground as he rushed toward her. He checked his impetuous run when he saw that she was not afraid. They came together and he nosed her sleek bright coat. But she broke away into a circling run. Pursuit ensued. Round and round they went in steeplechase. The race became a game. She let him come quite close, and then dashed away again. At last he stopped quite out of breath, and she started toward him, nosing the ground as she came, but turned and ran away again before she reached him. He pursued her even into her burrow. There they stopped and he adopted her dwelling as his own abode.

In the days that followed he had a new domain with which to familiarize himself. The tunnel had to be extended, an out-pocketing made in which one could

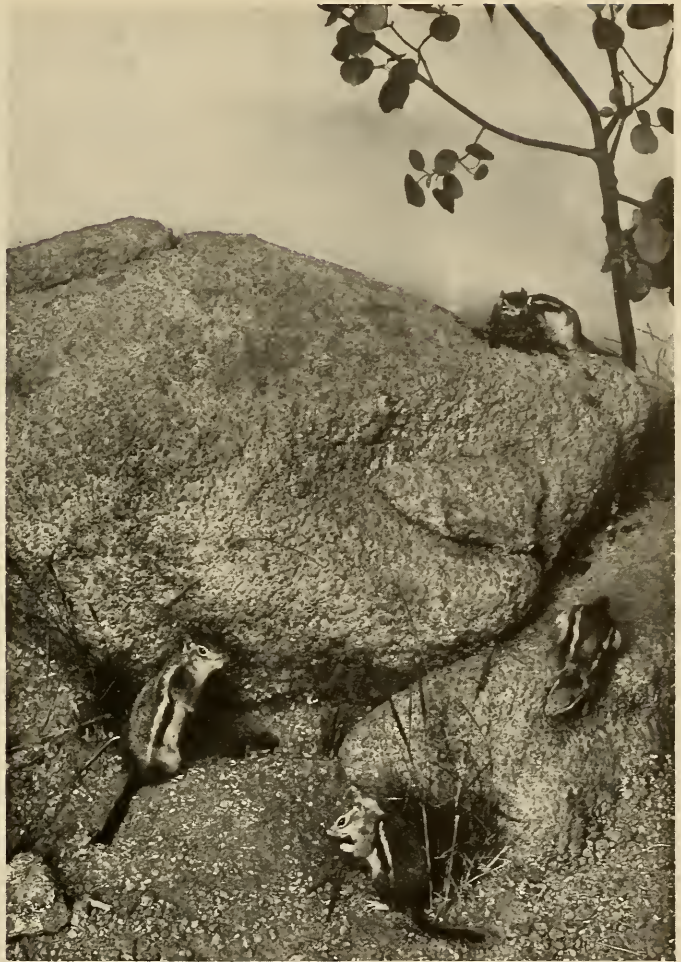


"THE SITTING BEAR LUNGED AT THE SQUIRREL"

squeeze while the other passed. The nest was enlarged. Visitors arrived. The ever present fleas and mites were with them always, but now came ticks, and less annoying camel crickets, millepedes, book scorpions, and ants.

Later came four other warm, naked, blind, and squirming guests. Our squirrel became annoying to his mate, so, after a time, off he went and built another burrow near at hand. When the youngsters of the brood grew to such a size that they could venture out on long forays, their mother took them on a journey to a house down in the valley. Here the ground squirrels and the chipmunks were daily fed flapjacks and bread crusts, and all these creatures from the slopes about came to the repast.

Many of the ground squirrels had learned to trust their human benefactress and took bits of food from her. The day the new brood came they found their father already there. At the moment he was driving away two chipmunks from a large slice of bread. When the smaller creatures fled, he seized the bread, and holding high his head, carried it away. A precipitous rock confronted him. He could, of course, have gone around. I do not know whether he was too stubborn or too stupid to do so, but instead of taking the easy route, up the rock he went. Head thrown far back, and arms stretched out, there was but trifling clearance for



From a Group in the A.M.N.H.

**"THE YOUNGSTERS OF THE BROOD GREW TO A SIZE
WHERE THEY COULD VENTURE OUT"**

the load, but yet he could move onward. Three feet up, a jutting pebble stopped all progress; but the squirrel threw his head still farther back in an effort to clear the obstacle, and over he tumbled, backward down the rock, his booty released and rolling after him. But like Robert Bruce's spider, he at last succeeded and hid the plunder in a crevice at the top. With this feat accomplished, he returned to the feeding ground below.

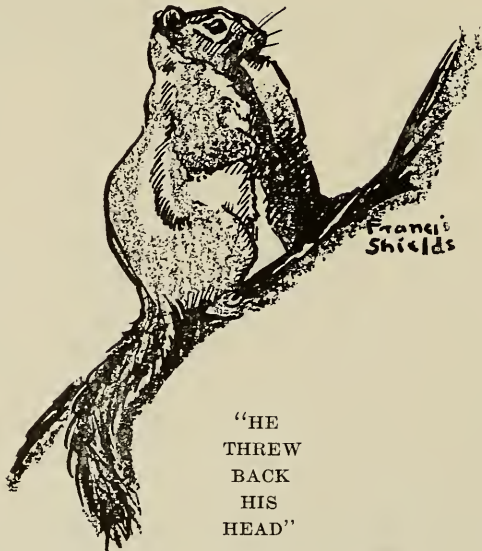
At his approach a youngster in apprehension gave a whistle of alarm from his lookout on a woodpile. The others came to attention. Our squirrel rushed in and



"HERE THE GROUND SQUIRRELS WERE FED"

scattered them. An older, larger squirrel took offence and came up to him, nipped him on the flanks, boxed his ears, chased him out of sight up the slope, and came back to feed. Sulkily the punished little fellow climbed upon a log and rested in the sun. Spying the head of a big mullein stalk near the other end of the log, he got

up and ran down to a point where the fine head could be reached. He extended a graceful hand and pulled it in, cut off the seed-bearing section and cleared it as a chickaree would a pine cone. Delicious were these still juicy seeds. The Oregon grapes were hardly better. He was too occupied to notice that the little



"HE
THREW
BACK
HIS
HEAD"



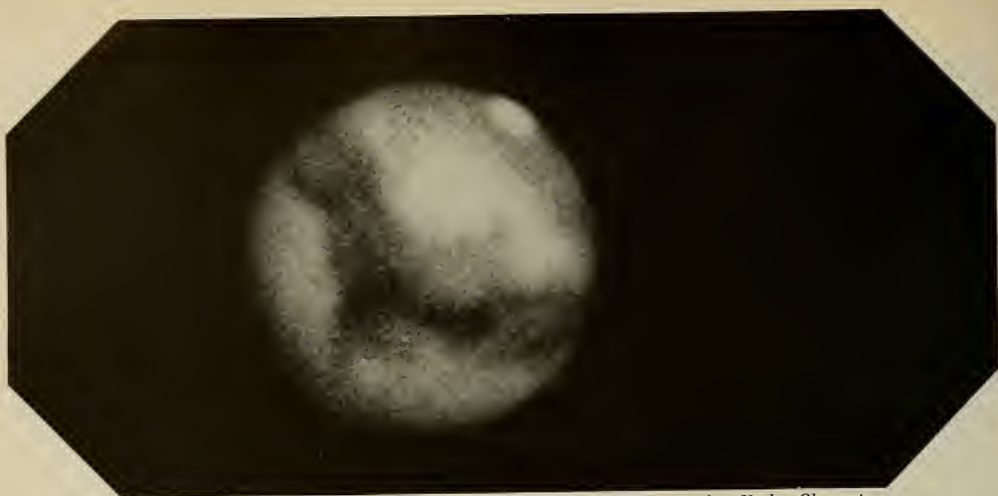
"A YOUNGSTER GAVE A WHISTLE OF ALARM"

birds about had become silent, too busy to see that over him circled a hawk. The hawk circled twice to get the best position for the plunge. Then with wings half folded, feet stretched out, talons held tense, rocket-like the hawk plunged, using his wings only enough to steady his aim and to break the force of his final impact.

The squirrel felt a rush of wind, and that was all. Two strong feet encircled him, eight piercing claws sunk deep and did their work. The hawk turned, crouched down, and with a powerful first beat of his wings, lifted himself into the air and sailed away down the valley to his feeding tree.



"TWO
STRONG
FEET
ENCIRCLED
HIM"



Photograph by Barnard at Yerkes Observatory

Mars, showing south polar cap (top), and Syrtis Major, the wedge-shaped extension of the darker belt toward the north

THE RUDDY WANDERER OF THE SKY

The Planet That Has Most Interested the Inquiring
and the Imaginative Mind of Man

BY CLYDE FISHER

Curator of Astronomy, American Museum

*"There is no light in earth or heaven
But the cold light of stars;
And the first watch of night is given
To the red planet Mars."*

—LONGFELLOW

CONSPICUOUS in the spring (1929) sky, a little southwest of the point directly overhead at eight o'clock in the evening on March first, is a planet that looks like a red star of the first magnitude, but it shines with perhaps a more steady light. It is Mars, the most interesting of the planets,—fascinating to the astronomer because of the many conditions that approach those on the earth and the perplexity he has encountered in studying them,—intriguing to the layman because of the perennial question of possible inhabitants.

Its orbit is next outside that of the earth, and at times it approaches almost as near our planet as does Venus, whose orbit is next inside. Venus when at inferior conjunction, that is, when on line

between us and the sun, is within 26,000,000 miles of the earth. Mars at a favorable opposition, that is, when on line opposite us from the sun, may approach as near as 34,600,000 miles from the earth. The last close approach of Mars was in August, 1924.

At an average conjunction, that is, when on the opposite side of the sun from the earth, Mars is 234,400,000 miles from us, is only about half again as bright as the North Star, and might readily be mistaken for a red fixed star did not its motion betray its true character. At a favorable opposition it is more than fifty times as bright as at conjunction, and surpasses Jupiter in splendor, being brighter than any other planet except Venus.

The diameter of Mars is 4200 miles, or a

little more than half that of the earth. It requires 687 of our days for Mars to make one trip around the sun. It is a striking coincidence that Mars rotates on its axis in almost exactly the same time required by the earth. Another surprising coincidence is that the axis of Mars is inclined almost exactly the same as that of the earth. Due to the last-mentioned condition, there must be seasonal changes on Mars similar to those on the earth.

Two tiny moons attend the planet, having been discovered at the favorable opposition of 1877 by Prof. Asaph Hall, then an astronomer at the United States Naval Observatory. Their names Deimos and Phobos, are those used by Homer for the fiery steeds which drew the chariot of the god of war. They are the smallest known bodies in the solar system except the meteors and possibly the smaller asteroids. Deimos occupies a little more than 30 hours in making one revolution and is 14,600 miles from the planet's surface. Its diameter is estimated at about five miles. Phobos, the inner moon, is only 5286 miles from the surface of Mars, and is estimated to be about ten miles in diameter. It

makes a complete revolution in 7 hours and 39 minutes, which is less than one third of the planet's day. Phobos is the only known moon which makes the trip around its primary in less time than the primary takes to turn once on its axis. In consequence of this unusual speed it rises in the west and sets in the east.

These small moons can be seen only with very large telescopes and when Mars is at or near opposition. They have been photographed at the Lowell Observatory at Flagstaff, Arizona, by Mr. E. C. Slipher, who has made many of the finest planetary photographs ever secured. According to Professor Lowell, neither of these



MARS IN CRESCENT PHASE AS SEEN FROM PHOBOS

An imaginative drawing of Mars as it would appear from its inner moon which is just a little more than 5000 miles distant. From a drawing by Howard Russell Butler, N. A.



MARS IN GIBBOUS PHASE AS SEEN FROM PHOBOS

To an observer on Phobos, the inner satellite of Mars, the planet would go through this phase. The polar caps and other surface details should be easily made out. From a drawing by Howard Russell Butler, N. A.

satellites shares the ruddy color of the planet.

Professor Howe has pointed out that the discovery of these satellites was curiously anticipated by Kepler, Dean Swift, and Voltaire. One of Kepler's strange speculations, which he mentioned in a letter to Galileo, was that Mars had two moons, Saturn six or eight, while Mercury and Venus were possibly blessed by a single attendant each. Dean Swift represents in *Gulliver's Travels* that the scientific Lilliputians had telescopes of great power, with which they had discovered "two lesser stars or satellites which revolve about Mars." Voltaire

makes a hypothetical inhabitant of Sirius take a celestial voyage, in the course of which he visits Mars and sees two moons that are intended to make up for the comparative feebleness of the sunlight.

Like all the planets and all their satellites, Mars shines only by reflected sunlight. This fact, together with the movement of Mars and the earth in revolution, causes Mars to go through changes of phase, but not so great as those of Mercury and Venus, the two planets inside the earth's

orbit. At opposition, when the earth is between the sun and Mars, the latter shows a full, round disc; at conjunction, when Mars is on the opposite side of the sun from the earth, it has the same phase, but at intermediate times we cannot see all of the bright hemisphere, that is, Mars is in a gibbous phase. However, as seen from the earth, Mars never exhibits a crescent phase, as Mercury and Venus do.

The planet is a beautiful object through even a small telescope, the disc, as a whole, being reddish or orange-colored, with diversified light and dark markings. The darker regions of "a bluish-gray or greenish shade" are mainly confined to a very

irregular belt around the tropical regions of the planet. During a single night it is quite easy to observe the rotation of Mars on its axis by noting the change in position of some easily recognized feature such as *Syrtis Major*, the wedge-shaped extension toward the north of the dark belt. (See p. 194.) These darker areas were long supposed to be sheets of water,—and the adopted names derived from classical sources were based on this theory,—but now it is practically certain that they are not water. If they were water, it is believed that the sunlight would be more brilliantly reflected than it is, and that the darker regions would be more uniform in tone than they are, that is, that they would exhibit less conspicuous detail. On two occasions Professor Lowell saw the *Mare Erythræum* “change from blue-green to chocolate-brown shortly after

the winter solstice, and return gradually to its former tone as spring approached.”

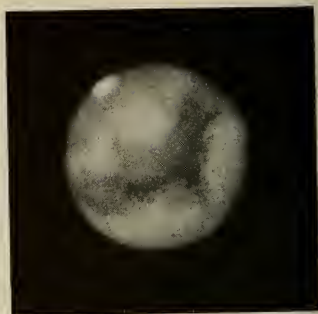
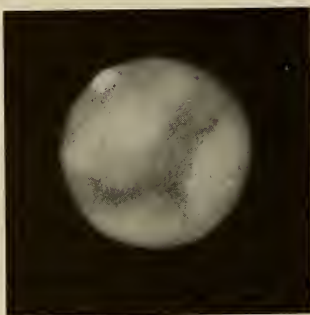
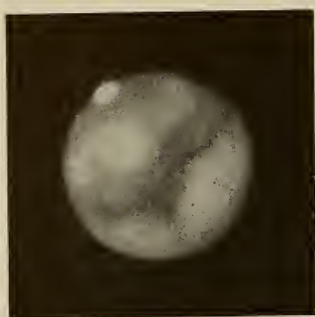
The reddish portions of the surface do not change with the seasons, and it is thought that they are the bare and almost smooth surface of the planet, upon which the other markings are to be seen.

The polar caps, which were seen soon after the invention of the telescope, have been observed ever since as conspicuous features on the surface of Mars. These polar caps change in size with the Martian seasons just as those of the earth do. When Mars is at winter solstice for the northern latitudes, the north polar cap is very large, often extending halfway to the equator. A little before the spring equinox for the northern hemisphere of Mars, the cap begins to shrink, and does so until late summer, when it becomes as small sometimes as two hundred miles

CANALS ON MARS

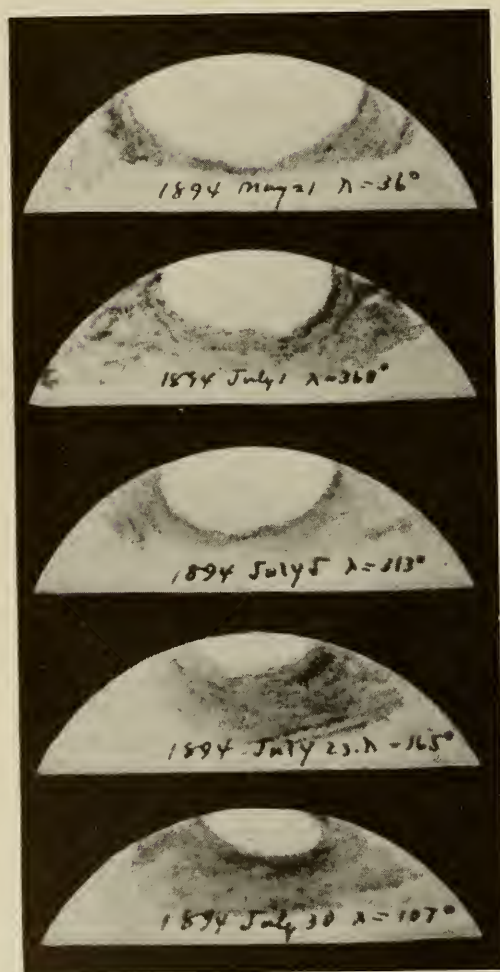
At the Lowell Observatory, Flagstaff, Arizona, is a series of globes upon which drawings of Mars were made by the late Percival Lowell, who believed the lines indicated the existence of irrigating canals which carry the water produced by the polar snows to every part of the planet. Note the south polar cap at the top of the picture





MARS ROTATES ON ITS AXIS

The photograph on the right was made first, the one in the middle second, and the one on the left last,—and all three were made within an hour and a half, yet a comparison of the position of *Syrtis Major*, the wedge-shaped projection of the dark belt toward the north (bottom), shows that Mars rotates on its axis. Photographs by Barnard at Yerkes Observatory



THE MARTIAN POLAR CAP SHRINKS AS SUMMER APPROACHES

Drawings of the south polar cap of Mars, made by Barnard through the 36-inch Lick telescope, showing how this cap decreased in size from May 21 to July 30, 1894. The polar caps on the earth behave in exactly the same way

in diameter. Similar changes are observed in the southern polar cap, but the shrinking is greater, for at least twice the southern polar cap has completely disappeared toward the end of summer. Although it has been suggested that these polar caps may be solid carbon dioxide, it is now quite generally believed that they are composed of snow and ice, that is, frozen water. Carbon dioxide volatilizes, at low pressures as exist on Mars, at temperatures much lower than those measured for the polar caps, as pointed out by Professor Russell and his associates.

The so-called canals, as they were called by Schiaparelli fifty years ago, have been perhaps the most puzzling feature of the planet. There are many narrow, dark, straight lines crossing the ruddy portions of the disk. No doubt such markings exist, but the drawings and descriptions by various astronomers disagree surprisingly. Professor Lowell observed and mapped more than four hundred canals, which formed a complex network of geometrical precision over both the ruddy and darker regions. From four to as many as fourteen canals come together at one point, usually a dark spot called an oasis. Some fifty of the canals he observed to be



By Courtesy of the Illustrated London News

**MARTIAN SCENERY: A THEORETICAL VIEW OF THE EDGE OF A "CANAL"
WITH A DISTANT SANDSTORM**

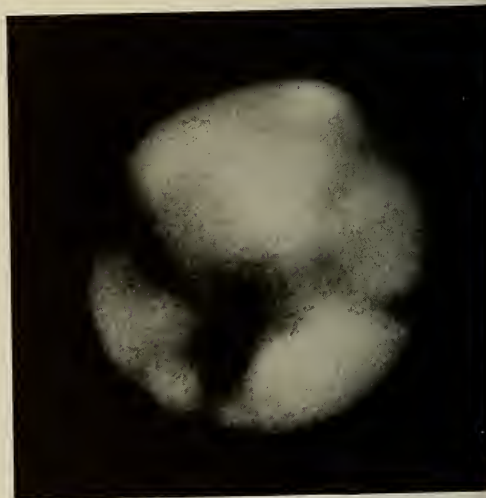
The markings on Mars, which appear as dark lines from the earth, whether natural or artificial in origin, are supposed to be strips of vegetation bordering streams, with perhaps a Moroccan type of climate. The actual canals would be too narrow to be visible to us. Drawn by Scriven Bolton

double. To be visible from the earth with the large telescopes, it is estimated that these canals must be at least fifteen miles wide, and Lowell thought them to be not more than twenty miles wide at most.

On the other hand, most of our astronomers have never been able to see this elaborate system of narrow geometrical markings, but intermediate positions from Lowell's to a practical denial of the existence of these markings are held. Although the coarser features of Mars

can be photographed, the canals cannot,—therefore the problem cannot now be solved by the photographic plate. The prevailing theory is that these markings are waterways bordered by vegetation, as suggested by Prof. W. H. Pickering. The valley of the Nile would appear much the same to an observer on our moon,—a green streak across the African desert.

The question of most widespread interest concerning Mars is whether life exists there. The possibility and the

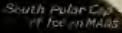


Photographs by Wm. H. Wright, Lick Observatory

MARS AND SAN JOSÉ AS PHOTOGRAPHED FROM MT. HAMILTON, CALIFORNIA

The two photographs at the left were photographed with violet light, and the two at the right with infra-red light. The obscuration in the upper left is due to the earth's atmosphere, and the comparison is suggestive of the presence of an atmosphere of considerable density on Mars. San José is $13\frac{1}{2}$ miles distant from Mt. Hamilton

Showing the permanent FEATURES recorded by most astronomers, also the faint and apparently straight lines suggesting vegetation bordering the so-called "canals," constructed by reasoning BEINGS to carry the scarce water across the DESERTS to the dark cultivated "OASES."



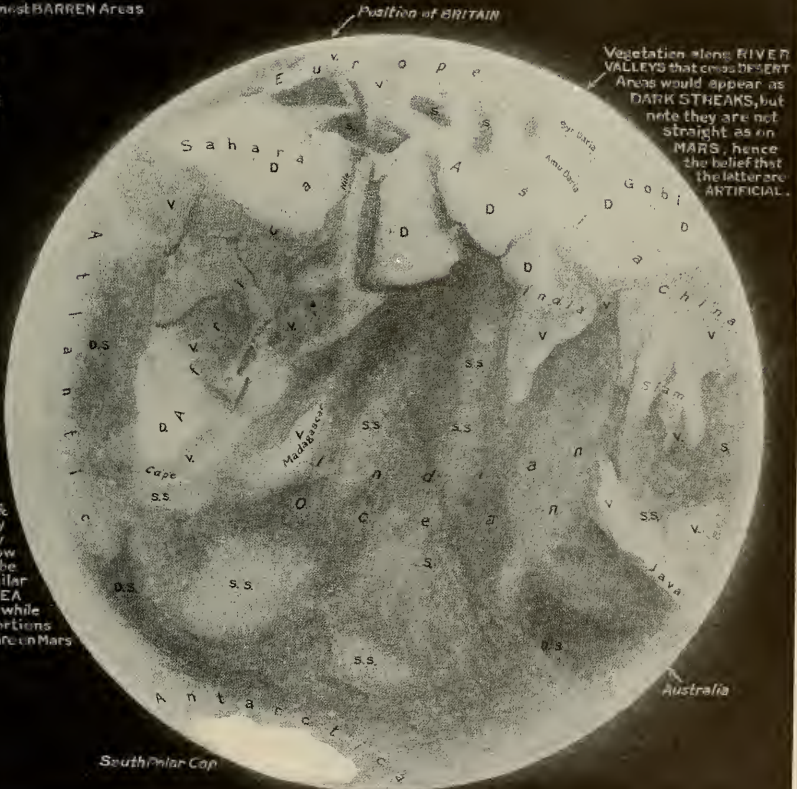
The EARTH as seen from MARS when approaching their nearest. When they are near or at their closest the EARTH is INVISIBLE to MARS altogether.



V - VEGETATION
S - SEA Areas
SS - Shallow SEA
DS - Deep SEA

The extent of each tint of shade indicates the Area

On SAME SCALE as Mars, & shown as it would probably appear as seen from, say VENUS. It can be seen how the LAND OUTLINE would be confused owing to the similar bluish green tint of the SEA and VEGETATION Areas, while the reddish DESERT portions would be distinct as they are on Mars.



Vegetation along RIVER
VALLEYS that cross DESERT
Areas would appear as
DARK STREAKS, but
note they are not
straight as on
MARS, hence
the belief that
the latter are
G O B. ARTIFICIAL.

C. F. MORRELL.

Courtesy N. Y. Public Library

MARS AND EARTH COMPARED

A drawing of Mars compared with an imaginary view of the earth as it would probably appear from, say Venus. The difficulty of making out definite outlines is evident. When the earth and Mars are closest together, the earth would be invisible from Mars, because the unlighted or night-side of the earth would be turned toward our ruddy neighbor. Drawing by G. F. Morrell



AS H. G. WELLS IMAGINES
THE MARTIAN JUNGLE
TO BE

"A jungle of big, slender, stalky, lax-textured, flooded plants with a sort of insect life fluttering amidst the vegetation." Drawn by William R. Leigh for "The Things That Live on Mars," by H. G. Wells, *Cosmopolitan Magazine*, 1908



probability of life depend upon conditions.

First, there is no doubt that Mars has an *atmosphere*, although probably much less dense than on the earth. If it were as dense as that of the earth we could not see the polar caps so distinctly. The polar caps themselves are pretty surely the precipitation of some substance previously held in suspension as vapor in an atmosphere. When Mars is in the gibbous phase, the sunlit portion encroaches on the dark part, only explainable as due to

atmosphere. Mars is brighter near the edge than in the center, since we are looking obliquely through a greater thickness of atmosphere and this reflects more light. Although rare, clouds have been observed and photographed on Mars.

The spectroscope shows that there are *oxygen* and *water vapor* in the Martian atmosphere, although in smaller proportions than in the earth's atmosphere.

Although colder than on the earth, the *temperatures* do not preclude the possibility of life. The temperature rises well above freezing at noon in the equatorial



MARTIAN ANIMAL LIFE AS CONCEIVED
BY MR. WELLS

"The same reason that will make the vegetation laxer and flimsier will make the forms of the Martian animal kingdom laxer and flimsier and either larger or else slenderer than earthly types." Drawn by William R. Leigh for "The Things That Live on Mars," by H. G. Wells, *Cosmopolitan Magazine*, 1908

regions, and may reach or exceed 50 degrees Fahrenheit.

Water is present as vapor in the atmosphere, as snow in the polar caps, and probably as liquid in the regions between the polar caps. However, it is believed that desert conditions prevail over a great portion of the surface of the planet Mars.

With these conditions established, it is very probable,—but not surely proved,—that there is life on Mars; very probably plant life—possibly animal life as well. Professor Lowell maintained that there are intelligent beings on Mars, evident



Drawn by Warwick Goble

ANOTHER OF MR. WELLS'S IMAGINARY MARTIANS

This octopus-like creature is one of the highly intelligent Martians, who, in H. G. Wells's novel *The War of the Worlds*, invade the earth, and for a time terrorize England, where the story is laid. There is, of course, no evidence to suggest that such creatures live on Mars. This novel first appeared in the *Cosmopolitan Magazine* in 1897



IMAGINARY INHABITANTS OF MARS, ACCORDING TO MR. WELLS



"There are certain features in which they are likely to resemble us, and as likely as not they will be covered with teathers or fur. It is no less reasonable to suppose, instead of a hand, a group of tentacles or proboscis-like organs." Drawn by William R. Leigh for "The Things That Live on Mars," by H. G. Wells, *Cosmopolitan Magazine*, 1908

from the engineering skill necessary to construct the intricate system of canals which he considered a great irrigation enterprise, but his whole theory rests upon conclusions that are not generally accepted by astronomers.

No careful scientist would deny the existence of intelligent beings on Mars, but most will want more evidence before coming to a positive conclusion concerning the question.

Courtesy of the
N. Y. Zool. Soc.



ECHIDNA, THE SPINY ANTEATER

Note the peculiar, long,
recurved claw on the
hind foot

STRANGE ANIMALS OF THE ISLAND CONTINENT

The Second of Two Articles Descriptive of the Many Unique Animals of the
Australian Region

By H. C. RAVEN

Associate Curator, Comparative and Human Anatomy, American Museum

AMONG the many unique animals of the Australian region with which I have come in contact in the field, few are more interesting than the echidna (*Tachyglossus*). These spiny creatures, while they are rare enough on the mainland of Australia, are comparatively common in southwestern Tasmania, and I consequently expected little trouble in studying and collecting them there. That, however, was before I had a great deal of first-hand information about the ability of echidnas to hide. If one should set down a full grown echidna on a smoothly clipped lawn, it would take the animal only a short time, were he so inclined, to dig a hole straight down quite large enough to shield him from inquisitive eyes, for as an echidna digs down, the earth falls in over him. A few square inches of prickly spines might still protrude slightly above the ground level—spines which, while not barbed, as are those of the American porcupine, are quite sturdy and sharp enough to protect him from rough handling. Or, with a little

more time, he might well burrow completely out of sight in a hurriedly dug hole slanting slightly from the perpendicular.

With such ability to bury himself, it can readily be seen that the echidna is not one of the simplest creatures to find when one is hunting for him in more or less wild country, where tufts of grass, irregularities of the earth's surface, bushes, fallen trees, et cetera, all tend to aid him in his desire to escape detection. The result was that I had very little luck indeed, and the echidnas I saw were very few and far between.

By great good fortune, however, I met a prospector who was thoroughly familiar with the country and its wild citizens. In a talk with him I told him of my difficulties, and he assured me that my troubles were over. He had a dog, he announced, that was especially interested in the pursuit of echidnas. What the dog's idea was in such a hobby I cannot imagine, for once he located them he usually damaged his nose and paws on their spines, for echidna spines are notoriously hard on

inquisitive dogs. However, I was less interested in the dog's reasons for his interest than in his efficiency in locating the creatures, and I asked to see the beast.

I was introduced to a thoroughly mongrel creature that had all the friendliness of the average mongrel, and after a try-out, in which the dog promptly located an echidna and barked madly while I captured it, I purchased the "echidna hound" from his master. From that moment on my luck changed for the better, and echidnas no longer presented the problem that had troubled me before.

An adult echidna is likely to be in the neighborhood of sixteen or eighteen inches in length. It is thickly covered with short, heavy spines that normally lie slanting backward. When the animal is frightened, however, these spines stand much more nearly perpendicular, and present a phalanx of spear points that demand respect. Growing thickly between these spines is the creature's hair, the longer portions of which are stiff, while underneath is some very soft fur. The

animals are subject to considerable variation in color, but the variation limits itself to shades of brown.

The spines are much shorter in proportion to their diameter than are the quills of a porcupine, and they are not barbed. Furthermore, they are attached quite firmly to the animal's back, and do not come out when they impale an object, as porcupine quills do. They are two inches, or a little more, in length, and at their bases may measure as much as a quarter of an inch in diameter.

The animal's nose is long and thin, ending in two tiny nostrils and a mouth which, when opened to its greatest extent, is hardly more than a quarter of an inch in diameter. There are no teeth within this cavity, and the long tongue, which may be extended from two to three inches beyond the end of the nose, is supplied with a mucilaginous substance from large salivary glands, thus making the tongue a sort of natural strip of sticky fly paper.

The forefeet of the echidna are armed with very powerful claws, and with these



Courtesy of the N. Y. Zool. Soc.

THE PLATYPUS

(Ornithorhynchus anatinus)

This is the strangest of Australian mammals and the most primitive. Superimposed on its lowly heritage are many striking specializations for an aquatic life, to wit: short legs, large webbed feet, a flattened beaver-like tail, dense fur, and a ducklike snout

the little animal can tear apart the rotted and porous logs inhabited by the insects, the larval insects, the grubs and worms that make up its diet. Once the claws have made an opening in a log inhabited by a colony of termites, for instance, the thin, sticky tongue darts out and explores the numerous passages cut by the termites through the wood. The unfortunate residents of that raided colony then find themselves stuck to the rapidly moving tongue, whereupon they are drawn into the mouth of the echidna and crushed between a rough pad that forms the back part of the tongue and a series of horny spines that grow, in lieu of teeth, from its palate.

To see one of these animals wandering slowly across an open place, when it has not been disturbed, is instantly to be reminded of nothing less than a tiny elephant, for its long nose, pointing toward the ground, has a most humorous resemblance to an elephant's trunk, and its body and short neck appear, at a distance, to be more or less the same in proportion as those of an elephant. Disturb it, however, even ever so slightly, and it changes its appearance utterly. It tucks its nose safely underneath. It sinks down on its short legs. It erects its spines, and lies still, having now become almost turtle-like in shape.

These animals do not bring forth their young alive, but following the methods of birds and reptiles, lay eggs. Only one egg is produced at a time, and this, which is about $\frac{1}{2}$ of an inch in diameter, white, and more or less spherical, resembles a turtle's egg more than anything else, its shell being leathery and tough. As is the case with so many Australian animals, the female echidna has a pouch, and in this the egg is carried, and, thus protected, the baby echidna is hatched. Nor is the new arrival thrust out into the cold world until, his spines beginning to develop, he makes it too uncomfortable for his mother.

For a time I occupied a shack in a

lumber camp in northwestern Tasmania, and kept an echidna as a pet. He lived in the board-floored place for some time, and, after I had thrust his nose into teaspoonfuls of milk several times, he learned to accept this new food. The room was not plastered, and I found, before long, that the little fellow could climb very well indeed. On one occasion I saw him waddle to the corner of the room, cling with his claws to the inequalities of the inside of the clapboards, and mount slowly to the very ceiling. He clung there for a time and then, quite abruptly, fell to the floor with a thump. He lay still for a minute and then ambled off, none the worse.

Occasionally I took him out and placed him on some insect-infected log, whereupon, with no hesitation, he would tear it open and search out the insects with his long, sticky tongue. If I picked him up he would promptly curl up defensively, but after a time, if I handled him gently, he would uncurl, and struggle mildly to escape. During the cold weather he loved to approach the fireplace and lie on his back before the blaze, soaking up the heat.

The fore claws of this animal are the more powerful, but each of the hind feet is equipped with an extraordinary instrument as well. As can be seen from the photograph of the echidna at the head of this article, one claw on the hind foot is exceptionally long, and curves out in a truly remarkable fashion. This is useful when the animal is burrowing in the ground, and is then used to push the loose dirt out of the way. Its greatest value, however, seems to lie in the fact that it is long enough to be inserted between the spines and used as a back-scratcher. I have often seen my pet echidna thrust that long claw in between the spines on his back, and scratch himself with what seemed to be the greatest satisfaction.

The echidnas of the Australian mainland have more spines and less hair than those that live in the colder climate of



Courtesy of the N. Y. Zool. Soc.

THE RABBIT-BANDICOOT

One of the rarer and more specialized bandicoots. Its pelage is soft, and in color pearly gray and white, with some black on the basal part of its tail. Its hind feet are elongate, resembling those of the kangaroos

Tasmania, but aside from that there are only minor differences. There is a related animal, however—the proechidna (*Zaglossus*)—that is about twice the size of the echidna. It lives only in New Guinea at present, although some remains of the animal have been found in the Pleistocene deposits of Australia. It has longer legs than its Tasmanian and Australian cousins, has fewer spines, and a very much longer snout. Its habits, however, are somewhat similar to those of the echidna.

Another Australian animal that is as unique as the echidna, and is, perhaps, even more intriguing to the average person, is the duck-billed platypus (*Ornithorhynchus anatinus*). It lives in streams and ponds where it feeds on larval insects and the various invertebrate and perhaps vegetable life that it finds in the mud and sediments at the bottom.

The largest platypus lives in Tasmania and attains a length of about two feet. The smallest is found in tropical North Queensland, where it is not likely to grow to a length of more than eighteen inches. As everyone knows, it has a bill

remarkably similar, superficially, to that of a duck. The bill is broader and heavier, it is true, but its shape is not greatly different, and the creature's mouth, too, is ridged more or less as is a duck's.

In addition to possessing a ducklike bill, the animal has webbed feet. In this case it actually outdoes the duck, for the web extends beyond the claws, although, when the platypus wants to use its claws, the web can be folded back, leaving the claws exposed.

The platypus feeds in a manner closely resembling that of certain wild ducks, in that it dives to the bottom, secures a mouthful of material, and comes to the surface, where it washes the mud and other matter out before swallowing the food. If one should add to this that the creature lays eggs, one realizes what an amazing parallel this is.

Actually, of course, the platypus is a mammal with a coat of heavy, dark brown fur. As with the beaver, the outer coat is coarse, while underneath there is a coat that is very soft and heavy. The animal's tail, also, is beaver-like in shape



Courtesy of the N. Y. Zool. Soc.

THE TASMANIAN DEVIL

An ungainly carnivorous marsupial, whose head is extremely large and powerful, but whose brain is not much larger than that of a rabbit

—that is, it is broad and flat and rather heavy—but, unlike the beaver, the tail is covered with coarse hair, although on the underside the hair is very short.

The platypus does not have a pouch, and it lives in tunnels dug in the banks of streams or ponds. The entrances to these are about at normal water level, but the tunnel tends to rise at an angle until the end of the burrow—where the nest is built—is only a little distance under ground. This is probably done in order that the air may penetrate the ground to the nest.

The nest itself is made of grass roots, leaves, or twigs, of bits of bark, and other material that might be found floating in a stream or stranded along the bank. Here two eggs, attached to each other, are deposited—like those of the echidna, these are covered with white and leathery shells—and from them two platypusses are hatched. Being mammals, the baby platypusses live on milk, yet the mother has no teats. Instead, the milk oozes from special pores in the skin, and adheres to the mother's fur, from which the babies obtain it.

Because these animals live in the water

and under the banks of streams, they are not caught readily. I have, however, occasionally caught them alive, and though the males are armed with short sharp spurs on the inside of their hind feet, through which run ducts supplied with poison from poison glands situated on the backs of the thighs, I have never had one of them attempt to use his spurs on me. The actual use of these spurs is not thoroughly understood, nor is much known about the strength of the poison. From my experience with platypusses, it would seem that they do not inflict poison wounds consciously.

As is the case with creatures adapted to aquatic life, such as beavers, crocodiles, and hippopotami, the platypus has its ears, its eyes, and its nostrils all situated on the upper part of its head and nose. Thus with a minimum of exposure above the surface of the water, it can hear, smell, and see. One can guess from this how difficult these animals are to capture.

There are many other animals in Australia that are strange and unreal to the inhabitant of other portions of the world. Among these the rabbit bandicoot should

not be overlooked. It is a creature about the size of a large cotton-tail rabbit, and although it, too, is called a *rabbit* bandicoot, it is not a rabbit at all. Its Latin name, *Thalacomys lagotis*, might be translated "pouched mouse with ears like a rabbit." Its long ears are somewhat rabbit-like. Its nose is decidedly like that of a shrew, but except for these superficial resemblances, it is decidedly a marsupial.

It is a pouched animal, that brings forth from four to six young, each of which, at birth, is about three quarters of an inch in length. As is the case with all pouched animals, the young are born when very much underdeveloped, and they live in the pouch until they are able to hop along with the mother. This mother, however, travels on all fours, unlike the kangaroo, and the pouch is ingeniously turned around so that the entrance is toward the rear, thus keeping twigs and other foreign matter from sticking into the pouch when the mother is walking or running.

Until the young are about the size of

large rats they live in the pouch, but then they are turned out, although they often stay with their mother for months—sometimes as much as a year. They live in the dry country of Australia, although they are not desert dwellers. Their burrows are dug in the plains, and their food is made up of grubs that they obtain from about the roots of plants, and from vegetable matter as well. Their fur is a beautiful pearly gray, and their tails are tipped with white, although most of that appendage is black.

The Tasmanian devil (*Sarcophilus ursinus*), on the other hand, is a carnivorous animal, limited, now, to Tasmania. It is not greatly different in size from the American badger, but its head is very large in proportion to its body. It is an eater of carrion, but is perfectly willing to attack any animal that is not too large. It is even said that, formerly, when these "devils" were more numerous, they would enter sheep pens and kill sheep.

I was out one night looking over some traps and had with me a dog that normally



Courtesy of the N. Y. Zool. Soc.

THE WOMBAT

A robust bearlike vegetarian that spends its days resting in long deep tunnels of its own making. At night it wanders about searching for leaves and roots of various grasses and shrubs

seemed able enough to care for himself, when I was suddenly startled by a series of frightful wails not greatly unlike those of a cat. The dog appeared from nowhere in the dark and stood tightly against my leg, the bristles on his back erect, and his legs quivering with fear. Investigation showed that two very lively and indignant Tasmanian devils were caught in two traps that were near each other, and although the dog had not been harmed, he certainly showed no inclination to attack the animals. As soon as I drew near the captives, however, they ceased their caterwauling, and did nothing except open their mouths and hiss in a manner not greatly different from that of an American opossum. I picked them up by their tails and carried them to camp, and although they protested a little, their protestations were so mild as to make no trouble.

On another occasion one of them (during the night apparently) got into the kitchen at the lumber camp where I was staying, and proceeded to crawl into the oven of the stove, in which there was no fire. In the morning the cook closed the oven door, lit the fire, and was amazed, when the stove began to heat up, to hear a frightful rumpus proceeding from his normally well behaved stove. Investigation showed him what caused the trouble, he promptly closed the stove again, and left it closed until the poor beast was dead. It was with great difficulty that I persuaded the men at camp that the animals could be carried safely by the tail.

Another pouched animal of Australia and Tasmania is the wombat (*Phascolomys*), a good-sized specimen of which will weigh more than a hundred pounds. Fossil wombats have been found of great size—some of them must have weighed as much as a grizzly bear—but nothing approaching that size is extant. They are vegetarians, living mostly on grass and leaves. They dig deep burrows, and bring forth their young one at a time. Wombats

are to be found in the southern half of Australia and in Tasmania, where they are hunted for their skins, which are sold widely in the fur market. The fur is somewhat grizzled, and their color is a grayish brown, but it must not be supposed that every skin one sees for sale as “wombat” is in reality wombat. Other skins often bear that name by the time they appear in the shops of furriers.

It cannot be said that wombats are dangerous, and yet one should use some care in reaching into their burrows after them. If the collector makes the mistake of putting his hand into a burrow and getting it between a wombat’s powerfully muscled rump and the stones and gravel of the burrow wall, the animal is likely to push it very hard against the stones, and from such a predicament one can pull his hand only at the risk of leaving a certain portion of the skin behind. I have been told by experienced hunters, and I know personally, that the safest way to extricate one’s self from such a painful position is to reach in with the other hand, and touch the wombat on the other side, whereupon he will immediately push toward the opposite wall, thereby releasing the imprisoned hand. The hunter must, of course, see that he withdraws both hands quickly else he will merely be out of the frying pan into the fire.

The largest of the marsupial carnivores to be found in Tasmania is the Tasmanian wolf (*Thylacynus cynocephalus*). Formerly it inhabited Australia as well, as numerous fossil remains in caves testify, but it is now restricted to Tasmania.

These animals are as long as a wolf, to which they bear certain superficial resemblances, but they are not so tall, nor are they so efficient. The dingo, which is a real dog, has probably been responsible for their extinction in Australia, but as this animal, which apparently came to Australia, probably from Asia, during the Pleistocene, has never penetrated to



Courtesy of the N. Y. Zool. Soc.

THE TASMANIAN WOLF
(*Thylacynus cynocephalus*)

The largest flesh-eating pouched animal known. It is at present very rare and inhabits only the dense forests and scrubs of western Tasmania.

Tasmania, the Tasmanian wolf has been able to hold on there. These animals travel alone, while dingos, travel in packs, and with both man and dingos as enemies frequently the Tasmanian wolf was forced to give way. It seems possible, however, that his lease of life will still continue to hold in Tasmania.

Australia is still the home of many unique animals, but already many have been eliminated. The Australian native black, together with the dingos, some of which he has tamed, may possibly have been the cause of the extinction of the giant wombat as well as of *Diprotodon*, which was a huge, wombat-like animal as large as a rhinoceros. It seems possible, too, that *Palorchestes*, a kangaroo that stood, perhaps, fourteen or more feet in height, was eliminated by the same enemies; and the future of many of the present Australian and Tasmanian animals depends upon their protection from these same enemies. Some of them—such as certain of the arboreal, leaf-eating phalangers the food of which is not effected by rabbits—may survive, if their habits make it difficult for dogs, cats, and foxes to catch

them. Platypus, too, if stringent laws protecting it from man are put into effect, will probably manage to survive, but other than these, it seems highly probable that every animal that I have mentioned is doomed to extinction within a tragically short period.

The modern world is not kind to animals. Man, and the animals that man has introduced, will most certainly eliminate the major portion of the strange and fascinating creatures that are typical of Australia and the adjacent islands. For millions of years these animals have been able to develop and thrive because the open seas protected them from more powerful and more efficient animals of other portions of the world, but now, with man's lust for killing, and with his introduction of foreign animals, the native species are bound to go. No longer do the seas protect them, and as yet man has not realized that it is to his interest to do so. The time has not yet come for their epitaph, but there can be little doubt that it will be in order before many more generations have passed.

A TRAIL THAT LED TO MONGOLIA

The Story of Roy Chapman Andrews, Whose Unquenchable Enthusiasm
Has Carried Him to His Spectacular Achievements

By STEWART A. McWILLIAMS

TWENTY-THREE years ago a slim, light-haired young man, fresh from Beloit College, came into the office of Dr. Hermon Carey Bumpus, director of the American Museum of Natural History, and applied for a job—any kind of a job would do since there were no openings on the staff. He got the job—as a taxidermist, but for some time his main occupation was washing floors.

That was the initiation of Dr. Roy Chapman Andrews into the realm of science.

"I didn't mind it, though," he says, "for I was working in a place where the men to me were as gods."

On January 21, this year, Henry G. Bryant, president of the Geographical Society of Philadelphia, conferred upon Doctor Andrews the highest honor in the gift of the Society—the Elisha Kent Kane Medal, emblem of distinguished work in the field of exploration, and hailed him as being not only a distinguished scientist but also a great leader and executive of the same type as Commander Byrd, the last man to receive the medal two years ago.

During the years since he began washing floors in the American Museum, Doctor Andrews' career has been one of varied and frequently spectacular achievement. His first field work—as a taxidermist—was carried out with James L. Clark, now

assistant director of the Museum in charge of preparations, at Amagansett, Long Island, in 1907, where they skeletonized a whale.



THE MEDAL OF THE GEOGRAPHICAL SOCIETY OF PHILADELPHIA RECENTLY PRESENTED TO DR. ANDREWS

This was only the start. The next year he traveled and explored in Alaska. He was recalled from a trip up the St. Lawrence River to be sent as special naturalist on the U.S.S. "Albatross" for a two years' voyage to the Dutch East Indies, Borneo, and the Celebes. He explored North Korea in 1911-12, and went with the Borden Expedition in 1913 to Alaska, where he made a series of studies of whales and other water mammals which gained him recognition as a leading authority on that subject.

In the performance of these tasks the qualities he constantly displayed of leadership, as well as his scientific ability, attracted attention. More than a decade previous, Prof. Henry Fairfield Osborn, president of the American Museum of Natural History and one of the world's foremost palæontologists, had prophesied that Central Asia would prove to be a great center of origin for much of the mammal life of Europe and North



THE REVERSE OF THE ELISHA KENT KANE MEDAL

America. The time had now come when the American Museum was prepared to test out his theory, and Roy Chapman Andrews was made the leader of the now famous Central Asiatic Expeditions.

The progress of the four expeditions sent out under his leadership so far has been marked by a series of epochal discoveries. They have explored Thibet, Southwest China, Burma, North China, outer Mongolia, and are now delving into the great treasure house of pre-historic remains they have uncovered in the Gobi Desert. Their finds have ranged from fossil mosquitoes to dinosaur eggs. They have discovered the oldest known mammals, hundreds of new species of animal life, and remains of primitive human life and other evidences which have convinced Professor Osborn that in Central Asia lies the cradle of man.

They have used motor cars for the first time in their Gobi Desert explorations, opening this vast plateau to modern commercial methods of transportation. They have found many geological strata previously unknown, the skull and parts of the skeleton of the largest known mammal—*Baluchitherium*—and the bones of other creatures stranger than anything man had ever imagined.

It was "in recognition of the unusual executive ability shown" in organizing and completing these expeditions, his "high qualities of leadership" and "the remarkable results obtained in different branches of science" that the Kane Medal was awarded to Doctor Andrews, as Mr. Bryant declared, when presenting it to him. But in this tribute he failed to mention the outstanding and perhaps the greatest quality of the man.

Today, Roy Chapman Andrews is just as enthusiastic about his work as was the young hero-worshipper who came to the American Museum years ago. In a sense he is still a hero-worshipper. He is a firm believer in the qualities of scientists as men, and one suspects that he measures

his own achievements not so much by their actual scientific value as by the magnitude of the difficulties overcome. It was this unquenchable spirit which gave him the courage last year to turn back with his expedition after months of dismal failure in the desert sands of southern Mongolia, and to strike into new territory to achieve a success even greater than he had hoped.

It is this attitude that enables him to keep his enthusiasm. One is inclined to feel that life is a succession of thrills to him—the thrills that come from overcoming great difficulties, from doing the things "which could not be done." When asked what has given him his biggest thrill, he confessed, "It is hard to tell," and after much hesitation he named the finding of the skeleton of *Baluchitherium* "because of the great size of the animal."

In his belief the personnel has been the biggest factor in the success of his expeditions. The scientific ability of his assistants is only a part of their qualifications. He declares that at least fifty per cent of their value is their ability to get on with other men.

Next to the human element he ranks a complete knowledge of the problems to be faced and careful preparation—down to the smallest detail, eliminating everything which may cause trouble by preparing for it in advance as much as is possible. Then, when the unexpected does occur, the emergency can be handled with the smallest amount of difficulty.

"But, no matter how carefully you prepare and study things out beforehand," he told a friend just before he started back to China, "something will always happen that you cannot possibly foresee. You never know what to expect. Still, that is one of the things which adds zest to the undertaking."

OGDEN MILLS

1856-1929

BY the death of Ogden Mills on January 29, 1929, the American Museum has lost a rare friend and a generous patron. He became a Trustee in 1910, when he succeeded his father, Darius Ogden Mills, whose many enterprises and interests he so faithfully carried on. During 1912 and 1913 he served as a member of the Auditing Committee and in 1914 became a member of the Executive Committee. The Museum has successively elected him a Patron, an Associate Benefactor, and an Associate Founder, in this way expressing esteem and gratitude to one who has been helpful in realizing the Museum ideal.

In building up an institution such as ours, with its wide scope and far-reaching influence, much depends upon the unseen forces which guide and shape its growth. Vision is needed, coupled with unerring judgment in choosing for development those phases of Museum activity which will prove of greatest benefit. Mr. Mills showed, through the many years of his useful life, just these needed qualities, and his fine discernment and square dealing in the field of capital and industry were carried over into the field of Museum administration. Known to his associates as a shy, kindly man, he had the underlying strength and wisdom characteristic of all great men.

Besides subscribing generously of his resources as need arose, he also chose to give of his interest and support to certain definite projects. Thus his name is closely associated with the construction of the fur seal group and with four of the Museum's expeditions, namely, the Crocker Land, the Fourth Akeley African, the Cañon del Muerto, and the Java expeditions. The scientific results obtained by each of these have amply proven their worth. Another of Mr. Mills's gifts is the series of Catlin paintings, which are now

on exhibition in the Eastern Woodlands and Plains Indian Hall. When the opportunity arose to acquire these originals by the famous Indian painter, Mr. Mills, realizing their historic importance, at once made their purchase possible.

The Library, too, was favored by his interest. It had been his habit for some years to present, as they came into the market, rare volumes in Americana and in various branches of natural history, especially ornithology, including a number of first editions. Among them are:

- GOULD, JOHN—27 volumes, including most of his famous monographs on the birds and mammals of Europe, Asia, and Oceania.
DE BRY, THEODORUS—*Peregrinationes in Indiam Occidentalem*. First Edition. 1590-1602.
DE BRY, THEODORUS—*Peregrinationes in Indiam Orientalem*. First Edition. 1598-1613
KINGSBOROUGH, LORD—*Antiquities of Mexico*. Colored Edition. 9 Folio Volumes. 1831-1848.
DE SPIX, J. B.—*Avium species novæ, quas in itinere per Brasiliam annis MDCCCXVII-MDCCCXX . . . collegit et descripsit* . . . J. B. de Spix.

By these gifts and finally by the gift of the collection of some twenty thousand volumes belonging to the New York Academy of Sciences, Mr. Mills brought the Library of this Museum to its present high rank among scientific institutions of the world. Having learned of the desirability of a permanent amalgamation of the Academy Library with that of the Museum, he paid a personal visit of friendly inquiry and shortly thereafter offered to purchase and present to the Museum the Library in question. It is due to his foresight, therefore, that the Museum now owns not only many rare monographs but also those early volumes of scientific periodicals around which it had for years been building up its files.

On January 4, 1926, Mr. Mills was appointed chairman of the Trustees' Library Committee and he continued in this office until his death. Always a friend, he left as a final token of his high regard for the aims of the Museum a bequest which will greatly increase the present endowment fund.

FREDERIC AUGUSTUS LUCAS

1852-1929

By ROBERT CUSHMAN MURPHY

Curator of Oceanic Birds, American Museum

TO speak of Frederic A. Lucas as a many-sided personality would not do him justice. In reality he belonged to a disappearing generation of wise men, schooled during a period when minds were not so highly specialized as today, unafraid to contemplate the whole scope of natural science and capable of becoming familiar with a surprisingly large part of it. In him were traits reminiscent of Benjamin Franklin. Both men had enjoyed a minimum of formal education, but both shared the inquisitive intellect, the shrewd understanding, and the retentive memory that enabled them to store away, and yet have always at hand, a fund of information amazing in its quantity and variety. Doctor Lucas' brain was a loadstone; he was so likely to know the answer to things that he became the arbiter of all sorts of questions that can arise to interest or perplex museum men.

To appraise our late honorary director at the height of his career, we must look back eighteen years, to the beginning of his term at the American Museum of

Natural History. He was then fifty-nine years old, a slight man physically but springy and vigorous. In appearance and

bearing he had changed very little for ten years. Neither did the succeeding decade bring perceptible alteration, for it was not until he had passed three score and ten that he can be said to have felt the weight of age. As the newly chosen director of the Museum he was entering upon the last stage of his career. What a foundation his extraordinary life had given him for this post!



Photograph by Champlain Studio

FREDERIC A. LUCAS, SC. D.

Director of the American Museum of Natural History 1911-1923, and honorary director 1923-1929

From early childhood in Plymouth, Massachusetts, where, according to

his own memory, his thoughts centered on animals, fishing, and other aspects of the out-of-doors, Lucas was taken by his father, a clipper ship captain, to the ends of the earth. Several times he crossed the Atlantic under sail. Twice he encircled the globe, spending months at sea. He strolled through the streets of Yedo (Tokyo), when the mere presence of a white boy, especially one with red hair, caused the Japanese to flock curiously in his footsteps. He witnessed stirring and bloody events at Shanghai, when the Chinese

showed early resentment against foreign penetration. He knew Peru in the terrible heyday of the guano traffic. Square-riggers in which he sailed dodged Confederate privateers through three oceans. And during all these wanderings his interest in natural history waxed continually; his notes and tabulations grew; his clever and faithful sketches, which are somewhat akin to the marginal drawings of a whaleman's logbook, multiplied. Seven pencil studies of totally unfamiliar fishes, made at the Chincha Islands in 1869, are today positively identifiable as to species. His notes on birds from the same region and period are just as usable as though made yesterday by an ornithologist experienced in that fascinating field.

Following his youthful voyages, Doctor Lucas began his labors at Ward's Natural Science Establishment in Rochester, an institution regarded as the great training school of natural history museums in America. The hours of work were from seven to six, and vacations were unknown, yet one gathers from Doctor Lucas' autobiographical notes that the leisure time of the Ward force was generally devoted to occupations related to the tasks of official hours. Among his associates of that period were Akeley, Townsend, and Hornaday, and the whole crew seems to have been filled with divine afflatus. Aside from the training in taxidermy and other museum methods, Doctor Lucas acquired at Ward's that extreme familiarity with the plan and variations of vertebrate skeletons which was to serve him so well in subsequent years. As he has remarked, one simply had to know bones before one could assemble perfect skeletons of a heron, an iguana, and a spider monkey, from a common disarticulated mess at the bottom of a maceration tub.

In 1882 Doctor Lucas went to the National Museum at Washington, filling

various posts connected with administration and with the sciences of anatomy and palæontology until he was called to be curator-in-chief of the Brooklyn Museum in 1904. During his career at Washington, however, he had been able to vary his routine by expeditions to the Gulf of St. Lawrence, to Funk Island, where he excavated the bones of the great auk, to Bering Sea for a fur seal investigation of far-reaching importance, and to the modern whaling stations of Newfoundland, where he laid the basis of his wide knowledge of the larger cetaceans.

When he entered upon his work in Brooklyn, Doctor Lucas fully believed that he had taken up his final task, and he put his whole heart into a matured scheme to express a new idea. Although hampered to some extent by local traditions, he succeeded in developing a hall of vertebrates which in clarity of plan, beauty of material, and enrichment by exhibits of biological significance, has perhaps not yet been surpassed. Corresponding exhibits of invertebrates were also partly installed under his direction, and an equally comprehensive botanical hall would have followed if the course of his life had not again been turned by the totally unexpected, and half-regretted, call to the American Museum.

Of Doctor Lucas' eighteen years of service to our institution others are more competent to speak. It may be profitable, however, to consider a little further the peculiarities of temperament and education that fitted him for such eminent success. When and how had he acquired his multifold abilities? He was accustomed to refer to himself as a man of scant schooling, and yet, in addition to his understandable knowledge of natural history, he wrote peculiarly lucid and expressive English; he could quote Virgil, his favorite Latin author, apropos of almost any occasion; he could speak very fair French. He knew the history of

biological science almost as well as the evolution of the museum idea, and he was never at a loss for an apt citation of Herodotus, Olaus Magnus, or Scripture, as those of us know who are familiar with some of the thousands of museum labels that have come from his pen. He could navigate a ship or build a boat. He could prepare exquisitely the skeleton of a tiny and delicate creature, such as a nestling humming bird. He was a good judge of taxidermy because he was also master of it. Dexterity in manual work, in fact, he always held in high regard; tools and a carpenter's bench were not considered beneath the dignity of office equipment. His penmanship was bold, clear, and attractive, and he was a skilful draftsman. Many of his line drawings have been published, not only in his own scientific papers but also in encyclopædic works of a generation ago.

Although Doctor Lucas' fame will doubtless rest chiefly upon his accomplishments as a builder of museums, let it not be forgotten that the insight of a genuinely scientific mind lay behind all this wider expression. As a matter of fact, he was a gifted research worker, and some of his friends among distinguished naturalists, including Dr. William D. Matthew, deeply regretted that force of circumstance had torn him away from the keenly analytical studies in comparative anatomy which he had carried through earlier in life. These related to all the classes of vertebrates. In ornithology, for example, he was among the first in this country to turn from the inspection and comparison of skins to more fundamental parts of a bird's structure, and a long series of papers on the skeletons and soft parts of swifts, humming birds, woodpeckers, honey-creepers, titmice, gallinaceous birds, *Hesperornis*, and others appeared chiefly between the years 1889 and 1900, throwing much new light on the re-

lationships of the families and higher groups of birds.

An outstanding example of the thoroughness and soundness of Doctor Lucas' anatomical investigations is that concerned with his views on the affinities of the penguins. When Stejneger, a master zoölogist, prepared the text on birds for the *Riverside Natural History* (1895), he grouped the penguins as a distinct super-order, equivalent in rank with the ostrich-like birds on the one hand, and with the Euornithes, or carinate birds, on the other. Lucas held strongly against this view, presenting excellent morphological reasons for his conclusion that the flightless, marine penguins are merely highly specialized members of the carinate sub-class, deserving of no very distinct rank in classification. Only in later years was this problem finally settled by further illumination of the embryology of penguins and by Wiman's researches on fossil penguins obtained during the Swedish Antarctic Expedition. The results entirely confirm Lucas' opinion.

Another triumph of his observations and their interpretation relates to his report on the Alaskan fur seal, after his residence at the Pribilofs during 1896 and 1897. The recommendations of the commission of which Lucas was a member were not only combated but were made to bear the brunt of violent calumny. We know, nevertheless, that the present flourishing state of the fur seal herds is due to action which he sponsored.

Doctor Lucas was a genial, deferential, always obliging, and sometimes almost shrinking, man, but anyone who mistook his self-effacement for moral timidity, or compromise with principle, was likely to be speedily enlightened. In addition to my association with him in museum work, we sat together for a number of years on the boards of directors of the National Association of Audubon Societies and the Explorers Club, and I have had occasion

to see how positive and unyielding he could be when the cause justified his position. His philosophy enabled him to take disappointment cheerfully, and he rarely expected to see even cherished plans carried out in their entirety. He often used an expression attributed to President Roosevelt, "Do what you can, now, with what you have."

The finest side of Doctor Lucas' character was always apparent in his courtesy, kindness, and perennial humor. These traits never lapsed, even during times of trouble. He never wore his heart on his sleeve. During long weeks when he was worried to distraction by the last illness of Mrs. Lucas, he kept to his accustomed Museum tasks as much as possible and preserved his usual demeanor toward friend and stranger. He was full of whimsical stories, and his humor sometimes took a highly sardonic form, as in his

famous regulations for the conduct of modern museums and the duties of the staff, beginning:

"A Museum is an institution for the preservation and display of objects that are of interest only to their owners.

"It is also a place where paintings, bric-a-brac, trophies of the chase, etc., may be deposited whenever their owner wishes to have them stored temporarily without expense to himself."

Doctor Lucas lived a long and rich life, and died practically in harness. We shall miss his comradeship and his inexhaustible funds of information, but the mellowness of his spirit will remain. If he had foreseen his end, I believe that he would have been content, and that he might have thought of the couplet inscribed on the title page of his unpublished bibliography:

"God be thanked, whate'er comes after,
I have lived and toiled with men."



"THE BRAIN FROM APE TO MAN"

A Review of the New Book by Prof. Frederick Tilney

By WILLIAM K. GREGORY

Curator, Comparative and Human Anatomy, American Museum

THE human brain with its twelve thousand million odd nerve cells¹ is an affair of such staggering complexity that there is some excuse for those who, like the present writer, too easily get lost in its super-labyrinths. Fortunately, the brain of the humble shark affords a key to the ground-plan of the human brain. Broadly speaking, the shark brain² as seen from above consists of a "nose-brain," an "eye-brain," an "ear-brain," a "skin-brain," and a "taste-brain," the latter grading into the spinal cord, while the "little brain," or cerebellum, rides on top of the eye-brain and the ear-brain. All these primary sensory centers are connected fore-and-aft in very intricate patterns by nerve fiber tracts.³

It has taken several generations of scientists to find out even in the most general way how this simple brain works. Suppose the shark's microscopic smelling organs, that are packed up in his rosette-like nostrils, get the scent of a piece of flesh floating on the water. The smelling organs thus stimulated send back their messages along the thick cable-like bundles of fibres of the olfactory bulbs to the forepart of the primitive end-brain or cerebrum. Here the discharge of these incoming currents sets off a new series of impulses that pass backward to various parts of the brain. Meanwhile perhaps the eyes have caught sight of the source of the odor and taste; messages from the eye-brain are flashed forward to the nose-brain and backward to the taste-brain. In general, the incoming messages or stimuli either reinforce each other or are balanced and played off against each other, so that after a very brief interval a definite "pattern," or make-up of messages is transmitted along the out-going motor nerves of the brain stem and spinal cord to the locomotor apparatus. The latter is set in motion, the shark turns and swims toward the desired object, and at the right moment the jaws open and snap,

and the throat muscles pass the meat down to the eagerly waiting stomach. This, of course, represents the simplest form of reflex action, uncomplicated by inhibiting factors.

The shark's front and hind pairs of paddles are represented in man by great bony and muscular outgrowths, which are the human limbs, including the hands and feet. The backbone, no longer horizontal, has been turned in man into the vertical position, and the weight of the body is cleverly balanced on the hind limbs. Thus the simple locomotor apparatus of the shark has given place in man to one of great complexity.

The brain of man has likewise advanced beyond that of the shark in the elaboration of a vast system of new control centers, which have grown out of and around certain of the old ones and which have greatly increased the complexity of the reactions accompanying even the simplest acts. The first and most conspicuous of these newer outgrowths is the greatly furrowed surface of the "neopallium" or upper division of the forebrain. The "frontal lobes" of the human brain are believed on good evidence to be the supreme court where the often conflicting impulses from the lower centers are held in leash and directed toward the channels favored by habit or by reflection. The "parietal region" of the brain, as is well known, has much to do with the conscious control of the limbs; the "temporal lobes" and adjacent parts are concerned with the memory of sounds, with the associations of sounds with other sensory images, and with the correlated movements of the organs of speech. The "occipital lobe" is concerned especially with visualizing.

The second major part of the human brain, which reflects the greater complexity of the human organism, is the little brain, or "cerebellum," which now consists of three huge, greatly folded divisions, one in the middle, the others on either side.

¹Donaldson, quoted by C. Judson Herrick in "Brains of Rats and Men," p. 4.

²*Ibid.* p. 71.

³*Ibid.* p. 132.

BRAIN OF
GORILLA
After Tilney



All this is preliminary to a brief notice of a recent work of the highest importance and interest entitled *The Brain from Ape to Man*, by Professor Frederick Tilney, the well known neurologist of Columbia University. The work also embodies chapters on the reconstruction of the brain stem of primates through the use of serial sections, by Dr. Henry Alsop Riley. The outer or surface areas of the brain having been treated by many other authors as well as in a previous work¹ by the same authors, the main theme of the present treatise is the comparative description and interpretation of the successive sections of the brain stem in a

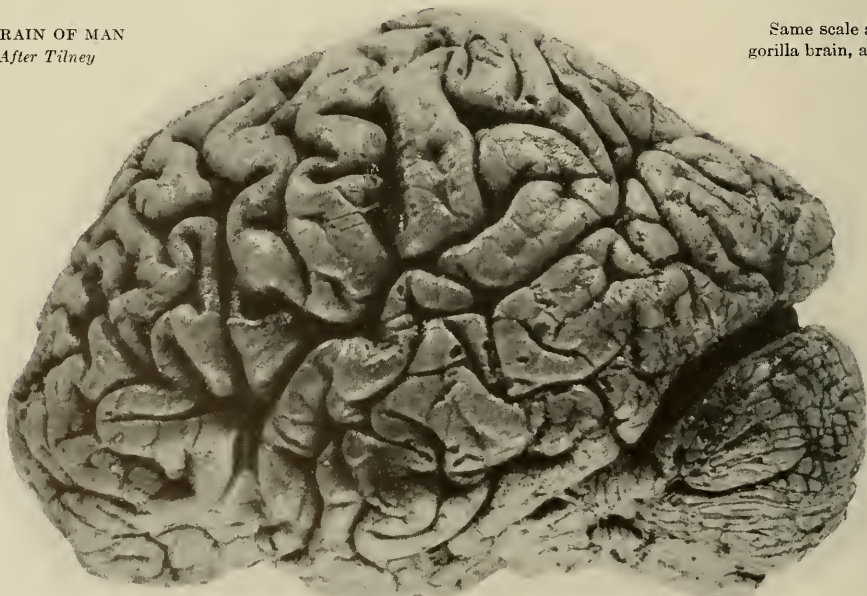
¹*The Form and Functions of the Central Nervous System.* New York, 1921.

considerable series of primate mammals from lemur to man. The brain stem contains the great conduction cables that lead down from the higher surface centers to the spinal cord, and Doctor Tilney has been able to show that its complexity varies almost directly with that of the centers above it.

One of the main results of the laborious studies by Doctors Tilney and Riley is a fuller

understanding of the evolution of *neokinesis*, by which is meant, in simplest terms, that in the mammals the new centers in the neopallium and other parts of the brain are tied in with, control, and partly take the place of the relatively simple reflex centers of the old shark brain. This "new movement" system becomes more and more complex as the capacity for skilled movements, as well as the general intelligence, steadily advances. There is good evidence for the inference that in the higher mammals, especially in man, the patterns of every posture, of every flowing stream of postural changes involved either in locomotion or in various special movements, as of the jaws and tongue, are predetermined by the neo-

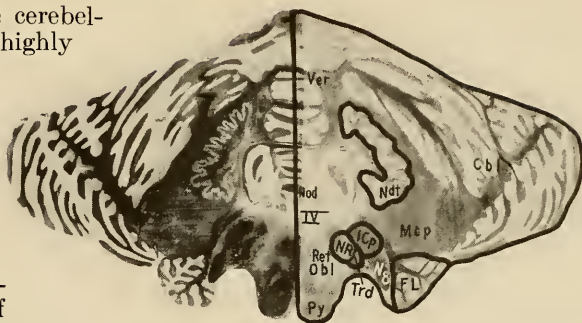
BRAIN OF MAN
After Tilney



Same scale as
gorilla brain, above

pallium, made up chiefly by the cerebellum and transmitted through the highly complex brain stem to the executive organs of the body.

The mammalian order of Primates, to which man belongs, is remarkable for the fact that, as compared with many other existing orders, it contains an unusually large number of "living fossils," or missing links, which in various parts of the world have, as it were, fallen behind in the ascent and have been content to remain on lower levels of existence, while some of their more progressive relatives have toiled on toward the summit. Students of the evolution of the skull, jaws, and teeth, of the hands and feet, as well as of the brain as a whole, have long since recognized that while the existing lemurs, monkeys, and apes obviously do not lie in the direct path of man's ascent, yet when studied in comparison with the known fossil primates of past ages, they do preserve in varying degrees the successive stages of that advance. To this body of recorded facts concerning the structural gradations among the primates, Doctor Tilney has now brought an enormous accession of new material, which sets forth the indisputable general progression of the brain from the lowest primates to man.



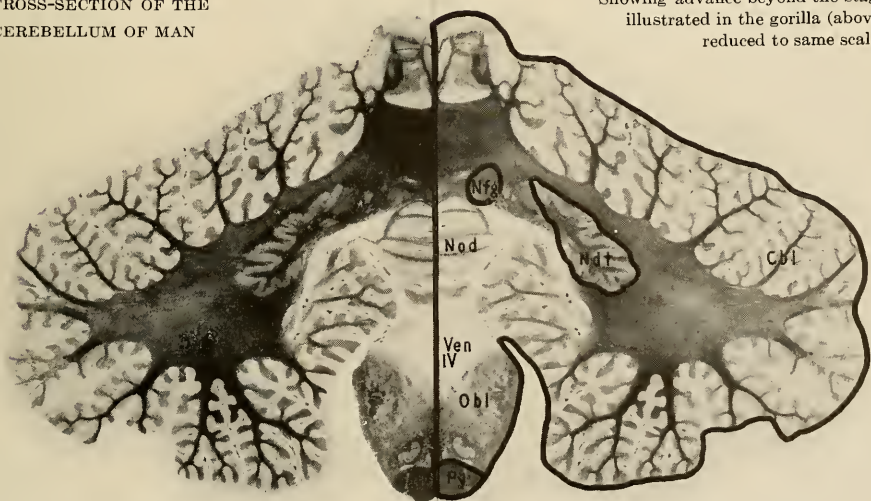
CROSS-SECTION OF THE CEREBELLUM OF GORILLA

Showing the complex folding of the lateral lobes and the high development of the dentate nucleus. The complexity of these structures reflects the relatively high ability of the gorilla to perform skilled movements of the body and limbs

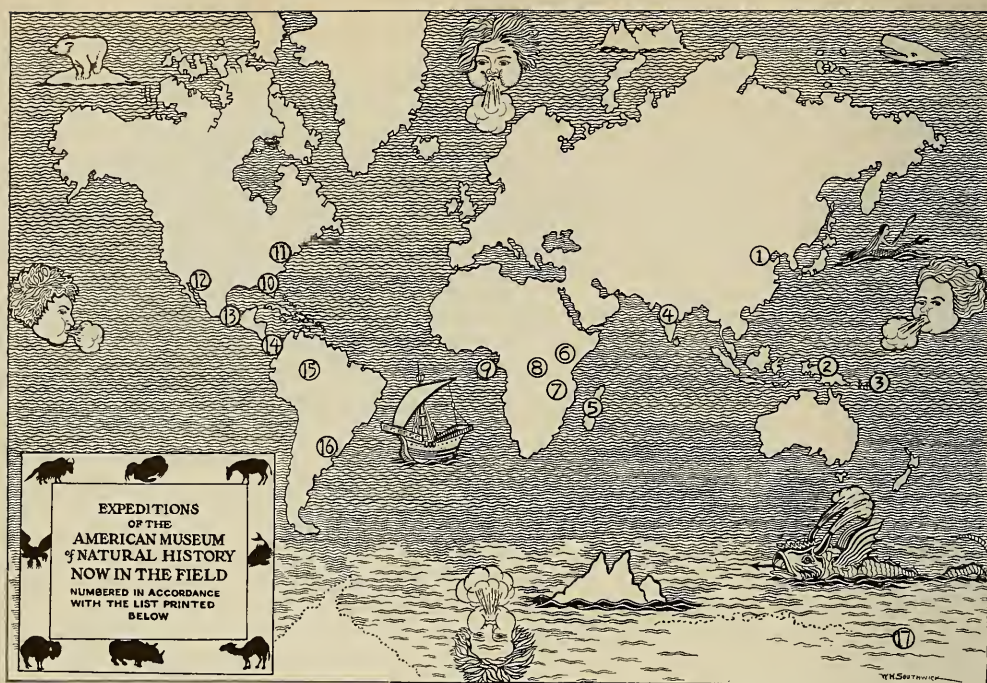
His studies also bring out more clearly than ever the fact that in respect to its brain structure, as in so many other ways, the gorilla is far nearer to man than he is to the lowest of the primates, so that from an evolutionary viewpoint there is now cumulative evidence for regarding the higher anthropoids as the backward and in certain respects specialized early branches from the primitive anthropoid base of the human family.

The publisher (Paul B. Hoeber) of this great work is to be commended for his courage and liberality in placing at the reader's disposal a store of costly, well executed plates in half-tone and colors.

CROSS-SECTION OF THE CEREBELLUM OF MAN



Showing advance beyond the stage illustrated in the gorilla (above, reduced to same scale)



1. Central Asiatic; 2. Beck, New Guinea, for birds; 3. Whitney South Sea, Solomon Islands for birds; 4. Vernay-Fauntshorpe for Asiatic mammals; 5. Madagascar for birds, mammals, and fossils; 6. Sanford-Patterson-Legendre, Abyssinia for mammals; 7. Straus, to Nyasaland for birds; 8. Tanganyika for birds and mammals; 9. Sao Thomé for birds (Thorne-Correa); 10. Simpson, Florida for fossils; 11. Chester A. Reeds, Lake Passaic varves; 12. Sante Fé for fossils (Frick-Rak); 13. Vaillant, Mexico, for archaeological finds; 14. Benson, East Panama for birds; Chapman, Barro Colorado for birds; Lutz, Panama, for insects; Blick, Honduras, for fossils; 15. Tyler Dujda, Venezuela, for birds and mammals; 16. Southeastern Brazil (Naumburg-Kaempfer); 17. Byrd, Antarctic.

TYLER-DUIDA EXPEDITION.—Mr. Sidney Tyler Jr., who was taking an active part in this expedition, as well as generously financing the project, has been forced to return to New York because of a tropical infection which could not be properly treated in the field. The other members of the expedition have remained at Mt. Duida where they continue to collect the mam-

mals and birds of this little-known district of South America.

DR. FRANK E. LUTZ is now carrying on experimental work with tropical insects at the laboratories of Barro Colorado Island, Panama.

DR. GEORGE GAYLORD SIMPSON, associate curator of mammals, has been in Florida since February 1, and will continue during the month of March, making an extended trip over the entire state, collecting vertebrate fossils in collaboration with Mr. Walter W. Holmes of St. Petersburg, and the State Geological Survey of Tallahassee. In a letter dated February 13, Doctor Simpson reports finding a skeleton of a *Manatee* in a fuller's earth mine of Middle Miocene age—a rare fossil. Doctor Simpson's extended work will clear up many problems relating to the distribution of late Tertiary vertebrates in Florida.

ASTRONOMY

A MOST GRATIFYING EVIDENCE of the growing interest in the Amateur Astronomers Association was the attendance of 1426 persons at the recent lecture by Oliver P. Medsker, on Jupiter, accompanied by the motion picture of that planet made by Prof. William H. Wright of the Lick Observatory.

ON MARCH 6, Mr. Wallace J. Eckert, astronomer of Columbia College, gave an illustrated talk on "The Minor Planets: Asteroids."

MARCH 20, Dr. Henry Norris Russell, director of Princeton University spoke on "Analyzing the Sun."

APRIL 3, Garrett P. Service will tell of some "Experiences of an Amateur Astronomer."

APRIL 17, Mr. Worcester Reid Warner will describe a "Starry Night at the Lick Observatory."

STUDY GROUPS.—The Amateur Astronomers Association is now conducting the following study groups for the benefit of its members at the American Museum:

The regular meetings of the Amateur Astronomers Association are held every first and third Wednesday of the month at 8:15 P.M. For full information address Dr. Clyde Fisher, president, or Miss M. Louise Rieker, Secretary.

EDUCATION

A JUNIOR ASTRONOMY CLUB has been organized as one of the activities of the Museum's division of public education, in coöperation with the department of astronomy. Miss Elizabeth A. Eckels, staff assistant in education, will direct the members, who will be boys and girls from public and private schools that have attended the fall term of lectures and talks on astronomy given by Dr. Clyde Fisher and Miss Eckels. Children of members of the Museum will also be represented in the club membership.

It has been arranged that one half of the membership will meet from 8 to 9 P.M. on the fourth Friday of each month, and the remaining half at the same hour on the fourth Saturday, thereby making it possible to keep the attendance at each meeting sufficiently small to afford the children the best opportunity for star gazing through the telescopes used by the adults of the Amateur Astronomers Association.

The following program has been planned:

March 29 and 30—CLYDE FISHER, Jupiter and His Moons; Orion, the Mighty Hunter.
April 26 and 27—OLIVER P. MEDSKER, Venus and Mars; Canis Major, the Big Dog; Taurus, the Bull; Gemini, the Twins.
May 17 and 18—MISS JEAN CONKLIN, The Moon; the Great Bear; the Little Bear.
June 28 and 29—CHARLES LIEBMAN, JR., Sunspots (A Daylight Meeting).

THE NATURE TRAINING SCHOOL, under the general direction of the Coordinating Council, on Nature Activities, which was held last year at Camp Andree, Briarcliffe, New York, will be held at Gardner Lake, Connecticut (near New London) throughout the month of June, with three periods of two weeks each, June 1-15, June 8-22, June 15-29.

STUDY GROUPS OF THE AMERICAN ASTRONOMERS ASSOCIATION

LEADER	EVENING	TIME	SUBJECT	MEETING PLACE
Mr. C. A. Federer, Jr.	Every Tuesday	7:30 to 9:30 P.M.	Learning the Constellations	Astronomy Hall
Mr. S. L. Toplit	Every Tuesday	8:00 to 9:30 P.M.	Location of Prominent Constellations	Room 201 School Service Bldg.
Miss Jean Conklin	Every Wednesday	7:15 to 8:15 P.M.	General Astronomy	Astronomy Hall
Mr. Frank Reh	First and Third Wednesdays	7:15 to 8:15 P.M.	The Stellar Universe, Nebulae, etc.	Room 202 School Service Bldg.
Mr. Paul Shogren	Second and Fourth Wednesdays	8:00 P.M.	Elementary and General Astronomy	Academy Room
Mr. Cornelius Wolff	Every Thursday	8:15 P.M.	Light; and later, Elements of Physics as Applied to Astronomy	Room 202 School Service Bldg.

Telescopes, apparatus, stereopticon, charts, blackboards, etc., are used.

Courses will be conducted in Forestry and Tree Study, Geology, Map Making and Surveying, Botany and Plant Ecology, Insect Life, Plant and Animal Life on Land and Water, Bird and Star Study, Outdoor Sketching, Photography, Indian Gardening and Lore, Music Interpretations with reference to Nature, Nature Education, Nature Excursions, Trails, and Games.

Following these June courses, and correlated with them, will be a trip of observation and study to the White Mountains in July, and in August a trip to Labrador especially for a study of the geology, botany, and ornithology of the Labrador coast area.

For full information concerning these courses write to Dr. Bertha Chapman Cady, Coordinating Council on Nature Activities, The American Museum of Natural History, 77th Street and Central Park West, New York City.

Oglebay Park School at Wheeling, Virginia, will also hold a training session from June 15 to 29, after which the students are invited to participate in the intensive field work program in the White Mountains and Labrador.

At the AVIATION SHOW held in New York City from February 6 to 13, the American Museum had a large booth devoted to a presentation of the important part astronomy has always taken in world exploration, and its close affiliation with present day exploration by air. The Museum's collections of meteorites, astronomical instruments, paintings, and books of travel attracted many visitors.

FISHES

A MEMORIAL TO DR. BASHFORD DEAN.—As a memorial to Dr. Bashford Dean, the present exhibit of fossil fishes in the southeast rotunda on the fourth floor of the American Museum is being enlarged and perfected, and will be known hereafter as the Bashford Dean Memorial Exhibit of Fossil Fishes. The work is in the hands of the Bashford Dean Memorial Committee, consisting of J. Leroy Conel, Hawthorne Daniel, Cleveland Earl Dodge, William King Gregory (chairman), Eugene Willis Gudger, Francesca La Monte (secretary-treasurer), John T. Nichols, Henry Fairfield Osborn, Mrs. George W. Perkins, George H. Sherwood, Bertram Smith, Alexander McMillan Welch. This committee is now engaged in having made a bronze bas-relief tablet bearing a portrait of Doctor Dean, that is to be placed at the entrance to the exhibit.

Fossil Fishes from Mt. Lebanon.—Through the courtesy of Dr. Alfred Ely Day, the department of ichthyology is in receipt of a valuable exchange from the American University at Beirut,

Syria, consisting of a collection of fossil fishes from the Mt. Lebanon district.

CONSERVATION

FORESTRY IN MOTION PICTURES.—To show fire-fighting, woods management, and other forestry principles and practices visually, the Office of Motion Pictures of the United States Department of Agriculture has prepared for the forest service of that department, thirty-five educational motion pictures on forestry subjects. Fire prevention, forest uses, reforestation, logging practices, recreation, and grazing are among the subjects covered. The films are loaned free for short bookings, or may be purchased at cost by outside agencies. Purchases are made through the Department of Agriculture.

HONORS

DR. ROY CHAPMAN ANDREWS was awarded the degree of Doctor of Sciences by Beloit College, Beloit, Wisconsin, on December 18.

DR. ROBERT BROOM, whose researches cover a period of thirty-three years in Australia and South Africa, was awarded the medal of the Royal Society at the anniversary meeting November 30, for his "valuable contributions to the determination of the relationships of the main groups of vertebrate animals, and to the definition and solution of the problems involved in the evolution of the higher groups."

THE MUSEUM LIBRARY has received as a gift the seven volumes of the Amiens Edition of *Sources Records of the Great War* which have been published by the National Headquarters of The American Legion. The volumes are registered in the name of The American Museum of Natural History and dedicated to the memory of CHARLES A. CONNOLLY of the American Museum staff, who gave his life while in the service of his country. Each volume has a distinct binding which in every case is a facsimile of the original art binding on the official copy of the Versailles Peace Treaty belonging to a stated country. The records are non-partisan, non-sectional, and non-sectarian, and will prove of increasing value as time goes on.

MINERALS

THE ADVANCE in the science of mineralogy that has marked the year 1928 may be said to express a tendency rather than a notable achievement. The science has largely outgrown the period of unrelated observation of facts, and has for more than a decade turned to the broad interpretation of existing data and those special investigations relating to the establishment of basic truths.

Much of this modernism in mineralogic research dates from the definite establishment of a knowledge of the atomic structure in crystals as revealed by the X-ray. Throughout the world more investigators are turning each year to this new and fruitful field of scientific endeavor, and the literature of 1928 has shown a high percentage of papers embodying new knowledge of the atomic structure and atomic groupings in crystals of minerals.

In the field of mathematical crystallography, a valuable compilation contributed to the literature of 1928 is the *Crystallographic Tables for the Determination of Minerals*, the work of Victor Goldschmidt and Samuel G. Gordon.

A number of new species have been discovered during the year, including two from the famous locality of Franklin, New Jersey.—H. P. W.

SCIENCE OF MAN

MONGOLIAN COLLECTIONS.—The latest collection of archaeological material to arrive at the Museum is that obtained during the summer of 1928 by the Central Asiatic Expedition in south-central Mongolia. Mr. Alonzo W. Pond of Beloit, Wisconsin, who served as archaeologist for the season, brought on the collection toward the end of January, having held it in Beloit since his return from the Orient last September in order to prepare his report on the same. Before this report can be published, however, it will be necessary to number and catalogue the specimens.

The new collection filled five moderate-size cases and comprises probably between 10,000 and 15,000 specimens. In quantity and general character this material corresponds pretty closely to that obtained by Curator N. C. Nelson in 1925 in west-central Mongolia. The 1925 collection is apparently stronger in culture levels; but the 1928 collection is somewhat richer in variety of artifact types, especially in objects made of bone. Both collections are however made up largely of flaked and chipped stone pieces; and of the 20,000 to 30,000 such objects now available, it must be emphasized that only a very small fraction are real implements, the vast majority being merely reject cores, flakes, and chips resulting from the production of implements. Nevertheless, our collections do furnish duplicates of a goodly series of typical stone tools and weapons, some of which, as has been repeatedly indicated, antedate the true Neolithic culture stage.

—N. C. N.

ENGLISH COUP-DE-POING.—An exceptionally large coup-de-poing, or hand-held implement of Chellean type, was recently brought for examination to the office of Honorary Director F. A.

Lucas by the owner, Mr. P. L. Munford, of Decatur, Georgia. The tool, or weapon, in general outline and contour resembles a large spearpoint. It measures $2\frac{3}{4} \times 4\frac{1}{2} \times 11\frac{1}{2}$ inches and might have served a powerful man very well as a stabbing implement. According to the owner, this specimen, with eleven other flint artifacts, was found by his father, about the year 1865, at a depth of forty feet in the deposit composing an old bed of the river Oxe, near Leeds, Yorkshire, England. The rare piece is said to have been exhibited as a loan, in the British Museum for about thirty years.

Doctor Lucas very kindly brought the specimen to the attention of the department of anthropology and in response to our interest, and with the owner's consent, he superintended the making of four excellent casts, scarcely to be distinguished from the original. One of these casts has been placed on exhibit in the English Lower Palaeolithic section in the archaeological hall.

—N. C. N.

LAUSSEL SCULPTURES.—Through the continued interest and good offices of President Osborn, the department of anthropology recently received excellent casts of the two most important of five remarkable human rock-sculptures discovered about 1910 by Dr. Gaston Lalanne of Bordeaux at the great rockshelter of Laussel, near Les Eyzies, Dordogne Department, France. Doctor Lalanne having died recently, to the great loss of French prehistoric studies, the American Museum is deeply indebted to Madame Lalanne for permitting and superintending the castings.

Illustrations of both these bas-relief sculptures are given in Professor Osborn's *Men of the Old Stone Age*, pages 328-9. One represents a woman holding in her raised right hand a curved horn, and is executed in considerable detail, except that the lineaments of the face are not brought out. The other is the incomplete figure of a man, thought by some to be represented in the act of drawing a bow or throwing a spear. Both figures are done in about two-fifths natural size. The rockshelter yielded three additional female figures, the best one of which found its way to the Ethnographic Museum in Berlin, where it is to be hoped we may ultimately obtain a suitable cast. The two specimens available have been placed in one of the two Palaeolithic Art cases in the archaeological hall.

—N. C. N.

THE SHOEMAKER LOAN EXHIBIT.—Recently, Mr. Ernest Shoemaker of Brooklyn, a long-time friend of the Museum, placed in our archaeological hall an interesting loan exhibit of 1000 selected specimens. This collection, which is to remain

on exhibit for a term of five years, is of interest for several reasons. It comes from the District of Columbia and can scarcely ever be duplicated. It comes from 22 definitely known sites, situated for the most part along the banks of the Potomac and Anacostia rivers. It is fairly complete and representative for the general region in question. Finally, it represents the avocational interest of Mr. Shoemaker—begun when he was eleven years of age—during his residence in Washington between the years 1877 and 1892. The collector modestly explains, however, that he received his inspiration, as well as some specimens, from his uncle, Dr. Wm. L. Shoemaker, who began collecting in the locality before the Civil War, and that, moreover, his own brothers, Dr. F. Shoemaker, C. W. Shoemaker, and George Shoemaker, also made minor contributions to the final inventory, now totaling about 2500 pieces. In other words, the Shoemaker collection is, as it were, a family monument.—N. C. N.

PALESTINIAN FLINTS.—A collection of 265 chipped flint artifacts from surface sites in Palestine and from rockshelters in the vicinity of Beirut, Syria, was transmitted to the department of anthropology early in January. This shipment, together with a fossil collection, was sent to the American Museum last summer by Prof. Alfred Ely Day, of the American University of Beirut, and is important to us, being the first archaeological material from southwestern Asia so far obtained by the Museum.—N. C. N.

THE AMERICAN MUSEUM'S small but growing collection from Lapland has been enriched by the gift of a Lapp woman's fur coat, presented by the noted author Hendrik Willem Van Loon.

A CACHE OF STONE DART POINTS has been forwarded to the American Museum by L. E. Bryant, Roberta, Tennessee. Forty-seven of these points, all of the same form, were found in a rockshelter, beneath a flat stone. From time to time such caches are found, indicating that even primitive man was thrifty in accumulating a store of weapons to be available in times of need. On exhibit in the Museum's archaeological hall, on

the second floor, is a large case filled with a cache of chipped blanks from which points could be made. This is one of the largest caches so far discovered in North America.

OBITUARIES

In the death of Mr. CYRIL GUY HARROLD the Museum has suffered the loss of a very able man. Mr. Harrold was born in England in 1895 and died in New York, February 4, 1929, of meningitis. For the past fifteen years he had been residing in Western Canada and making expeditions into parts of Labrador, the Canadian Northwest, Alaska and the Aleutian Islands. His interest lay principally in birds, and with them he was remarkably well acquainted.

A recent paper written jointly with B. W. Cartwright is entitled "An Outline of the Principles of the Natural Selective Absorption of Radiant Energy" and was published in *The Auk* during 1925. In it is developed the author's interpretation of the meaning of color in birds and of the nature of the chemical changes that have to do with the seasonal fading in the hues of feathers.

Mr. Harrold was on the eve of sailing as a member of the Madagascar Expedition which the American Museum is about to send in coöperation with the British Museum of Natural History and the Paris Museum of Natural History. To this undertaking he had devoted his heart and energies for several months. His passing is mourned by all of those who knew him.

As the magazine goes to press, word comes that DR. JONATHAN DWIGHT, research associate in North American birds, died at his home in New York City, February 22, 1929.

WILLIAM L. UNDERWOOD, widely known in the field of natural history, died on January 28 at Belmont, Massachusetts. Mr. Underwood studied and wrote on bacteriology as applied to the canning and preserving industries, and also devoted much time to the problems of the gypsy and the browntail moths, and to mosquito extermination.

NEW MEMBERS

Since the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum, making the total number 11,056.

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Associate Benefactor

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Rev. DR. WILLIAM PRALL, THEODORE F. SAVAGE.

Doctors J. GEIGER, HENRY T. LEE, RALPH EVERETT LEE, HOWARD E. LINDEMAN, ROBERT B. LUDINGTON, H. H. NEWCOMB, NICHOLAS J. POLTCHANINOFF, PHILIP COOK THOMAS.

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AUTHORS IN THIS ISSUE

Roy Chapman Andrews' brilliant leadership of the Central Asiatic Expeditions of the American Museum, and the world-wide interest in his publications, both scientific and popular, have won him a whole succession of honors and international distinction among explorers. His article in this issue "Further Adventures of the American Men of the Dragon Bones" brings the reader up to date on the experiences of the latest Asiatic expedition.

A trip around Cape Horn when he was a young lad, aroused in **John T. Nichols** so great an interest in the birds and fishes of the stormy Southern Ocean, that he later made a second trip, and though he has been curator of ichthyology at the American Museum for a number of years and has published much on fishes in general, his article in this issue entitled "At the Edge of the Antarctic Ice" proves to the reader how keen an interest Mr. Nichols still retains in those southern seas.

G. Lister Carlisle, Jr., the author of "Eleven Weeks in a Lion Pasture," was for eight years manager and part owner of a gold mine in Honduras where, in the intervals left to him by his work, he developed that intense interest in nature that ultimately caused him to organize the Carlisle-Clark Expedition to Africa. Mr. Carlisle's interest in animals is principally concerned with their conservation, and his own activities in the field are almost exclusively connected with the making of motion pictures of wild life. He has generously donated the lion group for the Akeley African Hall at the American Museum, his interest in which originated with his acquaintance with the late Carl Akeley. His article in this number of NATURAL HISTORY tells of the Carlisle-Clark Expedition, and especially reflects his interest in conservation.

When Rebecca Harding Davis, the authoress, visited Waynesville, N. C., some fifty years ago in search of local color, she bore a letter of introduction to the lawyer father of ten-year-old **Eugene Willis Gudger**. She took a liking to the boy, and when she returned home, sent him a copy of John Abbott's *Land and Water*. This book aroused in him a great interest in natural history, which subject he studied and afterward taught, becoming professor of biology at the State College for Women at Greensboro, N. C., in 1905. Here, in his leisure hours, he managed to turn out research work of such quality as to attract the attention of Bashford Dean. As a result, Doctor Gudger was invited to come to the American Museum in 1917 to work on the *Bibliography of Fishes*, and in 1919 Doctor Gudger became editor of Volume 3 of this great work. His article in this issue—"Wide-gab, the Angler Fish"—lies in the field in which he has specialized.

By an interesting coincidence, the publication date of this issue of NATURAL HISTORY is the twentieth anniversary of **Dr. Frank E. Lutz's** coming to the American Museum as assistant curator of invertebrate zoology. Later, when entomology was restored to the dignity of a separate department, he was made its curator. In addition to carrying on the more ordinary museum activities, the department has for the past four years maintained in the Harriman State Park a field laboratory where physiological work such as that described in Doctor Lutz's article, "Experiments with Wonder Creatures" has been done. However, this field station has not been devoted solely to research, for it was there that Doctor Lutz developed the "Nature Trail" method of outdoor education now being used in hundreds of places throughout this country and abroad.

Robert T. Hatt, assistant curator in the American Museum's department of mammals, who writes the "Odyssey of a Ground Squirrel," has devoted several years of study to the life histories of various North American rodents. Readers of NATURAL HISTORY will recall with pleasure Mr. Hatt's "Br'er Rabbit's Widespread Family" which appeared in the September-October number of last year.

Otis Barton especially interested in fossil primates of the Miocene and Pliocene. His article "Fossil Bones in a Persian Garden" describes his experiences in Persia last summer while searching for fossil remains.

Stewart A. MacWilliams, of the American Museum's department of printing and publishing, is a co-author of *China's Backgrounds*, a brief survey of China's art and culture. His interest in matters Chinese has fitted him especially to give to the readers of NATURAL HISTORY the personal glimpse of Roy Chapman Andrews that appears in this issue under the title "A Trail that Led to Mongolia."

"SUNSET IN THE GOBI"

In **A. A. Jansson's** painting that appears as the cover of this issue, the artist has caught, accurately, the color and the atmosphere of the Gobi Desert as the sun colors the western sky. When the painting was shown to Dr. Roy Chapman Andrews, whose long experience in the Gobi has made him the ideal critic of such a painting as this, and he was asked to make any suggestions for changes or corrections, he looked at the canvas for a moment and shook his head: "There is not a thing in it that I would have changed," he remarked. "The coloring is absolutely faithful to nature. The details are entirely correct. Even the man in the foreground bears a close resemblance to one I have long had on my expeditions. No, don't change it. That is the Gobi."

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FLIFTY-NINE years of public and scientific service have won for the American Museum of Natural History a position of recognized importance in the educational and scientific life of the nation and in the progress of civilization throughout the world. With every passing year the influence of the Museum widens, as is witnessed by the increasing number of visitors who daily enter its halls without the payment of any admission fee whatever.

THE NEW SCHOOL SERVICE BUILDING, with the increased facilities it offers, makes it possible to augment greatly the Museum's work not only in New York City schools but also throughout the country. Fourteen million contacts were made during 1928 with boys and girls in the public schools of New York and the vicinity alone. Inquiries from all over the United States, and even from many foreign countries, are constantly coming to the School Service Department. Information is supplied to, and thousands of lantern slides are prepared at cost for distant educational institutions, and the American Museum, because of this and other phases of its work, can properly be considered not a local, but a national—even an international—institution. Through its loan collections, or "traveling museums," which are circulated locally, 557 schools were reached last year, and 2,282,192 direct contacts were made with the pupils. More than a million lantern slides were lent to the New York City schools, and 4,851 reels of the Museum's motion pictures were shown in 223 public schools and other educational institutions in Greater New York, reaching 1,576,249 children.

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

THE LIBRARY, is available, for those interested in scientific research or study on natural history subjects. It contains 115,000 volumes, and for the accommodation of those who wish to use this storehouse of knowledge, an attractive reading room is provided.

MANY POPULAR PUBLICATIONS, as well as scientific ones, come from the Museum Press, which is housed within the Museum itself. In addition to *NATURAL HISTORY*, the journal of the Museum, the popular publications include many handbooks, which deal with subjects illustrated by the collections, and guide leaflets, which describe individual exhibits or series of exhibits that are of especial interest or importance. These are all available at purely nominal cost to anyone who cares for them.

THE SCIENTIFIC PUBLICATIONS, of the Museum, based on its explorations and the study of its collections, comprise the *Memoirs*, devoted to monographs requiring large or fine illustrations and exhaustive treatment; the *Bulletin*, issued in octavo form since 1881, dealing with the scientific activities of the departments, aside from Anthropology; the *Anthropological Papers*, which record the work of the Department of Anthropology; and *Novitates*, which are devoted to the publication of preliminary scientific announcements, descriptions of new forms, and similar matters. The Librarian of the Museum, who may be addressed in care of the Museum, may be called upon for detailed lists of both the popular and the scientific publications with their prices.

EXPEDITIONS from the American Museum are constantly in the field, gathering information in many odd corners of the world. During 1928 thirty-four expeditions visited scores of different spots in North, South, and Central America, Asia, Africa, and Polynesia, and nearly as many are now in the field continuing last year's work or beginning new studies.

From these adventuring scientists, as well as from other members of the Museum staff and from observers and scientists connected with other institutions, *NATURAL HISTORY MAGAZINE* obtains the articles that it publishes. Thus it is able to present to the constantly enlarging membership of the American Museum the most fascinating and dramatic of the facts that are being added to the Museum's knowledge, or are deposited in this great institution.

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Photograph by Alfred M. Bailey

A CITIZEN OF THE GULF COAST

The brown pelican is the largest of the nesting birds of the Gulf Coast, and its island cities are crowded with a dense population. When the downy young are quite small, the parents stand upon the edge of the nest to protect the babies from the direct rays of the sun.

—See "Wings Along the Gulf"

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XXIX

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WINGS ALONG THE GULF

Birds that Inhabit the Swamps and Islands of the Louisiana Coast—Hérons and Egrets—Pelicans and Terns—Geese, Gulls, and Others

By ALFRED M. BAILEY

Director, Chicago Academy of Sciences

THE coastal marshes of Louisiana are renowned as the wintering grounds of our northern breeding birds; hordes of ducks and geese wing their way from tundra lakes and arctic shores to the low lands bordering the Gulf of Mexico and seek refuge on the wide-stretching savannahs.

Many wild life reservations have been set aside in Louisiana, and ducks and geese of many species find food and safety within their borders. Snow geese, their black primaries dark against the sky, are a common sight, and ducks often are so numerous that it would be impossible to estimate their numbers. Blue geese are in flocks of thousands, and their quavering calls may be heard for miles when the wind is from the right direction.

Last fall I worked the marshes at the mouth of the Mississippi River, making my headquarters on the property of Mr. Joseph Leiter. This is in the center of the wintering grounds of the greatest flock of blue geese in existence. The blue goose has a very restricted winter range, limited practically to the coastal marshes of Louisiana. It is difficult to estimate the

number of birds, but this flock of geese, which was along the mouth of the Mississippi, numbered many thousands of individuals. I was so fortunate as to witness their arrival from their arctic breeding grounds, on October 25.

When we were chug-chugging down the bayou to our photographic blind along the shores of the Gulf, at nine in the morning, we flushed a flock of more than two thousand birds from the marsh. This horde went clamoring down wind to the mouth of Main Pass, where they rested in a great sea bend and acted as a decoy flock. We witnessed, in the next few hours, the most interesting flight of geese I have ever seen. From nine o'clock to four in the afternoon, at which time we left the blind, there was a continuous arrival of geese from the north. There were from one to three flocks in sight at all times, one flock following after the other over the same air trail, and the flocks averaged from 25 to 200 birds in each! They seemed to be calling to one another, the flocks in front guiding those in the rear.

Although Louisiana is famed for its



Photograph by Alfred M. Bailey

A HOME ON AVERY ISLAND

Many species of herons and other water birds are common here and, owing to the protection given them, are very tame. It has been Mr. E. A. McIlhenny's custom to haul branches to the shores of the pond during the nesting season that the birds may use them as nesting material

abundance of wintering birds, it also has an enormous avian population during the summer. The low marshes, mangrove swamps, and shell islands are the breeding places of thousands upon thousands of herons, gulls, terns, and other southern nesting forms.

The abundance of bird life along the coast is a lasting monument to bird conservation and to the men who caused legislation to be enacted for the preservation of our wild life. For it was not many years ago that feather hunting was at its height; there was a great demand for the plumes of the egret and the wings of the tern.

Boatload after boatload of hunters left the small settlements and scoured the shores for birds. They visited the heronries and shot the egrets as they were returning with food to their young, and they raided the colonies of the nesting

terns and gulls, killing the birds by thousands. The dull boom of black powder could be heard from all sides, and the slaughter continued as long as a target was found.

The result was inevitable; the birds were practically exterminated. And then came legislation to prohibit the killing of birds for millinery purposes, and President Roosevelt set aside many small islands as breeding sanctuaries.

For a few years it seemed the conservationists were too late, but gradually colonies were formed, the birds were allowed to breed in safety, and now, after twenty years of protection by the Federal and State governments, Louisiana has a wealth of bird life unequalled by any other state.

It has been my privilege to visit most of the interesting places among the lowlands of Louisiana in company with Mr.

Stanley C. Arthur, director of the division of wild life of the State Conservation Department. The department has several patrol boats and many efficient wardens constantly on duty, but of more importance is the campaign which it has conducted to educate the people of outlying communities. The inhabitants of the coast are a kindly and, for the most part, illiterate people, who make their living by fishing and trapping; they live along the tortuous bayous that thread through the marshes, far from the center of civilization, and it was only through education that their coöperation could be obtained.

The nesting birds of these lowlands and of the islands lying in the Gulf of Mexico have always interested me. Offshore, to the northward of Mr. Leiter's holdings, at the mouth of the Mississippi River, are the nesting grounds of many

thousands of "silver-winged" sea birds. I doubt if there is a like area in the world with a more numerous bird population. The little shell islands which a few years ago were barren of bird life, are white during the nesting season, with compact masses of terns, gulls, and skimmers.

A cruise over the shallow waters of this little bird world is a delightful experience. One season, Mr. Arthur and I started at Pass a'Loutre at the mouth of the Mississippi, and worked northward, visiting all the sand spits en route. It was June 1, and as we chugged through the pass late in the evening, we saw bands of pelicans stringing low over the water with slow, methodical wing beats. They were returning from their fishing grounds in the open gulf, and all were headed, like spokes in a wheel, toward the low-lying "mud lumps" which dot the waters well out from the main land.



Photograph by Alfred M. Bailey

A SNOWY HERON

The majority of these birds feed in the open marshes, often miles away from their nesting site, but occasionally a fisher bird may be seen stalking silently at the border of tangled growth, its wings reflected in the quiet waters



Photograph by Alfred M. Bailey

A PELICAN CITY

Pelicans in flight remind one of the reptilian-like birds of remote ages, for they assume grotesque postures as they launch awkwardly into the air, or as they sail above their homes preparatory to alighting



Photograph by Alfred M. Bailey

NEARLY FULL GROWN

These young pelicans were a clumsy lot as they sprawled awkwardly about, each one seemingly in the way of the others. They were usually tame, however, and made little effort to avoid a visitor in their midst



Photograph by Alfred M. Bailey

THE PELICAN CAFETERIA

Self service in is vogue at mealtime, and the young pelican with the most determination secures the lion's share of fish. The young are often so persistent in begging for fish that the adults often take wing to escape them



Photograph by Alfred M. Bailey

A GRAVE ASSEMBLAGE

Many of the young gathered in small parties and stood with great dignity upon the muddy shores. On occasion they have the bearing and solemnity of jurists drawn before the bar of justice, or of white-robed choristers



Photograph by Alfred M. Bailey

A COLONY OF NESTING TERNS

These are exceedingly tame birds and will often allow the photographer to walk within a few feet of them. Then, those on the outer fringe of the colony rise into the wind with the flashing of a myriad pearl-gray wings



Photograph by Alfred M. Bailey

A MAJESTIC SEA BIRD

Royal terns protect their young from the direct sun with drooping wings as they stand with crest erect and shriek their defiance to the world

The next day we visited these pelican cities and found birds in unbelievable numbers. Each island was crowded to capacity with great pouched, solemn-eyed tenants, and with hordes of wing-flapping, grunting, clumsy young, that stumbled over the uneven ground with great webbed feet splayed upon the heads of other youngsters too small or too slow to get out of the way.

As we landed from the skiff, all was confusion. Adult pelicans flopped overhead, making circles about their little island, while the large young formed into big bands and hastily swarmed into the water. We erected blinds that we might take photographs, and pry into the family secrets of the pelicans without their being alarmed. Scarcely had we concealed ourselves when a few of the parents dropped back upon the island; those with small "India-rubber" babies

were especially solicitous, and sheltered them with outstretched wings from the fierce rays of the semi-tropical sun.

The large downy pelicans were great beggars, and they pleaded for food from every adult in the vicinity, but they were usually received with vicious snaps of the strong beaks. The old ones were quarrelsome, and snapped bills at each other, especially when one would try to steal nesting material. The pelicans were so numerous that the material for nest building was at a premium, so, unless the owners held down their claims, other birds would steal the sticks with which they were made. It was amusing to watch a grotesque old pelican waddling unconcernedly along, until he came to an unprotected nest; he would grab a few sticks in his mouth, in spite of the protests of the young bird, and spreading his great wings, would lumber awkwardly into the air.



Photograph by Alfred M. Bailey

A LEAST TERN

When the adults alight near their babies, they hold their wings extended for a few moments and call excitedly with shrill, querulous voices



Photograph by Alfred M. Bailey

CABOT TERNS

The tern colonies are densely populated, each nesting bird owning as much territory as it can protect with its beak. Sparring with rapier-like thrusts of sharp beaks seems to be a way of passing time



Photograph by Alfred M. Bailey

THE AVERY ISLAND HERONRY

When feather hunting had nearly caused the extinction of the snowy egret, E. A. McIlhenny made an artificial lake on his estate and kept several pairs of herons captive during the summer season. These were liberated in the fall, and now the population of the colony is numbered in the thousands

An afternoon in a photographic blind on a pelican island is like a three-ringed circus; there is something going on all the time. The young pelicans which had paddled into the water on our arrival soon returned, and cluttered up the foreground so it was almost impossible to get pictures of other birds. Two, three-fourths grown, were a nuisance, for they seemed to be attracted by the lens protruding from the blind. They posed a few feet away, and refused to budge, in spite of our efforts to have them move along. Many old ones stood upright on their nests so that their shadows sheltered the small babies, and when a neighbor or a neighbor's offspring came waddling in the way, he was greeted with an angry snapping of beaks. Even the young ones would sit upon their heels and try valiantly to make noises with their rubber-like mandibles.

There seems to be no peace in a pelican city. There is a constant racket, a combination of weird sounds ranging from querulous caterwauls to elephant-like grunts. Most disturbances seemed to be caused by the constant begging of the young for food, and when half a dozen young pelicans, nearly full-grown, mobbed a parent bird for fish, there was continuous action. The young would thrust their beaks into the throat of the old one, in their anxiety for their suppers, and while one was being served the others whined as they milled about, stepping on each other's feet, and beating each other over the head with their wings. Near our blind was a nest of newly hatched young, black-skinned, naked fellows. When the old female stood alongside and opened her beak to feed one of them, the little pelican stretched to his full height and put his wobbly,

bald head into the mother's throat, until he was completely within the pouch.

After a day among the pelicans, we sailed northward over a rolling sea and dropped anchor at Breton Island. This was a favorite nesting place of the royal tern when Roosevelt made his cruise among the bird islands, but we found only a small colony, and none of the eggs had hatched.

Skimmers and laughing gulls rested upon the low bars, which were slightly awash with the rising tide; a pair of oyster catchers were upon a shell reef, their grotesque, orange-colored mandibles making them the clowns of the shore birds; while along the sandy, wind-blown beaches were many willets and Wilson's plovers. Nests of both species were found, the former in cuplike depressions in the wiry beach grass, and the latter upon the sand.

A willet staged a pretty show as she circled about us with drooping wings and cries of distress, flopping over the ground with all the appearance of a crippled bird. One of the men from the crew was completely fooled, and pursued the willet for a long distance until she gathered strength and took to wing. A Florida night-hawk was also flushed from under foot, and when we investigated, we found two protectively colored eggs in a slight depression in the sand. We marked the

spot, and on our return had no difficulty in getting pictures of the nesting bird.

A few hours later we landed on Hog Island, a small shell heap with a tangled growth of wiry salt grass and low mangrove bushes. Louisiana and little blue herons were nesting among the thick growths, laughing gulls' eggs were found in the grass, and skimmers' and royal terns' upon the beach. I photographed the Forster terns where they nested upon floating masses of dead grass in the arm of a sea bend; they were beautiful little fellows, with forked tails and bright orange-colored beaks and legs. They were reluctant to return to their eggs and



Photograph by E. A. McIlhenny

THE SNOWY EGRET

This most beautiful of the marsh birds nests in colonies in dense growths of button bush and willow, building its frail nest over the water



Photograph by Alfred M. Bailey

THE YOUNG OF THE LEAST BITTERN

Buff-colored, skinny little fellows, they perch on their frail platform among the tules until danger threatens; then they quickly tumble headlong into the rushes, where they remain quiet until the alarm is over

young at first, but hovered over the blind, uttering monotonous, querulous notes; finally, however, one of them dropped behind a screen of mangroves, and then, one by one, the others settled alongside their nests with their immaculate, silver-colored wings upraised for a few moments as they took a few short hops. The downy youngsters had crawled into the shade of near-by vegetation, but when the old ones alighted, they gave low calls, and little, fuzzy bundles came tumbling from their places of concealment, and took shelter under the drooping wings of the parents.

Laughing gulls nested on a ridge a short distance away, the three large eggs being laid in rather bulky nests of sticks and grasses. The whole gull colony scolded overhead as I put up my blind, but after I was concealed, it was not long until all was quiet and life went on as usual. The

bird I desired to photograph was reluctant to return at first, and stood behind a screen of mangroves for a long time, while I waited motionless with the camera ready. Finally, however, she climbed upon the nest and dropped upon her eggs before I could get a photograph of her standing over them. It was intensely hot, and the brooding bird panted and her body shook as she sat upon the nest, her mouth held open, and moisture dropping from the tip of her beak.

The next day we sailed over an opalescent sea to Grand Cochere, where we had found a great pelican colony the year before. The island was a foot under water! On Errol Island we found a great colony of sea birds,—Cabots and large royal terns. They were massed upon the gleaming shell keys in thousands, and their continuous screaming made it almost impossible for us to talk with

each other. We erected our blind in their midst and made many pictures. They were very quarrelsome and fought continually. The Cabot terns were particularly pugnacious and struck fiercely with their sharp-tipped beaks at the royals or their brother Cabots. The terns, like the pelicans, were very solicitous of their own young, but were extremely liberal with cuffs handed to their neighbors' children. They would peck the fuzzy little youngsters whenever they toddled into range, seeking shelter from the hot sun. The light was blinding, as it was reflected from the shells and the water, and the heat intense, and as there was no vegetation upon the shell of the nesting grounds, it was necessary for the babies to seek protection under outstretched wings.

The royal terns are strikingly handsome fellows, and remind one of turkey

cocks as they strut about with crests erect and feathers ruffled. The Cabots are contrasted by their smaller size and dark bills, but they are able to hold their own in a world of quarrelsome neighbors. There was a continual going and coming to the island as sea birds left for distant fishing grounds, while others returned with small fishes dangling from their beaks. The old ones were so quick in feeding the babies that I was never successful in getting a picture. They would stand off with the fish held crosswise in their beaks, and heads held high to ward off the attacks of others, and then one would suddenly dart in and cram a fish down a gaping maw before I could register it. The beach was so low that one catastrophe had already occurred, for we found one place where a wave had washed over a thousand eggs in one great windrow.

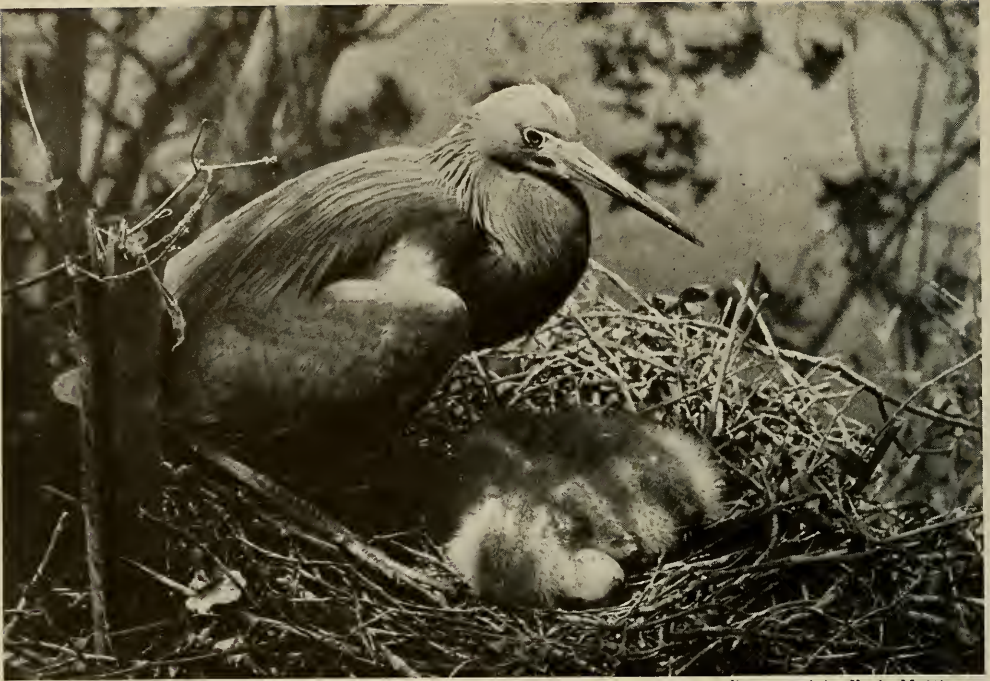
At the north end of Errol Island we



Photograph by Alfred M. Bailey

THE LAUGHING GULL

While gulls nest in colonies, the nests are usually isolated and hidden from one another by a screen of wiry salt grass. They are most reluctant to face the camera



Photograph by E. A. McIlhenny

GUARDING THE NEST

Adult Louisiana herons are more aggressive than the small egrets in protecting their homes. On one occasion Mr. Bailey found a yellow-billed cuckoo which had been killed with a jab from a heron's beak, as the cuckoo was attempting to steal an egg

found another large colony of terns—about thirteen thousand, we estimated. The Cabot terns were the most numerous, and fresh eggs were scattered about over a large area. Inland, on the higher slopes among the dense stands of mangrove, was a colony of pelicans, and attending them was a flock of several hundred man-o'-war birds. These predacious old fellows make an easy living plundering the hard-working pelicans of their fish. There was also a small colony of Caspian terns along an exposed strip of beach, while working the water's edge were several willets and Wilson's plovers. We were surprised to find two knots in breeding plumage—sandpipers which should have been north of the Arctic Circle at that time of the year.

We cruised along the Chandeleurs the following day, occasionally taking soundings as we passed over low bars, but we

did not land on any of the low, mangrove-grown keys, as there were few birds flying over them. Snowy egrets passed us on silent wing, poising overhead with their long necks outstretched, and an occasional Louisiana heron made excursions offshore to circle our boat, apparently out of sheer curiosity, but our time was short, and we did not care to investigate the Chandeleurs on that visit.

We headed for Free Mason Shoals, a great mangrove island with beautiful shell beaches, and a long sand spit that extended to the eastward. We saw oyster catchers upon the spit, and black-crowned night herons among the bushes. A colony of one hundred Caspian terns were on the highest part of the shell keys, nesting among the drift, while a couple of hundred royal terns were upon their nests closer to the water's edge.

There were several thousand laughing

gulls scattered among the wiry grasses, with fresh eggs in their nests, while of most interest to me was a colony of about seventy-five pairs of least terns. They flushed wildly when we came near, but I erected my blind upon the ridge where I found a few sets of eggs in little hollows among the gleaming oyster shells. The little "sea swallows" hovered anxiously overhead, their shrill, strident notes indicating their anxiety. When we were concealed, they began dropping to the shells, and in a few moments, what had appeared a barren mound was alive with downy youngsters.

The babies were so small, scarcely larger than golf balls, and so protectively colored, that we had failed to see them. They came tumbling from all sorts of places of concealment, from under shells or bits of driftwood, and many crawled within the shade of our blind for protection from the sun. When we lifted the canvas, several walked in!

The adults alighted within a few feet, and one was incubating an egg and sheltering two fuzzy youngsters at the same time; when we waved our hands from the blind, she would dart into the air with a quick stroke of the wings, circle about, and then alight, running to her nest with wings half lifted.

On a high beach near by was a large colony of skimmers, grotesque

fellows dressed in black and white, with long slender mandibles, the lower one being much longer than the upper. They were incubating their four speckled eggs which were laid upon the bare shell. There were also many solemn, long-legged, gray-and-black youngsters, and they usually tried to escape by taking to water or dropping flat upon the ground, hoping their dull colors would conceal them.

The terns, gulls, pelicans, and skimmers are typical salt-water birds. We studied and photographed them to our hearts' content on this little jaunt—just



Photograph by Alfred M. Bailey

AN INQUISITIVE BIRD

The Louisiana herons standing on their nests with necks silhouetted against the sky resemble a row of question marks. They allow a photographer to approach within a few feet of their homes before launching awkwardly into the air

one of many—among the gleaming keys.

There are many places along the Louisiana coast of interest to the bird lover, and I know of no spot more delightful than "Willow Pond" on Avery Island. This sanctuary has been described elsewhere, so I will not attempt to tell of the wealth of bird life that congregates on that little place of refuge. It is enough to say that thousands of snowy egrets, Louisiana and little blue herons, least bitterns, gallinules, and anhingas nest there in security.

In the dense cypress swamps surrounding the "island," which, by the way, is merely a high bit of ground rising several hundred feet above the surrounding marshland, are many species of southern birds. The great horned owl is common, and the bald eagle is occasionally seen sailing majestically over the open marshes. He nests in the tallest of cypress trees, the great bulky nest towering against the sky line.

To the westward, in Cameron Parish, is the picturesque Black Bayou meandering toward the gulf, its banks grown with majestic cypress. Along this bayou and the adjacent marshland, are to be found the last roseate spoonbills in Louisiana; wood ibis sail overhead on almost motionless wing, and white-faced glossy ibis

and fulvous tree ducks are seen in flocks.

"Bird Island," a bit of woodland in the marsh, has been set aside by the owner, Mr. William Lea, as a refuge for nesting birds, and the last of the roseates in Louisiana dwell there in company with American egrets, black and yellow-crowned night herons, the Louisiana, little blue and little green herons.

Farther down Black Bayou is an enormous tract owned by Mr. Luteher Stark that is one of the greatest wintering grounds of wild fowl in America, and if one were to attempt to list the birds occurring there, it would be necessary to name most of the wild fowl of the Mississippi Valley. Chenier au Tigre,—the name brings back pleasant memories of high knolls along the gulf, with wonderful moss-hung live oaks and thick-growing palmettos, of wind-whipped ridges, hardy hackberry, ironwood, and acacias, and fields of prickly pear. There are wide stretching sand beaches, vast salt marshes, wooded areas, and comparatively high prairies. Chenier au Tigre is typical of many places I have visited along the Louisiana coast, the climate is delightful, birds are abundant at all seasons of the year, and the kindly people who dwell there always make the visitor welcome.





An Actual Stage Scene in a Japanese *No* Theater

MASKS AND DRAMAS OF OLD JAPAN

The Myths and Legends of the Ancient Orient Live Today in the *No* Play of Japan—Its Traditions, Masks, and Costumes

By S. ICHIKAWA

Department of Anthropology, American Museum

THE MASKS ILLUSTRATED ARE FROM THE AMERICAN MUSEUM COLLECTIONS

ALL great peoples have developed some form of the drama and the stage. With these are associated the great traditional literatures of the world. For the most part, drama precedes the art of writing and written literature, thus taking form in the age of myth and magic, and so it comes about that when the art of writing develops and these old dramas are set down on paper, they are rich in mythical and magical elements.

Japan, like the other great civilized nations, cherishes her ancient literature and her traditional dramas. Among the most famous are the so-called *No* plays. These are highly individualistic types of drama and are still popular in Japan. The *No* plays require a special kind of stage and costume, for the characters in these plays are prominent in Japanese folklore, and the details of their costumes are fixed by tradition, so much so, that if the actor is correctly garbed, the audience knows what character he

represents. The facial features of these characters are also fixed by tradition and, in consequence, the actor wears an appropriate mask. Since the face is the truly expressive part of man and the key to his emotions, special attention is given to these masks; indeed they hold a prominent place in Japanese art.

Recently, the American Museum acquired and placed on exhibition in the Japanese Hall a collection of these Japanese dramatic masks, the gift of Dr. W. L. Hildburgh. Such masks are carved from kiri wood (*Paulownia imperialis*), or hinoki wood (*Chamaecyparis obtusa*), and then painted. The masks used in *No* dramas number about 120, and are usually classified in five types: old person, male, female, god or goddess, devil or goblin. Many masks still in use are of great antiquity, ranking as important specimens of ancient Japanese sculpture. It is said that some masterpieces are carved in such a way that they change expression when held

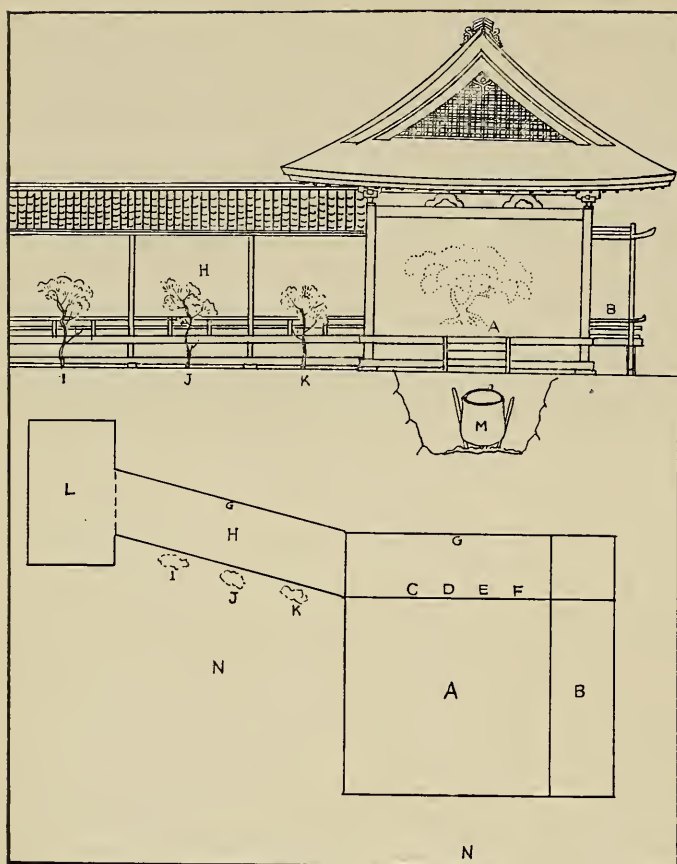


DIAGRAM OF NO STAGE

A. stage; B. chorus; C. stick drum; D. large hand drum; E. small hand drum; F. flute; G. back wall; H. gallery; I. J. K. real pine trees; L. greenroom; M. porcelain tub; N. audience

at different angles, so that when looking upward they appear cheerful, and when looking downward, melancholy. In all cases the expression on the mask must suit the character represented in the play.

There is an old story that a certain mask carver carried off a lovely maiden to a forest and, tying her to a tree, pricked her body with a knife to produce in her face the expression of mingled emotions of anger, pain, and despair, so that he might model a mask vividly portraying these emotions. He did succeed in creating a masterpiece, but only at the price of his life, because he was put to death, in accordance with Japanese law.

As in the case of many other ancient

customs, the origin of the *Nô* plays is believed to have been supernatural, and is accounted for in a myth. This tale, as told in the *Nihongi*, a book written in 720 A. D., recounts how once, in god-land, the god Susa-no-o-no Mikoto insisted on tormenting his sister, Ama-terasu Oho-mi-kami, the Sun-goddess and ancestor of the Japanese royal family. He let loose the heavenly piebald colts in her rice fields; he insulted her. All this she bore. But last of all, when he saw Ama-terasu Oho-mi-kami in her sacred weaving hall engaged in weaving the garments of the gods, he flayed a piebald colt of Heaven and, breaking a hole through the roof of the hall, he flung the skin in. Ama-terasu Oho-mi-kami started up in alarm, and wounded her-

self with the shuttle. This last indignity was too much to bear. She straightway entered the Rock-cave of Heaven, fastened the Rock-door, and dwelt in stubborn and haughty seclusion. Thereafter constant darkness prevailed on all sides, and the alternation of night and day was unknown.

Then the eighty myriads of gods met on the bank of the Tranquil River of Heaven (Ama-no-yasu-kawa) and considered in what manner they should supplicate her. One god gathered "long-singing birds of the Eternal Land" (cocks) and made them utter their prolonged cry to one another. Moreover, he made Ta-jikara-o-no Mikoto, the God of the

Strong Hand, stand beside the door, so that in case it were opened for even a crack, he might force it open all the way. Other gods dug up a five-hundred branched sacred tree of the heavenly Mount Kagu. On it they hung strings of jewels and a great mirror, and on its lower branches they hung sacred offerings. Then they recited their liturgy together. Last of all, the goddess Ama-no Uzume-no Mikoto took in her hand a spear wreathed with Eulalia grass, and standing on an inverted tub before the door of the Rock-cave of Heaven, gave forth a divinely inspired utterance and performed a stately mimic dance, while the tub echoed sonorously under the tap of her dancing feet.

Ama-terasu Oho-mikami heard this, and said: "Since I have shut myself up in the Rock-cave, there must surely be continual night in the Central Land of Fertile Reed-plains. How then can Ama-no Uzume be so gay?" Piqued by curiosity, the Sun-goddess opened the Rock-door for a narrow space and peeped out. Then Tajikara-o-no Mikoto took her by the hand and led her out, and she consented not to return to her cave.

In the modern stage of the *No* theater, arranged according to tradition, a porcelain tub is placed directly under the stage, so that the stamping of the actors' feet in the dance will echo with greater

resonance. This stamping of the shoeless foot is an important feature in the dancing; and considering also the fact that the sun plays a significant rôle in the primitive drama, some authorities accept these as light on the origin of the *No* drama.

The *No* stage is about eighteen feet square and of wooden construction throughout. The back wall is of bare boards decorated only with a painting of a pine tree executed directly on the wood. The front and two sides of the stage are open, no curtain being used. To the left of the stage runs a narrow, covered gallery leading to the greenroom, the entrance to which is curtained off. Sometimes the



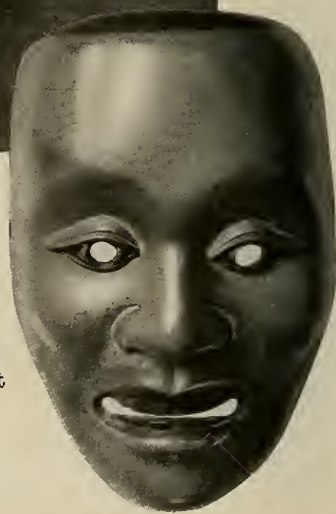
THE MASK-MAKER

A page from an old illustrated Japanese book devoted to the history of *No* masks



From a Modern Japanese Print

The print represents an actor impersonating the Yamauba, or "old woman of the mountain." This spirit is always represented as having long white hair, and carrying a cane with a T-shaped head. A bunch of leaves is fastened to the cane. As in all *No* plays, the actors are men. The mask used in the impersonation is shown at the lower right



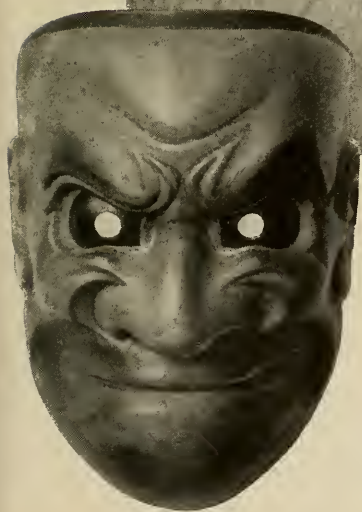
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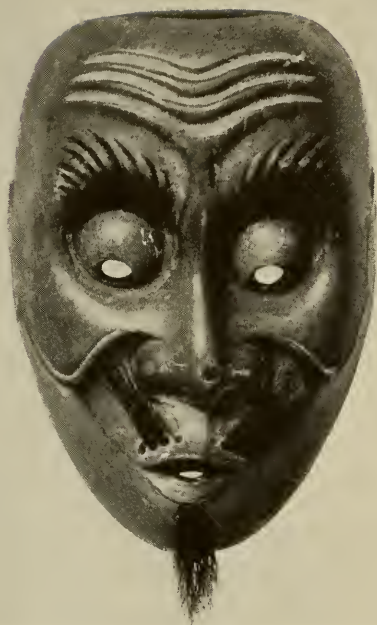
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From a Modern Japanese Print

Kumasaka carries a halberd in his right hand and a short sword on his hip. In the play he is killed by a small boy, in reality a great warrior and fencer. This boy in his disguise mingles with the servants of a rich merchant, who is held up by Kumasaka and his gang of desperate bandits. At the left is the mask used in this impersonation



THE WHISTLER

This particular mask is called "Usofuki" and belongs to a class of masks used in the *Kyogen*, or farces

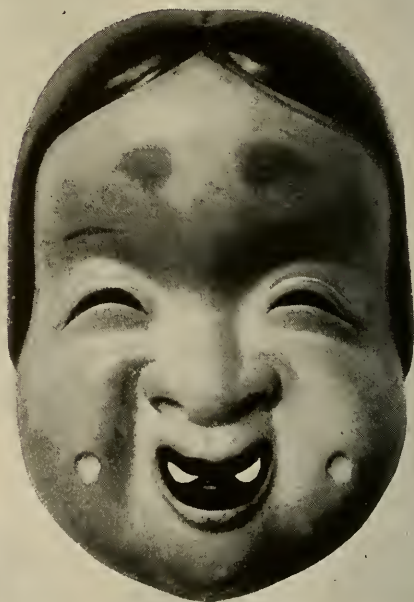
back wall of this gallery is painted with bamboo trees. The pine tree back of the stage is traditional, as are three small real pine trees planted in front of and close to the gallery. There are no "settings" whatsoever on the *No* stage. The properties are few and of highly conventionalized type and weapons alone are realistically represented.

The *No* relies enormously for its effects on gorgeous and elaborate costume. In olden times, *No* plays were given by the nobility only for members of their own class, and feudal lords, when entertaining each other, prided themselves on their *No* stages, and especially on the costumes, vying with each other to produce a dazzling impression. Incidentally, this fact stimulated the development of the art of textile weaving in Japan.

Since there is no curtain in front of the stage, the entrance of chorus and musi-

cians in stiff and stately movement marks the opening of the play. Their retreat from the stage in the same formal manner marks the end. There are in these plays only two leading characters; they are called "Shite" (doer) and "Waki" (assistant—always a male rôle). Each of these main actors has companions called "Tsuri"; some plays, however, need no actors but the two main ones; others use as many as ten or fifteen performers. The female rôles are taken by men. The movement of an actor's body is prescribed and regulated by severest rules. Every step, every movement, in the dance—even to those of the toes and fingers—is strictly governed by tradition.

The chorus is seated to the right of the stage, the musicians upstage. The music which accompanies the action consists only of a stick drum, two kinds of hand drum, and a flute.



THE JOLLY WOMAN

Another *Kyogen* mask called "Okame" or "Ofuku," a fun-making character known to all Japanese play-goers

The *No* dramas are based upon short, lyrical tales, taken for the most part from the folklore of Japan, China, and some adjacent countries. The texts are written in exceedingly ornate language and contain as quotations many ancient songs and sayings. The ethical principles exemplified in the plays are those of Shintoism, Buddhism, and Confucianism. The plays resemble the classic Greek drama in being performed out of doors, and are highly formalized in that the speeches are entirely chanted, movements are stylized, many of the characters wear masks, and the chorus takes up the action where the dialogue leaves off.

In regard to this traditional formalism, Mr. Arthur Waley says in his book, *The No Plays of Japan*, that

The theatre of the West is the last stronghold of realism. No one treats painting or music as mere transcripts of life. But even pioneers of stage



"HANNYA," THE CLASSIC FEMALE DEMON

One of the most popular characters in the *No* plays is represented by this mask



"SHIKAMI"—A MALE DEMON

The name of this *No* mask, representing a male demon called "Shikami," means "a cross-looking face"

reform in France and Germany appear to regard the theatre as belonging to life and not to art. The play is an organized piece of human experience which the audience must as far as possible be allowed to share with the actors. A few people in America and Europe want to go in the opposite direction. They would like to see a theatre that aimed bodily at stylization and simplification, discarding entirely the pretentious lumber of nineteenth century stageland. Such a theatre exists and has long existed in Japan.

Today only 210 of these early *No* plays are extant, but it is believed that a considerably larger number of them existed in olden times. There are still in Japan five different schools in *No* performance, each school having a history and tradition peculiar to itself. These schools are: Kwanze, Hōshō, Komparu, Kongo, Kita. The story of the Sun-goddess and the dance before the Rock-cave gives a legendary explanation for the *No* drama. It is interesting to note that this dancing is supposed to have taken place before the



KWAGETSU—A WANDERER
From a Modern Japanese Print

A young ascetic and wanderer is the chief character in a *No* play "Kwagetsu." When only seven years old, so the story runs, he was stolen by a goblin. His father became a Buddhist priest and by accident found his wandering son at the temple of Kiyomizu at Kyoto. In the play the wanderer thinks he has no enemies, so he carries only a small bow and a single arrow for driving away birds that he finds spoiling the beauty of the flowers



THE MYSTIC SERPENT IN HUMAN FORM

From a Modern Japanese Print

In the play called "Dojyoji," a beautiful maiden loves a Buddhist monk who is not permitted to marry. The monk flees from her and hides in the temple. The maiden pursues him but is stopped by a river flood. She is transformed into a large serpent and swims the river. The monk hides under the great bronze temple bell, but the serpent crushes the bell by the power of her coils, and kills him and herself

Japanese (Yamato) race migrated to the Islands of Japan, and if we take into consideration also the factors of cave, river bed, and Sun-goddess (female rule of the tribe occurs chiefly in the southern part of Asia and Oceania), we may reconstruct an imaginary picture of a tribal dance of the ancestors of the Japanese living somewhere in southern Asia under the sway of a female ruler.

It is generally accepted, however, that the *No* play is a gradually integrated development of Sarugaku (Shinto ceremonies). Dengaku (at first an acrobatic and juggling exhibition and later a sort of opera), Gagaku (the Chinese dance practised at the Japanese court), and various sorts of recitation and ballad singing,—a composite, in other words, of the sacred with the secular, of ceremony to honor the gods and entertainment for human beings. The religious *No* dance led to the secular *No* play. In the Muromachi period 1392-1603, the *No* play underwent popularization, becoming an adjunct of congratulatory or commemorative occasions, and also pure diversion. This



THE DANCE OF AMA-NO-UZUME

This old Japanese print shows the dance in front of the cave to which the Sun-goddess retreated when insulted

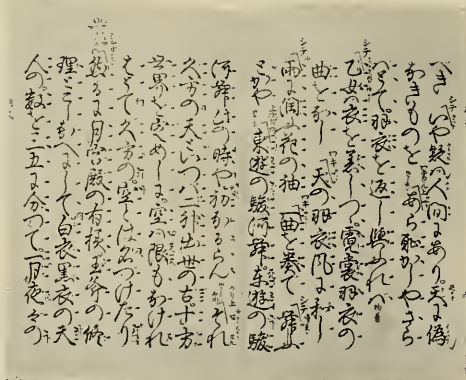
period produced many *No* dramatists and *No* was considered an essential part of every aristocratic entertainment, while the Shinto shrine continued to be the principal scene of its performance.

The *Nois* stately and solemn, but "Kyogen," farces are given as interludes between the scenes or as part of the *No* play. Some of these Kyogen also date from

the Muromachi period, and may have had a development parallel to that of the *No*. The masks used in this type of play are of course for the most part comic in appearance, as shown on page 246. At present there are three schools of Kyogen,—Sagi, Okura, Izumi.

The *No* play was really the source of the Joruri (epical drama) and the Kyakuhon (which is nearly the same as the European drama), both of which were developed during the Tokuzgawa period, 1603-1867.

Such, then, is a brief outline of the history of the peculiar ancient drama of Japan, a most interesting field for the student of drama and the dance.



A PAGE FROM THE PLAY
"HAGOROMO"



Photograph by W. A. Bentley

The rounded summits of this cumulus cloud show distinct thunder heads

WEATHER PROPHETS OF THE SKY

Significance of Cloud Formations in Foretelling Weather Conditions. The Importance of a Knowledge of Air Currents in the Layers of the Atmosphere

By HERBERT P. WHITLOCK

Curator of Minerals and Gems, American Museum

Then follow you, wherever hie

The travelling mountains of the sky.

—“Song of the Road,” STEVENSON

CLOUDS always have had and always will have a special appeal to people who love the out-of-doors; they are distinctly part of the facts, fancies, and phenomena that we group loosely under the term “natural history.” But to what realm of nature do clouds owe allegiance? The answer is that they are forms of mineral—for water is a mineral in spite of its usual state of fluidity.

When we contemplate a cloud-flecked summer sky, perhaps from a hilltop, or from the open fairway of a golf course, our imagination may need to stretch to a considerable degree to bring home to us the truth that these shreds of water vapor and masses of snow particles are floating suspended in a sea of air at the bottom

of which we crawl or scurry according to our mood. Since we have begun the mastery of the air,—the only portion of our environment not yet wholly conquered,—clouds have assumed for us a very vital interest, because they clearly indicate the currents and conditions existent in the various layers of the atmosphere.

Above the highest range of an aëroplane move the delicate, wispy plumes of cirrus clouds that often presage the movements of air currents in the lower depths of our atmospheric ocean, and as we come to consider the clouds of lower elevation above the earth, their significance as foretellers of weather conditions becomes more obvious and imminent.

Sailors, fishermen, and in fact all men



Photograph by W. A. Bentley

FRACTO-CUMULUS CLOUDS

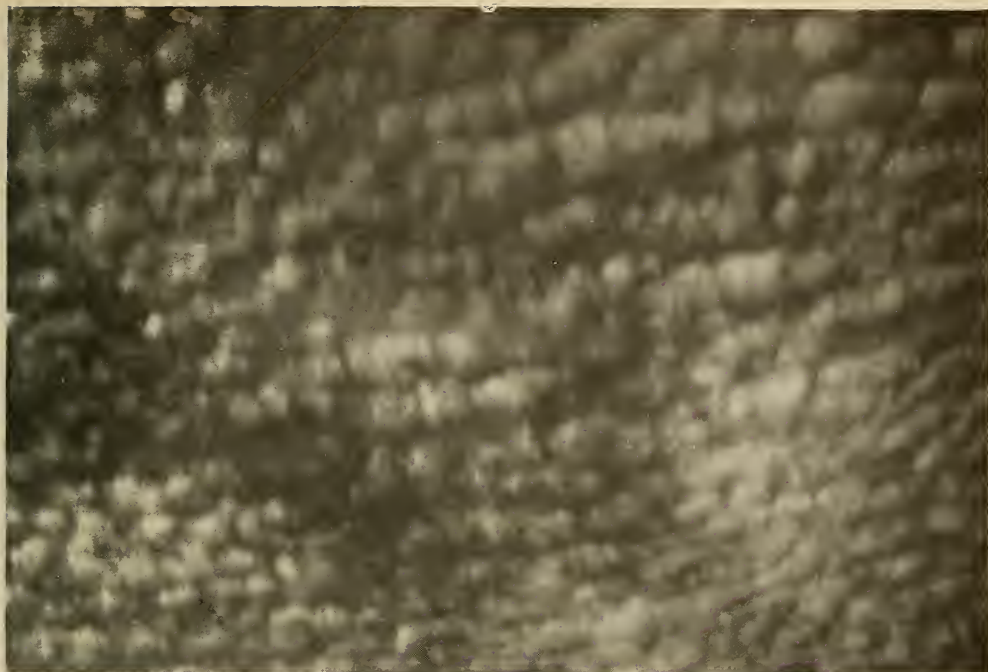
The characteristic flat lower side of this group of broken-up cumulus clouds of the alto level is well brought out in this photograph



Photograph by W. A. Bentley

HIGH FOG

This is still a cloud even though it has come to earth. Such a fog climbing up a hillside gives promise of sunshine before long



Photograph by W. A. Bentley

CIRRO-CUMULUS FORMATION

This is a typical mackerel sky. The small white clouds flecking it are familiar to everyone as prophets of rain in the near future



Photograph by W. A. Bentley

ALTO-CUMULUS WAVES

Aviators know that a wavy, cloud-streaked sky such as is shown above betokens treacherous air conditions, because the ribbons of cloud mean bands of unequal air pressure



Photograph by W. A. Bentley

CUMULO-NIMBUS CLOUDS

Ascending air currents have caused this cumulus cloud to build itself up to a vast altitude. The summit is probably five miles above the earth

whose lives are spent on or near the sea, are well versed in the meaning of cloud forms, but something of what they have learned at the price of long and often hard experience may be added to our natural history knowledge by the easier and shorter route of study and intelligent observation. *Cloud Studies*, by Arthur W. Claydon, published by John Murray, London, is one of the best books I know of for information on this subject.

To equip ourselves for "intelligent observation" requires a very simple appliance; all that is necessary is a black mirror made of a small sheet of glass painted on one side with a black varnish or lacquer. In this simple contrivance one may reflect the brightest sky without undue eye strain and, once accustomed to seeing the sky as if it were in an inky pool, one will find even the thinnest and most evanescent thread of cirrus reflected with startling clearness and detail.

Of course to make a record of an unusual cloud form, a camera equipped with a simple color screen is necessary, and since all but the darkest and most lowering skies register very rapidly on the photographic plate, the slowing effect of the color screen is neutralized. A little experience enables one to time exposures correctly and to achieve good results.

The camera has also been used to good effect in determining the height of clouds. For this two cameras are employed, set at the ends of a measured line and arranged to give simultaneous exposures. With the lenses covered by color screens and well stopped down, the cameras are directed at the sun's disc, the image of which is bisected by cross wires placed back of the lens combinations. As a cloud approaches the position of the sun, the two exposures are made at the same instant, with the result that the position of the cloud with respect to the sun is not quite

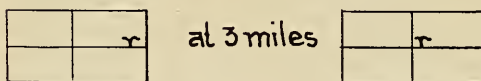
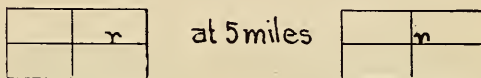
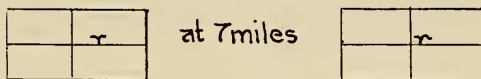
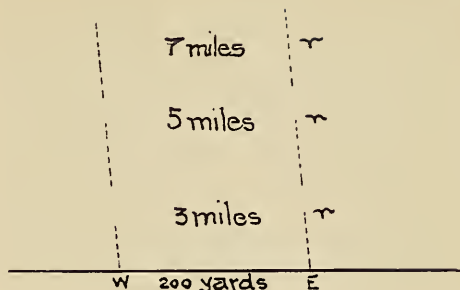
the same in both negatives, and the closer the cloud is to the cameras the greater will be the difference. The paired negatives are carefully measured with respect to this difference, and a mathematical formula, of course involving the distance between the cameras, is applied, which gives the height of the cloud. A glance at the diagram on this page in which the cloud is represented by a flying bird may help to make this plainer.

Owing to the temperature of the air, clouds of a certain type are higher in summer than in winter.

In naming the various types of clouds, in general, three descriptive words are used:

(a) CIRRUS (combining form, *cirro-*) includes cloud forms resembling delicate threads, feathers, or strands of wool.

(b) STRATUS (combining form, *strato-*) is applied to clouds that extend in more or less level sheets.



DETERMINING THE HEIGHT OF A CLOUD BY THE USE OF TWO CAMERAS AS EXPLAINED IN THE TEXT



Photograph by W. A. Bentley

CUMULUS CLOUDS

An approaching thunderstorm is indicated here in the billowing masses of towering clouds. These forms are often seen on hot August days



Photograph by H. P. Whitlock
 LONG, NARROW SHEETS OF CIRRO-STRATUS
 CLOUDS IN FORMATION



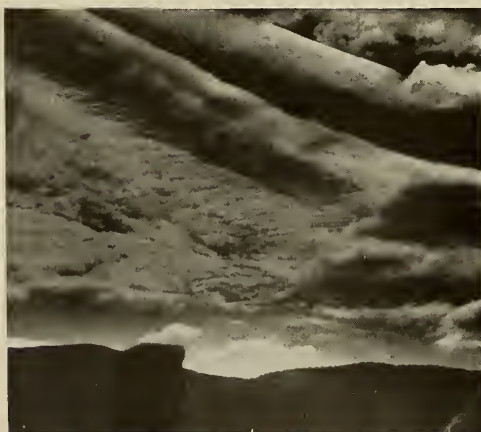
Photograph by H. P. Whitlock
 BEGINNING FORMATION OF
 ALTO-WAVE CLOUDS



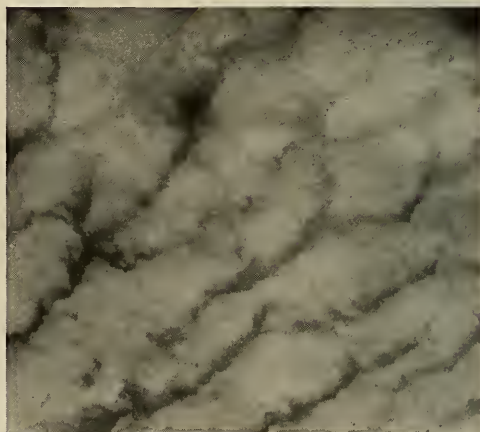
Photograph by H. P. Whitlock
 CIRRO-STRATUS CLOUDS CLEARLY
 DEFINED



Photograph by H. P. Whitlock
 ALTO WAVE STRUCTURE PARTIALLY
 FORMED



Photograph by W. A. Bentley
 CIRRO-STRATUS CLOUDS BEHIND DENSER
 ALTO-CUMULUS



Photograph by H. P. Whitlock
 CRESTED ALTO WAVES FULLY DEVELOPED,
 A SURE STORM SIGNAL



Photograph by W. A. Bentley

THIN, HIGH CIRRUS CLOUDS OF WIND-BLOWN SNOW



Photograph by H. P. Whitlock

TAILED CIRRUS—EACH THREAD A MINIATURE SNOWSTORM



Photograph by W. A. Bentley

THREAD CIRRUS—A HARBINGER OF GOOD WEATHER



Photograph by H. P. Whitlock

CHANGE CIRRUS—CONSTANTLY DISAPPEARING AND REFORMING



Photograph by H. P. Whitlock

HIGH CIRRUS—THIN WISPS OF SNOW CLOUDS



Photograph by H. P. Whitlock

BAND CIRRUS—ALWAYS FOLLOWED BY STORMY WEATHER



Photograph by W. A. Bentley

CUMULO-NIMBUS CLOUDS

The shadow cast by these dense thunder clouds as they come over the hills gives warning of the rain that will follow in their wake

(c) CUMULUS (combining form, *cumulo*=) denotes the rounded, lumpy shapes of cloud.

Then we have the division of clouds according to their relative heights above the earth, as, the upper clouds, the intermediate clouds, and the lower clouds, as well as those towering cloud masses that extend from the lower up into the intermediate regions of the air.

In general the highest clouds are of the cirrus and cirro-stratus types, which means that they occur as high as seventeen miles in summer, and fifteen in winter. The intermediate division ranging from fourteen to eight miles in summer, and twelve to six in winter, includes the types that are named cirro-cumulus, alto-stratus, and alto-cumulus. Nearer the earth form the strato-cumulus, cumulus, and nimbus, or storm clouds, ranging from five to two or three miles in the air. Cumulus clouds are often three miles in

depth, covering the whole range of the middle lower atmosphere in height, and the mountainous cumulo-nimbus, which herald a thunder storm on a hot summer day, tower some eight miles from the ground. Still nearer to the ground are the stratus, which merge into the high fogs that we often see on summer mornings suspended in air halfway up a hillside.

Since the rarified upper air, which is the region of clouds of the cirrus type, is below freezing point in temperature even in summer, it follows that cirrus clouds are formed of ice particles or minute snowflakes. In one of the illustrations, showing tailed cirrus (page 257), we can actually see a series of small snowfalls, each descending from its own cirrus cloud until melted and dissipated in the warmer layers of the atmosphere below.

Indeed, continual forming and melting away is a conspicuous characteristic of all

cirrus clouds. A good instance of this tendency is illustrated in the photograph of change cirrus (page 257) which shows a stratum of the air that has just become saturated with moisture to the point of forming a cloud.

Windy cirrus shows the effect of rapidly moving air currents in the upper air and foretells strong winds at the earth level.

Band cirrus, the broad radiating fans of cirrus cloud, is a sure omen of ill weather, falling barometer, and general storm conditions. The usual forms of cirrus cloud, particularly those with threadlike and feathery outlines, mean fair weather for at least a day after they are seen, and probably for several days to come.

It is not possible to draw a sharp dividing line between the high clouds of the cirrus types and those of the intermediate layer which are often called the alto clouds. In general we may assume that the alto clouds are composed of liquid instead of solid particles, and consequently they appear somewhat denser, in the same way that a fog at the ground level seems

denser than the air filled with a light fall of snow. In this category belong alto-cumulus clouds of several variations, including the familiar mackerel sky, and the less common, high, ball-cumulus, both of which foretell a rainy change in the weather. Alto-cumulus clouds will always merit close watching, as they often precede the formation of the huge, lofty, thunder clouds whose menace is unmistakable.

Clouds of the cumulus type, particularly those of the intermediate layers of the atmosphere, constitute the most picturesque and obvious of the cloud forms. As alto-cumulus and cumulo-nimbus they furnish us with the piled-up rounded masses of water vapor so dear to the hearts of painters and etchers. Each large cumulus cloud may be regarded as the visible top of an ascending pillar of moist air, the upper part of which is condensed by contact with the cold of the stratum of air at which it becomes visible. These are the clouds that cast shadows over the landscape of field and hillside,



Photograph by W. A. Bentley

ANOTHER FORMATION OF CUMULO-NIMBUS

The torn, dark masses bear all the indications of a rapidly approaching thunder storm

and the fact that they cut off, in a measure, the sun's rays, does more than create a pleasing picture. This shadowed part of the ground is cooler than where the summer sun has unobstructed power to heat the surface stratum of air, so that by means of the unequal temperature, a rising current of air is set up, carrying moisture with it to augment and heighten the cumulus cloud which is its top. Such a cumulus is generally formed during the afternoon of a warm day when there has been little wind, and the almost inevitable result is a thunderstorm. It follows, from the mechanics of this cloud type, that its base is nearly flat, and it takes the shape of an irregular cone.

The atmosphere, a knowledge of which is of great service to aviators, generally consists of layers of unequal pressure. Many disasters to aëroplanes have been caused by their unexpected entrance into one of the low-pressure areas. Now, when a series of high and low-pressure zones of the atmosphere encounter air almost saturated with moisture, there will be condensation in the high-pressure areas and evaporation in the low-pressure ones. The result is a series of wavelike move-

ments of cloud caused by alternate forming and dissolution of cloud masses. Such waves of clouds, traveling much as do the waves on water, occur at all altitudes. Seen during a period of fine weather, they invariably mean a change, with either wind or rain or both.

Alto waves are fascinating cloud types to watch, particularly if one is fortunate enough to see the preliminary steps in their development as well as the phenomenon at its height. In three of the series of cloud photographs used in this article, a succession of stages in the formation of alto wave clouds is shown, the plates having been exposed a few minutes apart (See page 256).

Several delightful books have been written on clouds, but the best way to learn about them is to sally forth into the country-side with stout heart and shoes, and see the clouds in their true environment, which, to my thinking, is not where one's vision is interfered with by a skyscraper or a church steeple, but where the sky line is fringed with trees and haystacks above which one may study to his heart's content these weather prophets of the sky.



"TRAILING CLOUDS OF GLORY"

Photograph by W. A. Bentley

A sunset sky, even without the color, is a thing of supreme beauty



Native road workers in the Sudan doing their part in modernizing Africa

BY MOTOR FROM NAIROBI TO THE NILE

An Automobile Tour Across Eleven Hundred Miles of Central Africa—Roads and Hotels, Rest Camps and Bridges, Factories and Golf Courses—How Central Africa Is Changing, and the Effect of the Change upon the Animal Life

By JAMES L. CLARK

Assistant Director, In Charge of Preparation, American Museum

STANLEY'S "Darkest Africa" has long since given way to Carl Akeley's "Brightest Africa," but even yet there are a great many misconceptions abroad regarding that continent.

That the great herds of game are giving way before the advance of civilization is a widely accepted fact, but the extent to which civilization is penetrating the districts where the gigantic herds formerly ranged unchallenged is not widely understood. There is a great deal of criticism of the sportsmen who take their safaris into that land and bring home "trophies" with which to decorate their walls and floors, but that the settlers are killing far more game than are the sportsmen, and are driving the remnants of the herds from their natural grazing grounds into more remote regions, is not so often called to the attention of the world.

It has been my privilege to visit East Africa three times. In 1909, when I first entered that animal Eden, the plains were literally swarming with herds of wildebeest and zebra, gazelle, impalla, eland, and scores of other animals. Rhinos and lions were numerous. Elephants were to be found in tremendous herds. Everywhere one went there were animals and signs of animals. Settlers were few. The natives had long since adapted themselves to life in a land teeming with game. There was little interference with the animals and as yet civilization had made little impression upon the creatures of the wild.

The railroad had been built from Mombasa to Nairobi, it is true, and a little way beyond, but aside from that route of travel there were few in the whole land. Roads led a little way from Nairobi in



A ROADWAY IN THE NEW AFRICA

On this broad avenue, bordered by acacia trees, Mr. Clark drove into Naivasha. Just beyond this spot a few kongoni and Thompson's gazelles were seen—practically the only game in evidence during 1100 miles of travel

various directions, but they did not go far, and only the native trails led farther across the plains and through the jungles. Thus the range was not cut up. The natural migratory movements of the animals were not interfered with, and the regime that Nature had built up during thousands of years was still in force.

In those days, the person who wished to see British East Africa did so with a slowly moving safari that made ten or fifteen miles a day—sometimes more, but rarely. The automobile had not entered the wilds. Automobile roads were unheard of, and the game was not tremendously impressed by the activities of sportsmen or professional hunters.

But all that is changed. Where, in 1909, not an automobile road existed in all of British East Africa, now there is a network of such roads over which one may drive at much the same breakneck speed

that is common on the roads of the United States. Bridges cross innumerable streams. Highways stretch in every direction across the plains, and the range is consequently broken up into small districts entirely surrounded by routes intended for the mechanical horse.

Now it is obvious that all of this is having its effect upon the game. There are all sorts of laws protecting the animals, of course, as there should be, but law cannot stop the advance of the settlers. As a matter of fact, the law aids them. And how can the settlers erect their fences and plant their fields if herds of elephants are permitted to wander about the place, stamping whole fields of corn into the ground, tearing down structures, and otherwise interfering with the developments and the labor upon which the settler's success depends?

In the United States the bison gave way

before the same inexorable advance of civilization, and for identically the same reason. It was impossible for the farmer on the Nebraska plains to make a success of what was, at best, a difficult job, if, in addition to the other difficulties that had to be overcome, herds of bison were permitted to stamp his wheat into the earth and otherwise interfere with the labors upon which the citizens of that new land were forced to depend. We have bewailed the passing of the buffalo, of course, and have managed to save a few—because they are hardy beasts—with which to decorate our parks and zoos. But if we could have the old herds back for the asking, would we accept them? Naturally not. They could not be made to fit into the present scheme of things.

That is identically the situation that is facing British East Africa today. The game, of course, in that land of animals is

comparable to what it was in our middle west, but already there has been a tremendous decrease in those numbers, and not a year passes but what the herds are smaller than they were before. Not a year passes but what British East Africa comes closer to the situation, in regard to game, that Nebraska and Kansas are in today. Nor are the sportsmen principally to blame. They kill many animals, it is true, but advancing civilization is the greatest killer of them all. Even if there were no sportsmen, the final outcome would be the same, although, of course, the finale would not come so soon.

Last year, after the field work of the Carlisle-Clark Expedition had been completed, I decided to go from Nairobi to the headwaters of the Nile, rather than to sail from Mombasa. It was my desire to see that portion of Africa between Lake Victoria Nyanza and the head of river



CROSSING THE DIVIDE

As one nears Uganda, the roadway stretches through dense forests of cedars and bamboos. This part of the country being mountainous, good roads are doubly appreciated. The above picture was taken at an elevation of 8500 feet, after leaving Molo



A MAIN THOROUGHFARE

Typical of the roads passing through banana tree groves is this one in Uganda. A subsurface of hard, volcanic rock, called ironstone, lying from one foot to eighteen inches underground, makes the construction of good roadbeds easily possible in Uganda

navigation at Rejaf in order that I might more properly attack certain problems in the Museum having to do with specimens that come from that region. And I naturally chose the easiest method of transporting my wife and myself across that eleven hundred miles of what, only a few years ago, was comparatively unknown country. Many people living today recall when Speke, in 1858, discovered the source of the Nile, and the route I chose was to lead us past Ripon Falls where the mighty river of northern Africa has its beginning in the waters of Lake Victoria Nyanza.

It will be seen, therefore, that we were to go through a land upon which civilization has had only a few years to work—in which the game formerly was to be found in enormous numbers—to which sportsmen have never gone in very great numbers. Furthermore, twenty years ago, a crossing of this very land would have called for a very well equipped expedition, and would have demanded the utmost care in plans and leadership.

As it was, Mrs. Clark and I packed what belongings we needed in the tonneau of a touring car, hired a native "boy" to serve as general factotum, and left Nairobi at noon on October 18, 1928, intent on reaching Molo, 134 miles distant, that evening. That alone shows how shrunken are the game fields of Africa. A "march" of 134 miles twenty years ago would have consumed a week at least, and that would have been very rapid indeed. Furthermore, from fifty to one hundred porters would have been hired in order to carry the equipment for the outfit. The leader would have looked over his guns and ammunition with the utmost care, and more than one adventure with animals would probably have befallen some one in the party during the course of that week.

With us it was very different. At the last minute, as I entered the car, Mrs. Clark asked where our guns were, and I smiled as I admitted that I had forgotten to include them. We were not intending to hunt anything, of course, and guns, consequently, would have been used, if at

all, merely to protect ourselves. But so changed is Africa that I decided we did not need even that protection, so I stepped on the starter and we began our journey without spending the fifteen minutes it would have taken me to get the guns and ammunition that would have been absolutely essential a few years ago.

Nor was this mere bravado. The truth is that we had no need for them. Eleven hundred miles of automobile roads lay ahead of us. Several towns of fair size were on the way. We did not even have a tent, for we would stay at hotels and rest camps each night, unless, of course, something unfortunate befell us, and then we would spend the night in the car.

It took us less than seven hours to reach Molo, after averaging twenty miles an hour. We could have done it in less time, but as Mrs. Clark preferred not to ride too rapidly, we took our time. To the hunter in Africa a few years ago it would seem downright inane to say that we "took our time" and still covered 134 miles in an afternoon.

Imagine yourself on a motor tour through a magnificently beautiful country with good roads and almost no one to use them but yourself. There was no one ahead of us—no one behind. There was no dust, few bumps, and the day was fine. Through the foothills of the Aberdares wound the road, past native garden patches, open fields, and stretches of dark, primeval forests where once roamed the buffalo and elephant. Now this is the Kikuyu Reserve where those natives grow their patches of maize. The huts and "shambas" of these natives are neat and well kept, for the Kikuyus are industrious, which cannot be said of all the native tribes of Africa.

Leaving this undulating country, we wound our way along hillsides and down valleys to Lumoro, where we dropped down the escarpment into the Kidong Valley. There lay Lake Naivasha surrounded by weird and rugged mountains, with a crescent-shaped island—a part of the rim of an extinct volcano—showing clearly above the smooth blue water.



THE RAILWAY HOTEL AT KISUMU

In this thriving little town a comfortable rest house in conjunction with the station accommodates both automobile and train tourists. Kisumu also boasts garages, and a number of small shops



ON THE WAY TO RIPON FALLS

What many readers still imagine to be the "wilds" of Africa often prove to be similar to portions of Long Island. Here a modern golf course completes the illusion, heavy traffic and billboards alone being lacking



FOR THE BENEFIT OF TOURISTS

In ceremonial attire of grass headdress and white clay smeared on their bodies, these Uganda natives wait by the roadside for passing wayfarers. They then dance and pose for their pictures in return for small change



A PRACTICAL USE FOR THE NILE

The British government has recently completed this new power plant, which takes advantage of the power of Ripon Falls to supply lighting for the town of Jinja. Native workers are employed under white supervision



THE HEADWATERS OF THE NILE

The Ripon Falls, sliding smoothly from the level of Lake Victoria Nyanza and dropping about twenty feet to start the White Nile, resembles a stream of cold, liquid glass. Bird life is particularly abundant about here



AN AFRICAN TREASURY AT KAMPALA

These ivory tusks, laid out for inspection by the government treasurer, are part of a collection worth \$100,000. Some have been paid in as taxes, others have been found, and many have been confiscated because they were secured illegally by hunters

We drove along avenues of acacia trees into the town of Naivasha, and ascended the rise to the northwest on the road to Gilgil. As we rolled away with Naivasha behind, we saw a few kongoni and Thompson's gazelles,—a dozen or so—and later, as we sped over better roads than we had had, we spied four or five impalla.

We had dropped into the Kidong Valley when thirty-one miles from Nairobi, and we followed the floor of the great rift which is divided into a series of basins holding lakes of varying sizes. Black rain clouds hung about in the sky and showered us twice, but always there were bits of blue sky visible, and the landscape still stayed bright.

From Nakuru north we could see great sweeping valleys, now taken up entirely by ranches. There were enormous areas given over to corn and wheat filling the valleys for miles, broken here and

there by patches of deep green trees. All this scene was enclosed by distant rugged hills that were tinted with late afternoon hues that radiated from the setting sun.

Leaving this, our sienna-red road undulated still upward into grass lands interspersed with great forests. As we entered these we became lost in big cedars forming a jungle rain forest, but on through the dense growth our smooth road ran, until, finally, we reached the little town of Molo which lay surrounded by the vividly colored open glades filled with Kikuyu corn. Behind the corn lay the heavy forest beneath a black rain cloud upon which glowed the setting sun.

We stopped for the night at "The Cross Roads Inn."

For nine days we drove through this land of beauty. We passed through luxuriant forests and bamboo thickets.

We rolled past parklike open spaces that were dotted with table-topped acacia trees, through the wide-spreading branches of which we saw wonderful vistas bathed in sunlight. We took the wrong road in one place and went sixty miles out of our way, but we did not mind, for the road was good and the views were delightful. Here and there, during those nine days, we did find sections of the road that were bad—sections that showed only as discolored lines stretching across the grassy plains, and in one place a make-shift bridge across a stream barely supported the weight of the car. For the most part, however, the roads were fine, and throughout the trip our enjoyment of Africa was tremendous.

In the country of the Kavirondo the roads were often lined with natives, but they were dressed in dirty white "Americano," which completely took the romance

from what otherwise was a charming picture.

Beyond Kisumu we skirted the shore of Lake Victoria Nyanza, and passed through a country very similar indeed to Connecticut. Had there been more roadside signs and more houses along the route, the comparison would be more exact. As it is, this portion of Africa has all the attractions of the Long Island Sound coast, without the unattractive elements that have been added.

We crossed an arm of the lake on a ferry, and near its terminus we spied a charming golf course which borders the waters of the lake and swings around to Ripon Falls, the headwaters of the Nile. A new power plant, too, stands near by, taking advantage of the power that for ages has been sliding smoothly over the falls to create the river that is the chief artery of Egypt.



A PRECARIOUS CROSSING AT JINJA

When the capacity load of five automobiles and as many natives as can hang on has been piled on to this ferry, which is nothing more than a scow equipped with a gasoline engine, a passenger recalls with little pleasure the fact that the waters are crocodile-infested



EVIDENCE OF ADVANCING CIVILIZATION

The Motor Tours Rest Camp at Soroti provides a comfortable overnight stopping place. The main dining hall and community house, shown here, is surrounded by a cluster of smaller thatch-roofed sleeping quarters and a kitchen. Tourists usually bring their own food, but "in season" they can buy it on the premises. The camp accomodates about twenty people

The falls are impressive as one approaches the edge of the stream and sees that tremendous volume of water flowing through this outlet of the lake like cold, liquid glass. A little below, the water breaks into a turmoil of foam, but a V of smooth water penetrates that brilliant display of white, as if fighting to quiet the broken surface below.

Bird life is abundant about the falls. White egrets, snake birds, cormorants, and others are numerous. Almost every rock is the resting place of cormorants, and others swim and dive in the white water below the falls. Fish, too, are numerous, and schools of them weave idly about, their dorsal fins showing almost as if they were small sharks.

Returning over the ferry, we started toward Kampala, fifty-four miles away, and two hours later, without having

changed gears, we arrived at that charming little city, where we put up at the Imperial Hotel for the night.

At Kampala, which lies on an arm of Lake Victoria Nyanza, we found a thriving little town—a town with garages, with shiny automobiles offered for sale in clean and attractive show rooms, with shops the equal of many small towns in the United States, selling goods that were not dissimilar. The hotel was good, and we were not unduly tired, despite the fact that we had driven 150 miles through what some people still imagine to be the "wilds" of Africa.

Except for the few head of game just outside Naivasha, we had seen none since leaving Nairobi, but now we saw, when we went to the government offices the next morning, about \$100,000 worth of ivory laid out on the ground to be examined by

the inspector. Because of the ivory trade, and the business that civilization has brought in, Kampala is a busy place. It is not as large as Nairobi but is much cleaner. The stores are up-to-date, shops and garages are numerous. There are several small brick factories, one of which is a bottle factory, no less. On a high hill above the town is an old fort, below which is an excellent golf course.

The sultani of the Wagandas rules here, and enjoys considerable prosperity under the British. The natives are exceptional and very independent, although they are said to be past masters at the art of stealing. The automobile roads are in excellent condition, with a native road-maker to every mile. Twenty pounds a year are spent per mile of roads in this district, and they are uniformly excellent.

A couple of days beyond Kampala

we stopped for the night in the Motor Tours Rest Camp at Soroti. What more is needed to tell of the advance of civilization into central Africa? Later we stopped again at these camps, which are all alike, and are anything but scarce in this region. They are built with a large grass hut in the center, which is a dining room and community structure, and about this central house, smaller grass huts, fifteen feet or so in diameter, serve as bedrooms and bathrooms. Truly, Central Africa is rapidly becoming devoid of its former difficulties.

The natives, after we had gotten well away from the larger towns, were dressed—if one calls it that—in native fashion, and there was a very definite atmosphere of Africa in the landscape when such natives appeared. But, having traveled five hundred miles or more from Nairobi, we expected this, for I do not mean that



USING EMERGENCY PROVISIONS

Occasions still arise which require that tourists be prepared for unexpected delays. Here Mr. and Mrs. Clark were held up for thirty-six hours by a swollen stream. They are pictured lunching with two other automobilists also delayed by the flood

all Africa is given over to automobile roads and rest camps.

At Torit, in the Sudan, we had to ford a stream, but the water was shallow and we had no trouble. Shortly beyond this spot—not more than a few hours—we found more trouble of the same sort. For fully three-quarters of a mile the road was under water. It was too much for our car, but after waiting a day, two small trucks appeared. We talked of all sorts of methods of crossing that section, and finally decided to leave our own car for our “boy” to take back to Nairobi, if we could get the trucks across. We plugged the carburetors and other openings in the motors, and with a small army of natives managed to tow those trucks through.

It was necessary for us to attempt some such method, for we were trying to catch a boat downstream from Rejaf, which lay not far ahead, and it was important that we get through. Beyond this flooded section the roads were less good, but we had no difficulty, and late that evening reached the banks of the Nile directly across from Rejaf. It was by moonlight we crossed the three hundred yards of the smoothly flowing Nile, and early the next morning, from the deck of the river steamer, we saw Rejaf slide away astern and realized that we had crossed 1100 miles of what was once “darkest” Africa—had crossed it without a gun and without any need for a gun—had crossed it, furthermore,—and this is the most striking fact—without having seen any game aside from those few animals that we had passed near Naivasha. We had seen a herd of about fifty baboons, and had seen an occasional animal here and there elsewhere, but game, as game has always been known heretofore in Central Africa, was entirely missing from the picture.

This does not mean, of course, that there was no game in the country. The

land was plentifully watered, and game, consequently, did not find it necessary to congregate at water holes. At another season of the year, hundreds of head of animals would be seen on the same route. But the farms, the ranches, and the towns, the automobile roads, and the other intricate trappings of civilization are rapidly converting all this land into a gameless region. The time is not far distant when to the inhabitants of Nairobi and Naivasha, herds of game will be as rare as they are to the inhabitants of Kansas.

At Rejaf I was told that the tusks of 1500 elephants are shipped through that point each year. Such killing of elephants is rapidly bringing to extinction these ponderous and slow-growing animals. If, in any single district, a thousand elephants lived, it would be impossible to kill more than thirty or forty a year if one wished to keep from reducing the herd. Thus it can be seen that these most appealing creatures are rapidly headed for practical, if not actual, extinction.

In telling this story of the “New Africa,” it is not my purpose to present too pessimistic a picture. Many things are being done in that continent in order to protect the animals. But no longer is Africa the Africa of Stanley, or even of Akeley. Sportsmen have been guilty of more than a little killing, and they, quite properly, should be carefully controlled. But civilization—and civilization only—will, before many years, practically eliminate the animal life of the greatest of animal lands. It is the duty of all of us who are interested in the preservation of this animal life, to do what we can to interest others in proper conservation, and that, in the final analysis, will be brought about only by the creation of more animal preserves, where hunting and collecting will be prohibited by law, and where that prohibition will be rigidly and honestly enforced.



Guahibo Indians in front of one of their grass huts

CHILDREN OF THE ORINOCO PLAINS

The Guahibos, a Little Known, Primitive Tribe of South American Indians, Impulsive, Moody, Curious, Unsophisticated as Children, that Wander Over the Plains of Eastern Colombia

BY SIDNEY F. TYLER, JR.

Mr. Tyler went to South America in July, 1928, as historian and photographer of the Tyler Duida Expedition, which is making intensive collections of the natural history specimens of the region and gathering all available geological and topographical data. The expedition had spent no more than a month at its almost inaccessible destination, when the illness of Mr. Hitchcock, the expedition's topographer and geologist, necessitated his temporary withdrawal in search of medical assistance, there being none of any kind available in the vicinity. Mr. G. H. H. Tate, leader of the expedition, was aware that a doctor was exploring on the Orinoco 400 miles below Mt. Duida, and therefore thought it advisable that Mr. Hitchcock should depart in search of him without delay. Mr. Tyler was asked to accompany Mr. Hitchcock on the long journey. A canoe and five Indians were procured, with whose assistance the two men soon reached the physician. It was here that an infection developed that brought about Mr. Tyler's return to the United States. While they were both under the doctor's care, they accompanied him on a short trip up the Tomo River in search of the Guahibo Indians.—THE EDITORS.

EIGHT hundred miles above the mouth of the Orinoco, which forms the boundary between Venezuela and Colombia, lies the drowsy village of Perico. It consists of forty clay and palm-thatch hovels modestly huddled together, wherein some two hundred half-breed peons drag out a weary existence. It was from this village that our small party set out in search of the Guahibos, a tribe of Indians that was said to wander

semi-nomadically over the plains of eastern Colombia. We numbered ten persons: five peons, four Americans, and a jovial Danish guide of true Falstaffian proportions.

The equatorial sun shone brilliantly on the lazy waters of the Orinoco. Its glassy surface, motionless beneath the weight of a stagnant and breathless atmosphere, reflected with colorful fidelity the scattered bursts of purple and yellow bloom, the



MR. TYLER IN CAMP NEAR THE ORINOCO RIVER

After five days of traveling in a simple native dugout, the expedition discovered a group of Indian rafts. Camp was pitched at once in the hope of discovering also the owners of the rafts

playful lights and shadows of an impenetrable vegetation, and its dainty, lacelike silhouette. A thick barrier of shrubs and tough marine plants stretched endlessly along the water's edge, behind which rose in impressive grandeur the imposing trunks of great tropical trees. Their limbs were festooned with a curtain of dogged parasitic vines which fell in tangled and riotous profusion to the ground. Macaws, parrots, parrakeets, and all the garish company of Venezuelan bird life darted restlessly to and fro, screaming and chattering harshly as they flew. Their bright colors relieved the jungle's interminable greenness and their unmistakable *joie de vivre* dispelled its loneliness and oppressive silence.

The vessel in which we were traveling was a simple native dugout laboriously and crudely fashioned from the hollowed trunk of a single tree. Its length did not exceed thirty feet. Into this were loaded

bags and boxes of every conceivable shape, on the lids of which we took a cramped and precarious seat. To us who crouched in this fashion for so many hours, and to the peons who paddled so tirelessly, the long days seemed unending; for the sun beat down upon our unsheltered heads with pitiless intensity, and swarms of insects transformed our hands and faces into raw and smarting flesh.

On the morning of the fifth day we quitted the Orinoco for the all but motionless waters of the Tomo, a small river which flows in a northeasterly direction from Colombia. Late in the afternoon the sharp eyes of one of the peons discerned within the thick tangle of the bank several gray objects half buried beneath heaps of dead leaves. We landed and investigated. They consisted each of a dozen parallel poles of moriche palm, a wood which is extremely soft. Driven at right angles through these poles were two narrow hard-

wood stakes, one at each end, which served efficiently as long nails. It was obvious that we had stumbled blindly upon a group of Indian rafts; their discovery was our first clue to the whereabouts of savages.

Camp was pitched and a large fire lighted with the hope of attracting any Indians in the vicinity. None came that night. The following morning, while we were preoccupied with the business of breakfast, a slight rustling caught my ears. I glanced over my shoulder and there to my amazement I beheld the motionless forms of twenty Indians stonily observing our actions. In the dim and intercepted light of sunrise they were scarcely visible, especially since not a ripple of motion disturbed their statuesque alignment. They uttered no sound, and it was still too dark to take note of their expressions.

We advanced at once to greet them. They responded with suddenness to our

demonstration of friendship by leaping and crowding frantically about us and by pressing forward to touch hands. This done, they turned their energies to a searching examination of our clothes and personal effects. Mystery and astonishment struggled for supremacy in their bewildered countenances. The culinary implements and the brightly labelled bottles and jars of American canned goods seemed to attract them most; several of the bolder spirits indicated their delight by deftly concealing some of the gaudier tins in the encircling underbrush, a maneuver which exacted our unceasing vigilance.

The chocolate color of their bodies blended so perfectly with the shadows and dirty greens and browns of the surrounding forest that even in the growing light they were, when motionless, almost indistinguishable. They were uniformly short in stature, the tallest of them not exceed-



A FIRST GLIMPSE OF GUAHIBOS

Although a fire lighted at night apparently failed to attract the attention of any Indians, the following morning twenty of them appeared silently in the bushes about the camp



CARRYING THE EXPEDITION'S BELONGINGS

Though the average height of these Indians is barely more than five feet, they do not hesitate to carry great weights. They almost invariably travel in single file and usually at a great pace—a kind of jog trot

ing five and one half feet. Feline lithe-ness and grace marked their movements. Their glistening bodies, naked save for a loin cloth, were superbly developed, although many exhibited the swollen abdomens of hookworm and the scars of numberless infections. Beards and mustaches were conspicuous by their absence. The gloss of their straight black hair falling thickly to their shoulders, the narrowness of their small, restless eyes, and the undue prominence of their cheekbones, gave to each head an unmistakable Mongolian stamp.

The behavior of an old Indian with a cigarette marked his tribe as one of the very few in South America unfamiliar with tobacco. He insisted upon tearing one end of it apart to examine its contents. His curiosity at length appeased, he placed the torn and ragged portion to his lips and lighted it with a brand from the

fire. In consequence of the harsh treatment which it had received, the cigarette could not be made to draw properly, to the owner's huge disgust. The loose tobacco, furthermore, came apart, and filled his mouth with fragments bitter to the taste; whereupon, after a few ineffectual puffs, he rose and cast it disdainfully into the fire.

The distribution of Mr. Woolworth's finest brass bracelets was received with boundless enthusiasm. Loud cries of "*Caripana!*" rent the air. The Guahibos—for such they proved to be—required no further inducement to snatch our baggage and set off for their village. Securing their loads by means of broad lianas slung across the forehead and shoulders, they departed in high glee, chattering hoarsely among themselves. The individual burdens amounted in some cases to seventy-five pounds, but the ease with

which they bore them and the rapid pace which, in single file, they relentlessly maintained, seemed to give the scales the lie.

For six miles beneath a scorching sun we followed the well-worn trail across arid savannas. At last the village came into view. From a distance it resembled a group of stubby, yellow mushrooms, nestling snugly in the withered grass. The delusion persisted until our arrival. It was situated on the edge of the savannas with a thin border of jungle a hundred yards behind it. Six large huts were grouped about a seventh, this last belonging presumably to the chief. The dimensions of all were alike, approximating seventy-five feet in length, twenty in width, and twelve in height, each hut being solidly constructed of closely woven palm leaves and stems. They seemed quite capable of withstanding the torrential winds and rains which occur so often throughout the Orinoco basin.

The entire tribe, numbering at the outside three hundred, had assembled to witness our arrival. There were the long files of athletic males peering in silent astonishment upon the strangely garbed beings approaching them,—the bright sun flashing and sparkling upon their feathered ornaments and bronze bodies; there were the dirty, unkempt women, their harsh voices momentarily hushed, snatching a few moments of welcome relief from their endless labors to gaze from behind the forms of their august husbands upon this unprecedented event; and there were the groups of small, round-eyed children, clinging in nervous excitement to the rags and tatters of their mothers' garments. Well in advance of the multitude, where he occupied a position in accordance with his rank, stood the thin but wiry form of the chief, his face heavily checkered with broad daubs of red paint, and in his hand a wooden scepter bearing the crude,



IN THE GUAHIBO VILLAGE

From a distance the seven large huts of which the village is composed resembled a group of stubby, yellow mushrooms. They are solidly constructed, however, and can withstand heavy winds and rain



HARMONICAS CREATED ENORMOUS INTEREST

As soon as these ten-cent-store harmonicas were distributed, bedlam broke loose. The second Indian from the left is the "heir to the throne" of the Guahibos

mysterious carvings which symbolized his office. His stalwart carriage and commanding mien betokened the forcefulness of his character.

The silence which remained unbroken throughout the brief formalities of reception impressively bespoke the discipline which the old chieftain enforced. There was neither sound nor movement among the assembled ranks as he muttered a few incomprehensible words and with lofty dignity nodded in sign of welcome. In return we presented him with an elaborate necklace of glittering beads, also from the house of Woolworth, which he donned without acknowledgment or change of

expression. These brief courtesies terminated, he turned toward the multitude and with imperious gesture solemnly beckoned us to follow. To one of the huts he led us, through dense ranks of gaping, motionless Indians. His official functions thus completed, he promptly left us to ourselves.

It was indeed a relief to escape the scrutiny of the gathering outside. We found ourselves in a huge chamber which ran without partitions the entire length of the edifice. Neither benches, hammocks, nor other articles were in evidence. The floor was of plain dirt, and the walls were so closely thatched that not a single beam of light succeeded in filtering through. The small size of the two entrances severely restricted the circulation of air, a condi-

tion which the heat and filth of the interior rendered almost unbearable. From the absence of any indications of former occupancy we judged this hut to be reserved for councils and important tribal meetings.

The discipline which had ruled the assembled Guahibos vanished completely upon the withdrawal of their chief; and the scene which had occurred in camp that morning was reenacted in our hut upon an infinitely greater scale. They swarmed into the structure and filled it to the limit of its capacity. Men and women vied with one another in striving for a closer view and in fingering our persons

and possessions, at the same time panting loudly from their exertions. In the presence of this gallery of constantly changing faces peering at us with such insatiable curiosity, we felt like the principal exhibit of a museum, or, more accurately, of a circus "side-show." Through the almost opaque darkness came the immense murmur of countless voices sibilantly whispering. Blasts of hot breath smote our faces. But worse than the heat and darkness and confusion of the situation was the pungent odor of overheated and underlaved women fresh from their labors in the fields and domestic toil.

When the excitement caused by our arrival had subsided, and the normal life of the village had been in some measure resumed, we strolled leisurely through some of the adjacent huts. To each there were, roughly, fifty inmates. The men reclined indolently in their palm-fiber hammocks, comatosely indifferent to stranger and family, lacking energy even to brush the plagues of flies from their faces; small boys played casually in the mud; while the women, assisted by the girls, in accordance with the immemorial custom of tribal people, labored mightily under their husbands' eyes at the preparation of cassava and at other menial occupations. The air was heavy with nauseating odors. Hammocks dangled idly from walls and roof, and simple baskets and wooden bowls lay scattered

about in aimless confusion. Everywhere there was poverty, squalor, filth.

The lassitude of these people, remarkable even for Indians, resulted principally from a dangerous habit that was rapidly bringing about their destruction. From the leaves of the *Erythroxylum coca*, which they desiccate, pulverize, and then mix with wood ashes, they obtain a substance which possesses powerful narcotic qualities. Frequently we saw them, women as well as men, inhaling the yellow powder by means of a highly painted snuffer, a strange tool which they fashioned from the hollow leg-bones of deer. It was this practice more than anything



GRINDING MANIOC

As in the case of many other South American Indian tribes, the Guahibos use manioc as a staple food. From these roots they prepare cassava. The man in the picture, though he appears to be working, is in reality merely superintending his wife's labors

else that rendered them lazy to the point of insensibility and destroyed so thoroughly the possibility of mental effort. It made them the constant prey of hardier tribes who swept irresistibly down from the encircling hills to plunder and pillage at will; and it accounted for the lowness of their cultural level, the absence of morals, and in general the bestial conditions amid which they lived. Indeed, unless a speedier and more vicious fate in the guise of the white man's conquest should overtake them, their addiction to this drug spells extermination.

That night we visited the chief and rewarded him substantially for countenancing our observations and photography. We presented him with a large knife and an assortment of bells and rattles such as would have delighted the heart of any ten-months-old child. One stirred his martial ardor and the other flattered his vanity and rhythmic ear. In recognition of this he turned to one of his numerous wives and ordered her to fetch the contents of a wooden bowl which stood in a corner near at hand. She brought a foam-bespattered, beery liquid, which she had transferred to a skilfully woven palm-leaf receptacle. At sight of this we shuddered, and then bravely gulped down as small a quantity as was consistent with politeness. It was *chicha*, warm and indescribably bitter, a fermented liquor that is imbibed only at monthly tribal feasts and on occasions of great moment. The manner of its preparation is revolting. The women of the tribe, having ground yucca roots to a sticky paste, fill their cheeks with it and chew it. It stimulates the salivary glands, with the result that the women continually expectorate into a common bowl provided for the purpose. This is the well-known *chicha*, common among most of the tribes of South America. As the foul liquor coursed hotly down our throats, each of us ruefully speculated upon the

genus and contagiousness of the bacteria which we were absorbing.

The overwhelming preponderance of women over men, a condition which resulted from the frequent predatory raids of neighboring tribes, was responsible for the low opinion of the former which the male Guahibos universally entertained. Under the surveillance of their overlords, to whom was reserved the pleasurable pastime of shooting fish and game, the women of the tribe devoted themselves to the painful drudgery of gathering yucca roots, otherwise known as manioc, and converting them into the indispensable cassava. Yucca is a starchy, purple substance not unlike our potato, which forms throughout the year the staple article of their diet. The existence of the tribe depends upon it, for it yields them at once their food, their alcohol, and their poison for tipping arrows.

The women first rubbed the yucca up and down inside a wooden trough, the interior of which was rough and furrowed with ridges, until the allotted supply had been reduced to a moist paste. It was back-breaking work, for the trough lay on the ground and the women for hours at a time were obliged to bend nearly double. In this state the yucca was transferred to a narrow, cylindrical wooden bowl where, by means of a heavy pole, the poisonous juice was expressed. The third step in the process was the removal of the paste to shallow palm-fiber baskets about eighteen inches in diameter. Water was added and the baskets were then placed in the sun for their contents to rise. Finally the yucca was roasted over a huge fire and set aside to cool. The result was a coarse, hard, breadlike substance that resembled a gigantic gray buckwheat cake. If taken with water, it possessed a very agreeable flavor.

But the most striking instance of the male's adamant disregard for his wives



A VERY PRIMITIVE MEANS OF NAVIGATION

This inadequate little raft, which barely supports the wielder of the paddle, forces the navigator to sit in the water. More primitive "boats" than this hardly could exist

was an event that occurred a few hours prior to our departure. It happened immediately before our eyes, but so rapidly that remonstrances or more cogent arguments on our part were impossible. A young Guahibo ordered one of his older wives to prepare additional cassava. He left his hut and returned a few minutes later to find that the work had not yet been commenced. Incensed at such flagrant insubordination, he seized one of the knives which we had given him and threw himself bodily upon the unfortunate offender. The struggle terminated only after he had in cold blood slit wide open the crown of the woman's head. Cleaning the weapon by plunging it into the damp earth, he repaired nonchalantly to a neighboring hut where he proceeded to solace himself in the company of one of his other wives. Had we not had with us the services of a capable doctor who promptly sewed up the gaping wound, the

woman would undoubtedly have bled to death. But to her callous husband the outcome in either case would have been of little moment; did he not possess an abundance of wives and dependents who could easily minister to his whims and needs?

To us, however, who appeared to these savages doubtless as creatures sent from another world to bring them gifts, they showed only the better side of their natures. In their exuberance, artlessness, and impulsive ways, there was undeniable charm. Unsophisticated children they truly were, with all the variable moods and flights of fancy, the flashes of enthusiasm followed by depths of languor and despair, and then again the fits and starts of a restless curiosity which refused to be satisfied. They seemed so perfectly contented with their lot, so utterly oblivious to the world which throbbed outside, and to the possibility that

some day the white man would descend to put an end to their freedom and time-honored tribal life, that one contemplated with a pang the fate which must inevitably overtake them.

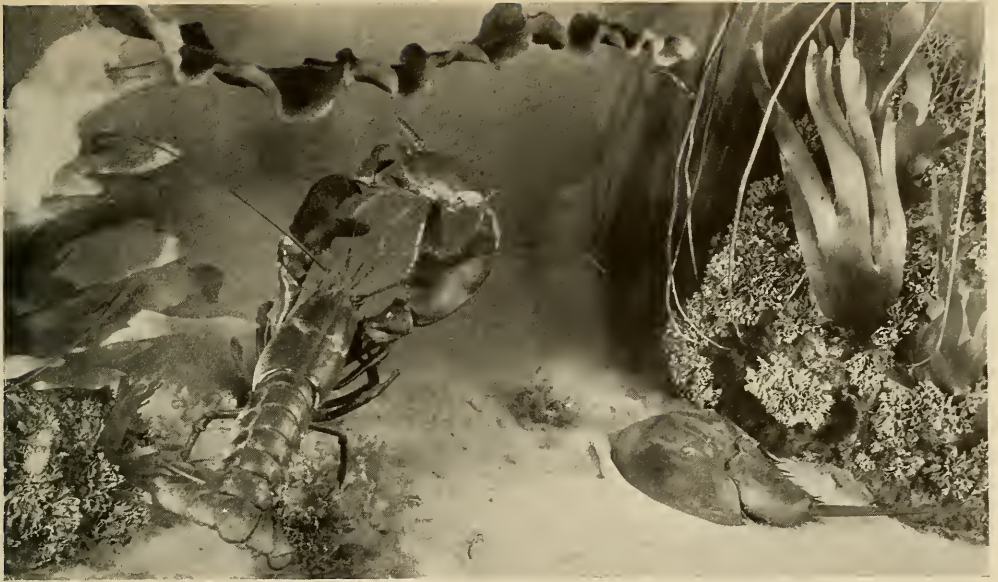
There could be no better example of the playful unstableness of their natures than the contrast which, in spite of an uninterrupted shower of gifts, marked the scenes of our departure with those of our arrival. In place of the wild singing and shout-

ing, the vast, immeasurable curiosity, there was now an atmosphere of ill-concealed relief. Perhaps the constant glitter of many-colored beads and bracelets or the gleam of highly polished knives, had dazzled their eyes and dulled for a time their senses. In silence they bore our baggage back to the canoes; their wild natures could no longer brook the presence in their midst of a disturbing, if benevolent, element.



THE EXPEDITION PREPARES FOR ITS DEPARTURE

The Guahibos were delighted to receive the visitors, but lost their interest after the gifts had been distributed



Animals of a submerged sandy sea floor

OUTPOSTS OF THE SEA

The Animals of the Tidal Realm—Marine Hosts that Today Assail Our Continental Borders, Endeavoring to Repeat the Conquest Attained Ages Ago by the Ancestors' of the Present Land-animals

By ROY WALDO MINER

Curator of Marine Life, American Museum of Natural History

THE daily rise and fall of the tides along the seacoast alternately submerges and lays bare a strip of the shore which varies in width from place to place according to the local range of the tide.

Thus, the vertical rise of the tides off the New England coast south of Cape Cod is only from one to two feet. Within Cape Cod Bay and Massachusetts Bay, on the other hand, it rises nine to ten feet. This is also true along the Maine coast, where the tides are deflected to the northwest by the curvature of the shore, joining the incoming waters farther north. These, in turn, are finally compressed into the narrowing funnel of the Bay of Fundy with the result that huge tides of thirty to forty feet are created at its tip.

In Passamaquoddy Bay, New Brunswick, the rise is twenty-two feet, and this is

the extent to which it covers the vertical cliff-walls of Bliss Island, at the entrance to the bay. St. Andrews Point, within the same bay, has a very gradual slope, and, at low water, is uncovered for two miles. Hence, the tidal zone varies greatly in area.

The nature of the substratum composing it also differs. It may be of rock in the form of vertical cliffs, as above mentioned, or sloping and, perhaps, broken into terraces. On the exposed shores it may consist of sand beaches, or mud flats in sheltered coves and bays. It may be covered by rocky boulders, broken down from the cliffs by wave action, or eroded out from headlands of glacial drift by the washing away of the soil enclosing them.

The animal and plant life of the permanently submerged continental shelf has overflowed into this stretch of semi-



Photograph by Mary C. Dickerson

A SAND BEACH AT LOW TIDE, WOODS HOLE, MASSACHUSETTS

Long lines of seaweed, thrown up by the waves, are arranged in ribbon-like bands, beneath which sand hoppers and beach fleas are concealed

terrestrial, semi-marine territory. The continental shelf is the submarine continuation of the tidal zone seaward. It slopes gradually to about one hundred fathoms, beyond which the bottom falls more rapidly to the greater depths of the ocean. This outer face of the shelf is known as the continental slope, and varies in its abruptness from a clifflike drop to a gradually accelerated gradient continuing the surface of the shelf itself. The width of the continental shelf also varies considerably. It is extremely wide in the North Atlantic, from the American side around to the British Isles, but quite narrow off Spain and Portugal and the western coast of Africa.

It is believed that the comparatively shallow waters of the continental shelf and slope witnessed the great evolution of marine life. Here it became diversified and abundant, for here the conditions of life are at their best. From this

region marine creatures were crowded out into the deeper oceanic waters, on the one hand, or specialized for the pressures and darkness of the deep abysses. On the other hand, they invaded the tidal zone, the fresh waters and, finally, the land. The evidence is strong that wherever and whenever life originated, the continental shelf is the region of its greatest evolution and the center of its radiation. The very fact that its location has shifted during geologic ages, as the continental areas were thrust upward or were worn down again through erosion, until the continental shelf invaded their lower reaches as epi-continental seas, has caused the living creatures inhabiting the shallow waters to be subjected to varying conditions and an intense struggle for existence, resulting in the preservation of adaptive changes and the elimination of those that were nonadaptive. As we see it now, the tidal zone and its inhabitants

represent a present-day phase of that struggle, for here only those sea creatures can exist that are adapted to the strenuous daily changes of environment involved in being alternately exposed to the air and submerged by the tidal flow. It is so striking an example of the results of natural selection on a large scale, and so accessible to everyone, that the thinking visitor to the shore will have no difficulty in reading the chief lessons taught by the inhabitants of the tidal region.

In the first place, it must be remembered that the tidal zone is the pulsating border of the great life-association of the submerged continental shelf. Secondly, life is so abundant that animals and plants of all species not only live where conditions are appropriate and easy for them, but also struggle to live under ad-

verse circumstances. Those that inhabit the totally submerged shallow seas find life comparatively easy, exposed as they are to the sunlight, yet covered by oceanic waters chemically harmonious with their body fluids—a fluid hydrosphere filled with food and replete with oxygen for the animals, and carbon dioxide for the plant life. Nevertheless, many also struggle to live under the more trying conditions of the tidal zone, where they maintain their position in proportion to their hardiness and their capacity to withstand exposure.

Everyone who walks along the shore at low tide is familiar with the zonal or banded distribution of the animal and plant forms. This is especially conspicuous on the rocky shores of New England, north of Cape Cod. The white band of rock barnacles (*Balanus bala-*



THE CLIFFS AT NAHANT, MASSACHUSETTS, AT LOW TIDE

The tidal zone is clearly marked on the vertical rocky face, as a band nine feet in width, showing the white frieze of barnacles above the stratum of seed mussels and rockweed which extends to the water line. A rock tide-pool, overarched by a weed-festooned natural bridge, is shown in the foreground. This locality is reproduced in the American Museum as the "Tide-Pool Group"



A CROWDED COLONY OF MUSSELS AND BARNACLES

Both mussels and barnacles can withstand long exposure to the air by enclosing enough sea water within their shells to keep their breathing organs moist. Together with the periwinkles (*Littorina litorea*) and "purple" snails (*Thais lapillus*), they invade the upper regions of the tidal zone. The snails, especially, suggest a transitional stage toward terrestrial life

noides) is displayed at the summit of the zone, their close-set marble wigwams crowding each other to form a snowy frieze. Ambitious periwinkles (*Littorina litorea*) swarm here and there, climbing slowly but surely upward over the house-tops of the barnacle colony, and even mounting far up the bare rocks above it.

The barnacle frieze is overlapped below by the rockweeds (*Ascophyllum nodosum* and *Fucus vesiculosus*), their olive-brown fronds draped in graceful fringes down to the water's edge, disclosing beneath their parting masses the continuous em-

bossed mosaic of the black edible mussel (*Mytilus edulis*), which encrusts the rock up to the lower limit of the barnacle zone. Bright patches of gaily colored and banded "purple" snails (*Thais lapillus*) may be seen grouped upon the mussel colony, which extends downward and below the water mark. Here it is succeeded in turn by another zone characterized by the green sea urchin, a small animal rejoining in one of the longest scientific names known to zoölogy, *Strongylocentrotus droehbachiensis*.

The sea plants below the rockweed zone include the common pink coralline (*Corallina officinalis*), the Irish moss (*Chondrus crispus*), and the dulse (*Rhodymenia palmata*). These are laid bare only by the lowest tides, and even then are continuously washed by the surf. Also at this level the two species of the common

sea star (*Asterias vulgaris* and *Asterias forbesi*) are to be found, the former varying in color through red, orange, purple, and blue, and distinguished by a white spot, the ambulacral plate, between two of its arms. The latter is usually greenish brown, with a bright orange ambulacral plate. Associated with them are the common sea anemone (*Metridium dianthus*) and two species of rock crab (*Cancer borealis* and *Cancer irroratus*).

This zonal arrangement depends upon two main factors, the exposure factor

and the food factor. It is obvious that the height above the low-water mark at which a sea animal can live depends upon its ability to withstand exposure to the air, for the upper limits of the tidal zone are, of course, left bare the longest. The periwinkle, in fact, is far on the way toward adaptation to terrestrial life. As the tide falls, it captures a few drops of water, which bathe its breathing organs and are kept from evaporation by a closely fitting horny plate closing the shell-opening. In this way it may remain many hours out of water. It is a vegetarian, feeding not only on the surface of rockweed, but also on minute algæ high on the rocks and among the barnacles.

The barnacles likewise are provided with means of retaining a few drops of moisture or moistened air beneath four little valvelike plates that close the top of their shells. They feed on the microscopic diatoms brought on the crest of the incoming tide. When they are submerged, each barnacle may be seen to unfold its quadripartite doors, whereupon the little plume of feathery feet waves to and fro, and, like a casting net, captures its tiny prey, which is immediately withdrawn within the closing gates. Agassiz has said that a barnacle is nothing but a shrimp standing on its head within a marble house, kicking its food into its mouth with its feet!

The mussels, occupying the zone immediately below the barnacles, can withstand exposure, but for a shorter time. They, too, feed upon diatoms. Both mussels and barnacles are preyed upon by the voracious "purple" snails, which also can withstand exposure at low tide, though many remain hidden under the moist drapings of rockweed.

The mussel zone is limited above by the barnacles, which tend to spread over the mussel shells and choke them by their more rapid growth, and below, by the zone of green sea urchins, which feed



COLLECTING IN THE TIDE POOL AT
NAHANT, MASSACHUSETTS

Basins and crevices in the rocks remain filled with water when the tide falls below their level, and thus harbor not only the life of their own zone, but also many creatures which ordinarily live below the low-tide mark

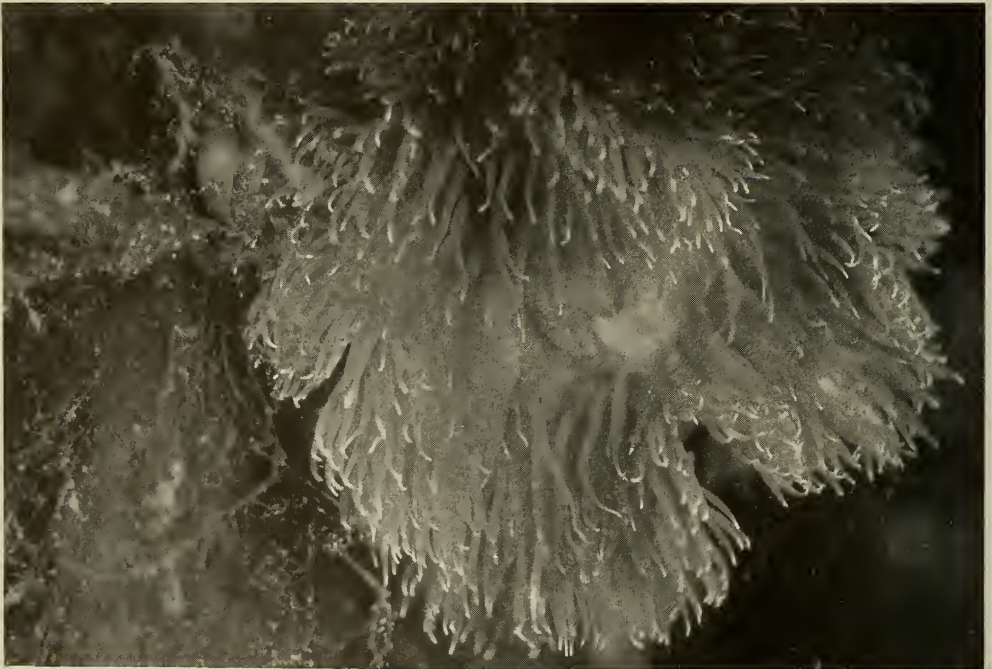
upon the mussels. The latter are also preyed upon by dog whelks (*Buccinum undatum* and *Lithodomus decemcostata*), two large snails found on our northern rocky shores. The whelks bore round holes into the mussel shells and suck out the animal.

Down near the low-water line voracious sea stars envelop the mussels with their arms, attaching their tube feet to the opposing valves, which they pull apart by gaining a purchase with their arm tips on the surrounding substratum. Then each sea star protrudes its saclike stomach from the central mouth on the underside of its body, and inserting it between the valves of the mussel, pours out its digestive fluid. Thus, it digests the poor creature within its own shells, while it absorbs the fluid products of digestion through its stomach walls. Sea stars devour oysters even more vor-

ciously, and are the most hated enemies of the oyster fisherman.

On terraced and sloping rocky shores there are many crevices and basins that are left filled with water at low tide. These occur at various levels and, in the lower part of the tidal zone, are especially rich in concentrated animal and plant life appropriate to the level at which they occur, and also to all the zones below that level. At flood tide they are invaded by the eggs and larvæ of many creatures usually found only below the low-water mark, which are able to live and develop in the pools because these are always filled with water. Thus the pools become veritable sea gardens of great beauty and fertility.

Here gay-colored sea stars occur in great abundance, hiding in crevices between boulders covered with velvety brown Irish moss glimmering with iri-



Photograph by Mary C. Dickerson

A SEA ANEMONE WITH BEAUTIFULLY EXPANDED TENTACLES

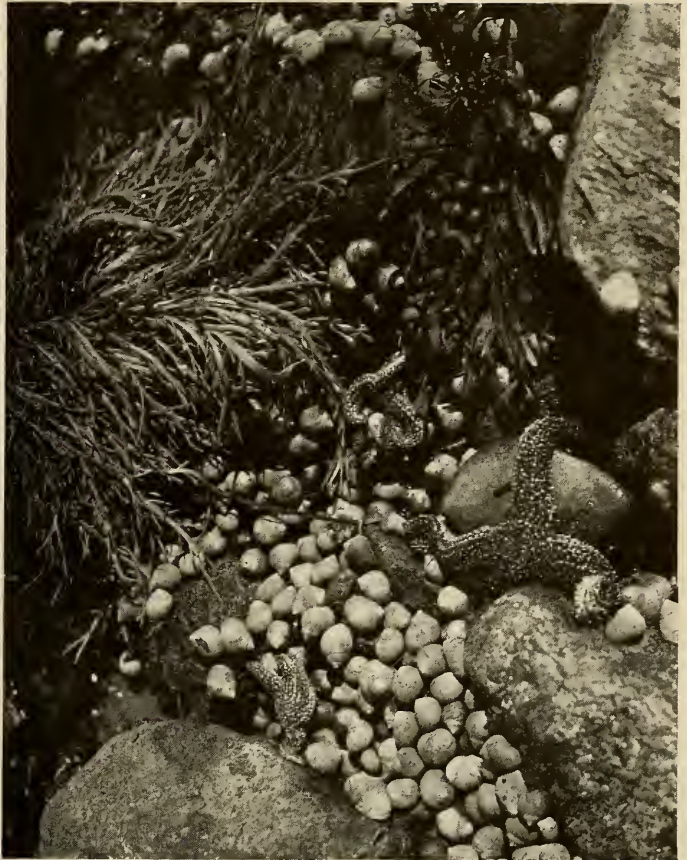
These flower-like animals (*Metridium dianthus*) live at or below the low-water mark, often in great numbers. Their petal-like circlelets of tentacles are armed with sting cells and surround a central mouth. Free-swimming creatures, including small fishes, are caught, stung to death, and devoured. The anemones vary widely in color, from brown through pink, cream, white, and deep orange

descent violet tips and overhung with clustered chimneys of the gray-green crumb-of-bread sponge (*Halichondria panicea*). Feathery, ruby-hearted hydroids (*Tubularia crocea*) fringe a shelf occupied by sea anemones with their rich stock-in-trade of color, ranging from brown, mottled with white, through plain white to rich pink and deep orange.

Two green crabs (*Carcinides mænas*) are sparring with each other in a corner beneath the ruffled overhanging fronds of the brown kelp (*Laminaria agardhii*). The entire rock surface, lining the pool, is gay with sea mosses or encrusted with red-purple and brown calcareous algæ. Thus the pool is replete with life, refreshed and renewed by the periodic incoming tides with their floods of food and oxygen.

While the northern New England shore is characterized by its rock-bound coasts, sandy beaches occur here and there, hemmed in by granite headlands, and mud flats are found in sheltered locations. But southern New England is typically low and sandy, beginning with the great sand spit which is Cape Cod. This forms a barrier hindering, to a degree, the intermingling of northern and southern forms.

Animals of the rocky coasts and regions of high tides must be adapted for clinging to crevices and for withstanding the battering of the waves and the rush of



Photograph by Mary C. Dickerson

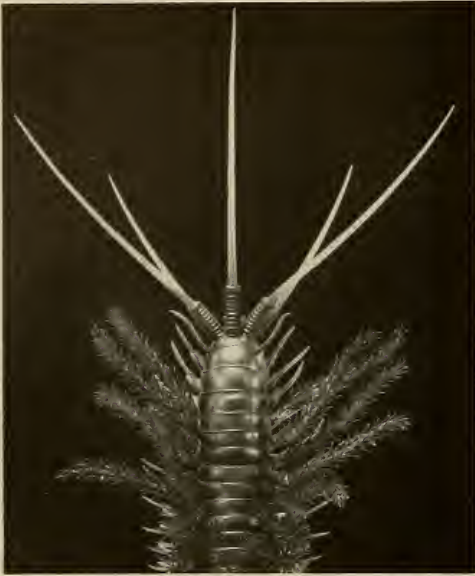
PERIWINKLES AND SEA STARS EXPOSED AT LOW WATER

The ubiquitous periwinkles are abundant near the low-water mark, as well as in the upper reaches of the tidal zone. The sea stars, on the other hand, can withstand exposure for only a short time, and are therefore confined to the lower part of the tidal zone and the waters below the low-tide mark

tidal currents. Animals of sandy and muddy regions, on the other hand, tend to be of burrowing habits, while the surface-living creatures are scavengers.

A sand beach, at low tide, appears to be a particularly barren place. Yet the close observer will detect signs of life. For example, he may chance upon little heaps of sand here and there, which betray the presence of the sand-collar snail (*Natica duplicata*).

If one waits till the tide begins to rise and covers these burrows, a stirring of the sand may be seen, and soon the snail will issue forth and crawl slowly over the



THE PLUMED WORM

This martial looking knight (*Diopatra cupræa*), of the sea bottom, lives in a chimney-like den, the upper portion of which projects into the water above the ocean floor

sea bottom. As it unfolds its foot and expands its "apron," it seems impossible that so huge a creature could have been packed into a spherical shell the size of a tennis ball. Above the apron it waves a pair of tapering tentacles, furnished with eyespots near the base.

The egg-case of this snail is a flat, nearly circular, collar-shaped structure, to which the sand adheres. The under-side is completely lined with transparent, beadlike eggs. These sand collars are often picked up on the beach in a dry condition, when they crumble at a touch.

Other burrowing animals of the sand beach are the razor-shell clam (*Ensis directus*), so called from its elongate bivalve shell suggesting the handle of an old-fashioned razor; the lady crab (*Ovalipes ocellatus*), a swimming crab with hind legs terminating in oval paddles and a carapace beautifully marked with



A FLEET-FOOTED INHABITANT OF SAND BEACHES

The ghost crab (*Ocypoda albicans*) is aptly termed, for its light, sandy markings so closely resemble the color of the beach, that it flits like a shadow along the shore and seems actually to disappear from the sight of the observer when it comes to rest



Photograph by Mary C. Dickerson

A COLONY OF GREEN SEA URCHINS

These sea urchins (*Strongylocentrotus droehbachiensis*) are abundant at or below the low-water mark on our northern rocky coasts. They feed upon the edible mussels (*Mytilus edulis*) and both, in turn, become the prey of the voracious sea stars (*Asterias vulgaris* and *forbesi*)

small purplish spots; and the ghost crab (*Ocypoda albicans*), found on sandy beaches from Long Island southward. This crab makes its burrows above the low-water mark and its whitish carapace so closely imitates the sand that it is difficult to see it, except when in motion. It runs with great speed, and, when it stops, seems to disappear.

Mud flats are especially rich in sea life. Everyone is familiar with the great stretches of edible mussels (*Mytilus edulis*) that are found on certain mud flats between the tides, and the kind of sandy mud in which one digs for clams, whether the soft clam (*Mya arenaria*), or the "hard shell" (*Venus mercenaria*).

But let us take a water glass (which is just a bucket with a glass bottom), and wade at low tide in a sheltered cove near the edge of a patch of eelgrass. Where the shallow sea floor is composed



A MEMBER OF THE STREET-CLEANING FORCE OF SHALLOW WATERS

The hermit crab (*Pagurus pollicaris*) is one of the scavengers of submerged, muddy sea bottoms



SEA STAR DEVOURING OYSTERS

The sea star mounts the shells of the living oyster with its five arms partly enfolding the two valves of its victim. It then applies its hundreds of tube-feet to the outer surface of the shells by means of small terminal suckers. With the tips of its arms it braces itself against the surrounding objects and exerts a strong, steady pull, that gradually forces the oyster shells apart

of sandy mud, let us place the water glass on the surface and look through it. A busy scene at the edge of a miniature submarine forest composed of the eel-grass roots, is disclosed to our eyes. Tiny hermit crabs (*Pagurus longicarpus*) are scuttling to and fro. Soon they gather about a bit of decaying substance and immediately begin to pull it apart. Mud snails (*Nassa obsoleta*), attracted by the tumult, crawl up from various quarters, leaving a little groovelike track in the mud behind them. A larger hermit (*Pagurus pollicaris*) lumbers along and scatters the smaller fry as he pulls the decaying morsel to pieces. Small, transparent shrimp (*Palæmonetes vulgaris*) dart in to get their share.

The hermits, the shrimp, and the mud snails are the scavengers of shallow water—the street-cleaning department of the

submerged mud flat—and they are thorough in their work. It is true that the hermits acquire their uniforms by theft, for they appropriate the shells of sea snails. Sometimes they find them empty and ready for use. At other times, they are said to eat out the former occupant first, thus obtaining a meal and a home simultaneously. When they grow too large for the shell they happen to have, they hunt for another, and it is amusing to see them make the change. They leave the old shell and, quickly settling into the new one, try it a few seconds, then change back to the old home. After a short interval the new shell is tried again, and the process is repeated several times. In the end, the hermit may walk off with the old shell after all!

We now direct our gaze at the shallow

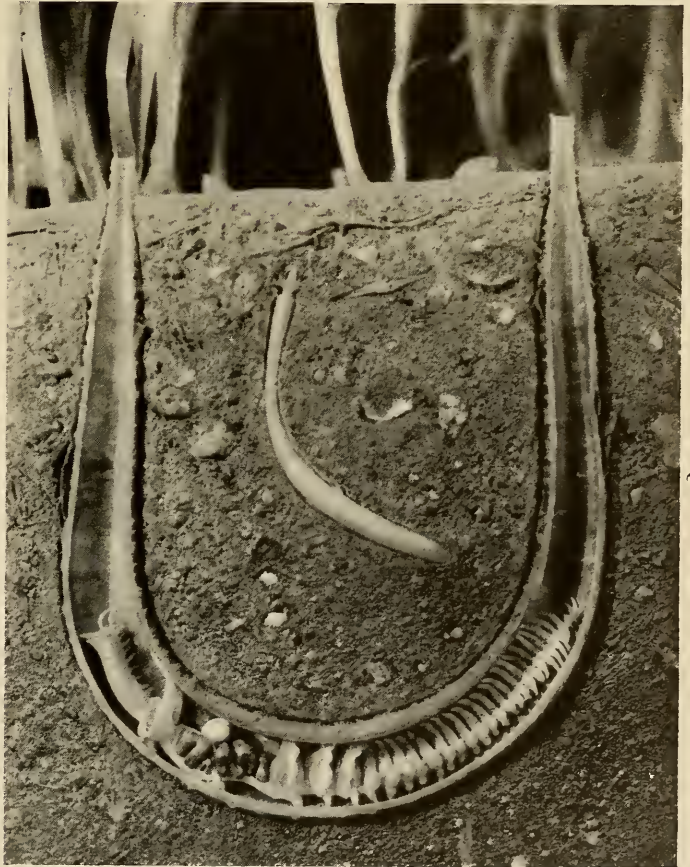
sea floor in the clear space between the eelgrass and the shore. Here on the sandy mud we begin to see certain details that hitherto have escaped our attention. Clusters of broken shell and bits of seaweed, apparently caught together by the currents, now resolve themselves into neatly cemented chimneys leading to some underground abode, for gently waving filaments projecting from the summit betray the existence of an occupant.

We carefully dig down into the sea bottom around the structure and remove a long, tapering, parchment-like tube, with the thickened chimney of shell-fragments at the top. After washing it, we cut it open in a glass dish of sea water, and out floats a beautiful, struggling creature, clad in segmented steel-blue armor, and bearing several sets of blood-red plumes upon its shoulders, while five tapering, lancelike palps are flourished in front. This knight of the submarine castle is the plumed worm (*Diopatra cupræa*).

Likewise, paired chimneys of smoother texture a little nearer the shore cause us to dig up a U-shaped tube, also of parchment, belonging to the parchment worm (*Chætopterus variopedatus*). This is the most curious worm of all. It is a strange creature with a flat, shovel-like head, armed with bunches of golden bristles, behind

which is a pair of long arms having grooves lined with moving cilia. Then comes a pulsating cup, attached to the upper side of the body, followed by three disc-shaped segments, and last of all is the tapering tail, disclosing through its transparent walls an internal structure brightly colored green, yellow, and pink.

The parchment worm lives in the bottom of its tube, the three disc-shaped segments fitting the cavity neatly. As



A BUILDER OF SUBWAYS BENEATH THE SEA

The parchment worm constructs for itself a U-shaped tube formed of a glue-like secretion from glands in its own body, which hardens into a parchment-like substance upon contact with the sea water. The strange looking architect lives in the bottom of his home, the two chimneys of which project into the sea. By means of three disc-like segments in the middle part of its body, which just fit the interior of the tube, the creature pumps a stream of water into one chimney and out through the other, from which it abstracts the microscopic creatures that form its food.



ANIMALS OF THE WHARF PILES

The piles of old wharves along our shores are completely covered with a great diversity of animal forms, all of which are adapted to filtering out the microscopic food from the sea water in which they are submerged

the worm contracts its body rhythmically, these segments move like the pistons of a suction pump, drawing a stream of water into one chimney, passing it through the tube, over the body of the worm, and out the other chimney. The microscopic food contained in the sea water is filtered out by the combined action of the arms and moving cup, and transported through a trough lined with moving hairs up the mid-line of the body to the mouth of the worm.

It is obvious that not only the sea bottom, but the soil beneath the sea as well, is alive with myriads of creatures, adapted by their structure for breathing and obtaining their food in this particular habitat. Likewise, if we examine the wharf piles of an old wharf, we shall find it clothed completely with sea grapes, tube-building worms of brilliant, flower-like hues, feathery hydroids, scarlet

sponges, mussels, sea anemones, members of every animal phylum, all adapted to a stationary form of existence, equipped with various contrivances for extracting minute creatures for food from the life-giving sea in which they are bathed.

Life pulsates wherever we search along the borders of the sea. Living creatures endeavor to occupy every kind of habitat, and, if it is favorable, swarm through it so vigorously that all the space is occupied and many are crowded to the limits where marine life is precarious.

The pressure to escape to an air-breathing existence drives certain species to the limit of the tidal zone, so that we see, at the present time, compromises between the marine and terrestrial form of life, as in the case of the periwinkles and purples among mollusks. These are closely related to other snails (*Ampullaria* and *Siphonaria*) which have both water-

breathing branchiæ and air-breathing lung, and finally the snails, *Cerithidea* and *Cyclophorus*, terminate the series with a complete air-breathing apparatus. The same pressure now continues which, in the Carboniferous Age, forced the conquest of the air by the lowly progenitors of the land vertebrates.

The comparative anatomy of marine invertebrates shows us that there has been a gradual closing of the body cavity and circulatory system in higher marine animals, thus segregating the body-fluid which bathes their tissues and is closely similar in composition to the salt solution that we call sea water. It is very significant that the inorganic salts of the

blood of terrestrial animals are the same as those found in the ocean.

Thus the water of the seas, closely adapted in its composition for the life requirements of the lowest marine creatures and circulating freely through their cavities, has been succeeded by a fluid closed off from the outside within the bodies of higher organisms, some of which finally shook themselves free of their ancestral abode and emerged into the upper air. It is almost as if the invaders of the land carried a portion of their original habitat enclosed within them to bathe their tissues with the precious sea environment and so insure their continued existence in their new world.



THE SUN STAR OF OUR
NORTHERN SHORES

This brilliant creature, (*Solaster papposus*), bright scarlet with white-banded arms, is one of the most conspicuous inhabitants of our rocky coasts

SEEDS OF DISASTER

The Tragic Account of the Fall of a Thriving Community of Bolivian Umbrella Ants.
How the Supplies They Garnered Caused Their Dramatic End

By DAVID LOCKE

WITH FIVE DRAWINGS BY LYNN BOGUE HUNT

In the following article the author has told a story which, in part, is frankly fictionized. It has been carefully read, however, by Prof. William Morton Wheeler, Research Associate in Social Insects, American Museum, and America's outstanding authority on ants, who refers to it as follows:

"It seems to be correct and of interest as showing the variety of food and behavior of Atta. I have some doubts about the last part of the article describing the plundering of the nests and killing of the inhabitants thereof by another colony of Atta. The author's conjectures may be correct, although I have never seen any tendency of Atlas to war on their own species or plunder the contents of their fungus chambers."

With this introduction, Natural History Magazine presents it, glad to be able to publish an account so filled with action and interest.—THE EDITORS.

UP and down the sandy streets of Santa Cruz de la Sierra marches Sepi, her green umbrella spread. Through flower-gardened patios and even into neat white-plastered dwellings she blithely takes her course, serenely ignoring the chill welcome with which she is received by the human beings who consider as their private property the territory she invades.

On she marches, her lithe red body borne rapidly along by its six slim legs, toward the rounded dome surmounting the subterranean city wherein the green leaf umbrella will be stored for her fungus gardening. For Miss Sepi of the well-known Umbrella Ant family is a strict believer in the patronizing of home industry, and an ardent advocate of scientific truck farming.

No Battle Creek invalid was ever more fixed in the determination of his diet than is she. No manufacturer of bread or breakfast food can boast more truly than Sepi of "food no human hand has touched." Neither meat nor bread nor anything that grows upon the surface of the earth can tempt her from her home-raised fungus menu.

Leaves, fresh or dry, she prefers for her underground gardening, but other

woody things will serve. Rose bushes, vines, and shrubs in Santa Cruz must be surrounded by circular pottery gutters sunk in the ground and filled with water so that the insects cannot cross, or some fine morning the gardener may look out upon his patio and discover that the Sepi army has passed in the night, and that cherished plants have been stripped to bare and desolate stems. Consequently Miss Sepi is not popular with her human neighbors, and many and novel are the schemes which have been devised to get rid of her, yet, despite them all, she thrives and flourishes.

But, all you girls who take to business and professional careers, look upon Sepi and be warned in order that her fate shall not some day overtake the human race. Miss Sepi knows none of the simple joys of family life, nor has she sweetheart or husband or child to cherish. Neither is her way lightened by the prospect of "dates," dances, or movies. Her only pleasure is in her daily toil and the intervening periods of rest from it. By the same token, all you men who complacently look on as these girls usurp your occupation of breadwinner, you, also, beware. For the gentlemen of Sepiland are few, and what may be their fate is not

surely known, unless they furnish armored hams and sides of bacon for some cannibal and unvegetarian sprees of the unloved and unloving "poor working girl."

Our house in Santa Cruz, like innumerable others, was of plaster on a frame of bamboo, unceiled and roofed with tiles. There was a large front room, or sala, which extended entirely across from one adjoining house to the next. Back of this extended in single file a series of other rooms somewhat less than half the sala's width. Beside these rooms ran a tile-roofed gallery, also connected with the sala by a doorway. House and gallery were floored with brick, by no means evenly. Between the gallery and the solid mud and bamboo wall of the neighboring house was the patio which ran back some fifty feet behind our house to a large area in the center of the city block. This patio contained a few rosebushes and other shrubs, two or three papayas, and one tall *algarrobo* tree.

Beneath the gallery eaves sat great earthen jars, half buried in the ground, containing the household supply of rain-water. They contained, in addition,

sundry other things such as pink aquatic worms, several types of water bugs including one closely resembling a miniature submarine, and innumerable wiggle-tails which the local children were sure would grow up into snakes. However, we resolutely refused to think of these things when we drank water.

All Santa Cruz houses had these things, even more and better than our own, for, this being a rent house, it and its patio had been poorly tended. Our house was by no means crowded with furniture either, whereas in even the most ordinary Santa Cruz home the number of chairs and sofas was limited only by available space. We were, therefore, not a little proud that, as an added attraction of our own, the sala boasted a populous *Sepi* city beneath its floor, the entrances being between the bricks, one large portal and two or three smaller ones. We enjoyed the company of our industrious fellow inhabitants, though they were an endless source of concern to our visitors, who put down our forbearance toward the insects as another of the inscrutable eccentricities of the gringo.



SEPI, OF THE UMBRELLA ANT FAMILY

"Up and down the sandy streets marches Sepi, her green umbrella spread and her lithe red body borne rapidly along by six slim legs"

The Sepis were a busy folk, but they preferred to do their work under cover of darkness. By light of day only half a dozen workers and occasionally a great, square-jawed soldier—perhaps an “M. P.”—strolled about the surface, but as dusk came on, the city below began to awaken and the army of industry poured forth and set about their business of collecting and transporting supplies from the patio.

A handful of scouts appeared, darting swiftly about the environs of the city to see that all was clear. Soon there was a busy column of workers streaming across the floor and on to the gallery. Lesser columns diverged from the main one into the patio. Seemingly the order of the day was given before leaving the nest and each knew just which turn she was to take at the branching of the ways. Having reached their field of operations, they would begin the return journey to the city with bits of leaves and twigs and all sorts of odds and ends of wood. The outward bound ants dashed recklessly and with no thought of traffic regulations through the slower-moving bearers coming in. Now and then there was a halt and an exchange of greetings or gossip—if this feminine trait is still retained by the neutered maidens of Sepiland.

If a bearer appeared to have more than she could handle, she was often aided by a passer-by, who either gave her a hand in fixing the load so it could be carried, or, if it was entirely too large for one ant, made the whole return journey as an assistant. Often the efforts of two ants on a load seemed far from coördinated; in fact, it frequently appeared as though each were hindering the other, but somehow they always progressed. Here and there along the way a soldier patrolled slowly beside the column of workers, a creature with a great bulldog head vastly too large for

her slim worker-size body. These probably acted as traffic officers, though I never saw an occasion where they exercised their authority by directing the busy column, nor did there ever appear necessity for straightening out a traffic jam.

The habit of the Sepis of throwing down their burdens exactly where they stood when the quitting-time signal was radioed from the nest was rather untidy, for invariably each morning there was a line of assorted bits of trash strewn thickly from the city gates across the sala, over the doorstep and along the gallery, decreasing in volumes as the branch roads ran off into the patio.

At the doorstep of the sala entrance there was always laid aside the greatest heap of freight. Here was the chief obstruction in the Sepi road. Here they struggled ceaselessly to raise their heavy loads over the inch-high, vertical wall of the doorsill. The angle between the floor and the sill was particularly pernicious. A long twig, say of half an inch, would jam diagonally in the space, and the bearer, holding the stick by the middle, would find herself lifted on to tiptoes so that she could get no purchase, up, down, forward, or back. Here she would wrestle and twist, sometimes with the assistance of fellow workers, until the contrary burden could be juggled around to a manageable position or lifted over by some Sepi clinging precariously to the edge of the sill above. It was not so bad for the leaf bearers. They could climb on over the barrier, balancing their green umbrellas overhead. But leaves were rather scarce with our ant family, for they had harvested the nearer end of the patio pretty thoroughly.

We annoyed the Sepis quite a little, no doubt, by sweeping up the sala and gallery two or three times a week. Good housekeepers may hold up their hands in holy horror at this, but, after all, two



"SHE PREFERS LEAVES"

"Rose bushes, vines, and shrubs must be surrounded by circular pottery gutters sunk in the ground and filled with water so that the insects cannot cross"

lone men living temporarily in such circumstances should be excused for not cleaning house every day, even though they had such careless companions as the Sepis. We never could determine how the ants reacted next evening to the discovery that the previous night's accumulation of supplies had disappeared. This could not have been unusual in the Sepi world, at least among the Santa Cruz dwellers, so they probably took it philosophically.

We must have trampled to death a number of ants, also, walking about in the evenings when we could not see our little neighbors. However, they accepted this with the fatalistic unconcern of New Yorkers who see one of their swarming nest dwellers stricken down in some traffic accident—all in the day's work, each survivor mildly thankful he was one to escape.

The ants must have scouted constantly for new prospects and possibilities of food supply. One day we incautiously allowed the protecting ring around a rose bush in the patio to become dry. The observant Sepis discovered the fact immediately and next morning our poor bush bore but a solitary leaf, the busy workers having stripped it bare of every other one and even gnawed the tips off the smaller branches.

My bedroom was the last in the row from the sala. A door opened from it on to the gallery and patio. On a night as dark as the proverbial sack of black cats, I was awakened by a queer sound near the open door—a steady rattling, snapping, and rustling—not loud but as regular and unceasing as the rush of water over a rapid. For a minute I lay trying to determine what this strange disturbance could be. It was inside the

room and near the door. It sounded not unlike a slow fire in half-dry leaves, yet there was neither light nor odor of smoke. It was not, either, the sound of any creeping or crawling thing, animal or reptile; of that I was sure. My companion in the next room, the wall of which was just beyond the gallery door, snored peacefully. Evidently I was not deceived by some acoustic freak of the building. The sound was not in his room; it was in mine. But what it was I could not imagine.

With one hand I drew my six-shooter from where it hung under the head of my bed and with the other I reached for a match from the table beside me and struck a light. Nothing unusual was visible at first, but the sound continued, calmly, steadily as before, from the corner of the room just beyond the door. Here stood our household broom, a bundle of young palm shoots with dry, spiny leaves, stiff and woody. In that was the sound. Then I perceived a dark moving band on the floor, extending to and beyond the doorway. I took another match and hopped out of bed to investigate. The broom swarmed with *Sepis* engaged in cutting up those bristly spines and hustling home with them. I left them at their work and returned to bed.

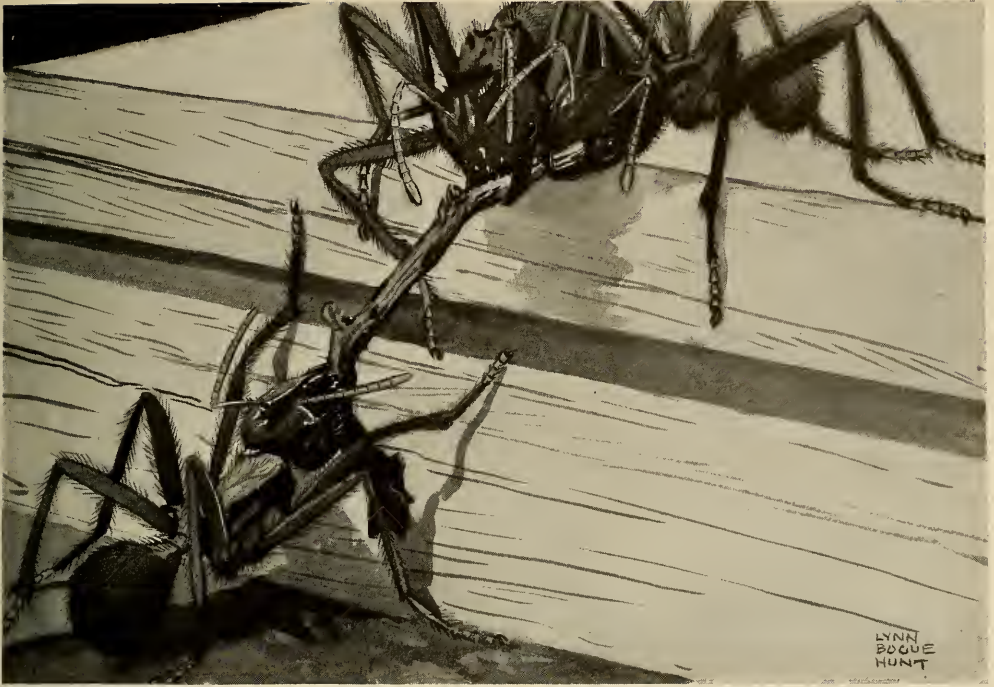
It took them two nights of persistent effort to demolish that broom, denuding it to the bare stems. We never were fully decided whether this was simply a foraging enterprise, or if the astute *Sepis* had discovered in the broom the immediate author of the disappearance of many a night's supplies left along the roadside at daybreak, and were taking this occasion to remove, as they thought, permanently, the very troublesome and destructive nuisance. It seemed strange that they should have taken to such tough material as that broom, when in the back of the patio were so many tenderer and what appeared to us to be much more

choice leaves and small bushes. But these may not have been suitable for ant mushroom culture.

In the meantime we had begun unwittingly to sow real Seeds of Disaster about our *Sepi* city. It was the height of the orange season. For a Bolivian ten-cent piece, worth, say, three cents in United States money, one could purchase seventy big juicy oranges of a fineness and flavor that would have caused a native Californian to drop dead of envy and chagrin. Every morning boys peddled them through the streets in squeaking carts with solid wooden wheels and drawn by yellow and white spotted oxen. It was hard to see how, at the price, they made the expenses of the distribution. Actually, I suppose, there were no expenses. The cars required no gasoline and it was self evident to the ear that they received not even axle grease. The oxen ate oranges. So did everything else in Santa Cruz, even dogs and cats—and *Sepis* could find use for them.

Every morning before going round the corner to where that good old lady Doña Lucinda served us breakfast, my partner and I ate from twenty to twenty-five oranges apiece. We tossed the peels in a heap at the back of the patio to dry, after which we burned them. The seeds we dropped along the edge of the gallery as we ate. A careless procedure, no doubt.

Soon we noticed the *Sepis* were taking advantage of this windfall of supplies and were nightly harvesting the seeds of the morning before. We felt we were doing our neighbors a favor and were careful to keep a good supply of seeds on hand for them daily. A new and interesting feature came into their working columns. Through the ranks of leaf- and twig-bearers was a slower moving column of orange seeds, whole companies and battalions of them, glistening like ivory in the candlelight which served to make



"THE DOORSTEP WAS THE CHIEF OBSTACLE"

"Here they struggled to raise their heavy loads over the inch-high, vertical wall of the doorstep"

less visible the dark bearers in the shadows on the dark floor and gave the seeds the appearance of fat, shiny, white bugs moving along in procession.

The seeds made particularly difficult burdens both on account of their size and of their shape. Also, it seemed remarkably hard to hold on to them, perhaps because of their smooth, polished surfaces. A bearer, after much maneuvering around the seed and several tentative graspings, front, back, and sides, would finally take hold and get all arranged to go when suddenly the contrary object would slip from her grasp and spin away or roll over, Sepi and all, perhaps overturning a couple of other loaded ants in so doing, and occasion a whole new start.

Such tugging, pulling, pushing, as those orange seeds required! Then, when they had been moved so far, what indescribable difficulties were experienced

at that bugbear of the road, the doorstep! Every morning, when the weary workers had retired within their brick-capped city to rest and prepare their gardens from the woody supplies they had carried in the night before, we would find an embankment of orange seeds at the sala door. All night long a continual struggle went on to hoist the unwieldy objects across the wooden bar. Now and then an ant would get a seed, longer than herself and far bulkier, balanced over her head precisely like a leaf umbrella, and with this great load would calmly ascend the vertical wall, like an automobile on a Pike's Peak trial, and, crossing the top, unconcernedly fall off the other side into the sala, right herself, never losing hold of the seed, and continue to the nest. But such feats of skill were rare. Usually three or four Sepis might be seen struggling with each seed, beneath and above it, the slippery seed escaping them again

and again, rolling off over the patient toilers or dragging them down with it from the sill.

It was a business which might well have tried the patience of saint or Sepi, yet they kept perseveringly at it, buoyed, no doubt, by the thought of the luscious orange-flavored fungus that was in store. Perhaps they even boasted to strange Sepis of other cities of their good fortune, detailed the advantages accruing to the *citoyennes* of the sheltered City of the Sala, and extolled the superiority of their mushrooms, nurtured on orange seeds. Perhaps scouts from some rival city discovered the treasure trove which our Sepis possessed and from which they garnered nightly. Since ant maidens at least retain one old-fashioned maidenly virtue and seldom if ever speak to total strangers, even of their own race, the latter supposition is more probably the correct one.

Whatever the means, the report must have gotten out, and, just as in the human world the wealth and contentment which one nation enjoys invariably arouse the envy and hatred of those others that lack them, so the orange seeds, which our Sepis may well have considered a dispensation from the gods and an indication of special favor from their particular deity, turned instead into the precursors of destruction which war and rapine released upon the happy city.

One day after we had acquired a new broom, I swept clean all the house including the Sepi road and the environs of their city. Next morning the sala and gallery presented a strange appearance. There were neither seeds, twigs, nor leaves to be seen, but everywhere was some fine reddish stuff scattered and heaped all about like a too plentiful sprinkling of cedar sweeping compound. It was thickest about the city gates. Also it was piled high on either side of that fatal doorsill which had caused the Sepis

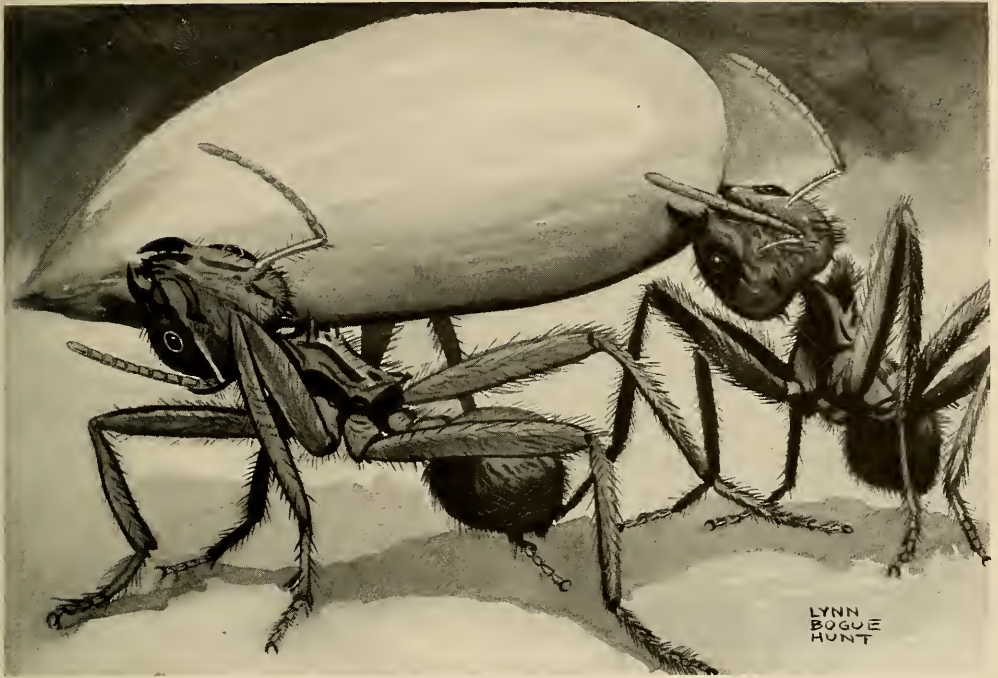
so much hardship. What had the Sepis been collecting that night, we wondered.

On investigation we were horrified to discover the red "sweeping compound" was all a tangled mass of little Sepi bodies thickly heaped in fragments about the floor. All were alike. Sepi had fought with Sepi and here was the fruit of their nocturnal combat. What an awe-inspiring sight must have been that frightful struggle between the hosts of diminutive warriors. Alas, that on that night of all nights something else occupied our time and the battle raging at our very side went unobserved!

However, after a study of the battlefield, one may reconstruct all the catastrophe. Inasmuch as scientists hold that ants of a city never fight among themselves, there must have been some outside enemy which fell upon the industrious workers of the City of the Sala.

Could we, then, have looked into some neighboring Sepi city on that fatal evening, we would have seen the warriors massing in the tunnels and passageways and moving up toward the surface, eager and excited at the prospect of the coming foray. Workers, too, are gathering to join in the raid and help harvest the spoils of victory. For long the dwellers of this city have struggled to find wood scraps and leaves in some barren patio with which to raise their scanty gardens of fungus, and much foraging has left little to supply the needs of an ever-increasing population. They are hungry, living on short rations. But now, their scouts have told them, they will find plenty, even overabundance of food in the rich and favored City of the Sala. Small wonder that the waiting Amazons are eager, combing their feelers nervously, the very taste of orange-flavored mushrooms already in their mouths.

With dusk they sally forth in a great stream, marching swiftly, led by the adventurous scouts who have already



"AN ORANGE SEED MADE A DIFFICULT BURDEN"

"Through the ranks of leaf- and twig-bearers was a slower moving column of orange seeds, whole companies and battalions of them"

spied out the land. Into our patio they go and across it to the brick-floored gallery. Meanwhile, the workers of our city have set out as usual, all unsuspecting of danger, to their nightly harvesting. The branching columns have come down into the patio among the orange seeds and the leaders have already taken up their loads and started back toward the city, when the raiders strike.

Some advance worker of the Sala city catches the signal of danger on her sensitive feelers and sends the note of warning to her companions. But it is too late. A great noiseless telepathic cheer vibrates from the forest of upraised feelers and the Amazons hurl themselves upon the workers all along the gallery edge.

Through the heaps of orange seeds the opening skirmishes are waged. The working girls of our city are no cowards. Attacked, they unhesitatingly turn to

give battle, pitting their little cutting jaws against the mighty crushing ones of the soldiers. In the patio and along the gallery they stand little chance. The scattered lines are quickly overwhelmed by the masses of the enemy. But the survivors retreat steadily toward the city, their number constantly increasing until they make a decided stand at the doorsill.

Here the battle rages furiously. Though the workers lose ten to one, many an invading warrior is dismembered, her legs and finally her great head hurled upon the field by the desperate and determined working girls of the Sala, even though those warrior jaws work fearful havoc with the smaller opponents ere they are torn from body and limb.

Gradually the invaders gain and hold a footing on the disputed doorsill. The workers are driven back and all the sala

between the door and the city gates becomes a battlefield, a swirling maelstrom of tossing bodies, writhing legs, and slashing jaws of the frenzied combatants, of little groups of workers fiercely cutting a soldier invader to pieces, of Amazons charging back and forth, perhaps dragging an enemy or two on their legs, slashing and crushing with their mighty jaws. Nor is the battle noiseless. There are quite perceptible sounds of combat. A scratching and shuffling by that myriad of tiny feet pounding upon the bricks of the sala. A faint cracking and crunching as jaws grind through skulls and horny chest armor of smitten fighters. Even, I can believe, there rose a tiny dust cloud from the field where these miniature Greeks and Trojans contended for a city and its wealth.

Surely the question in every worker's mind as the battle raged must have been, "Where are our own soldiers? Why don't they come to our aid?" Truly, where were they? Why indeed did they not sally forth to aid their hard beset worker sisters? Were they so besotted and enervated by gorging on delicious orange mushrooms that strength and courage had left them? Were those beds of orange-seeded fungus a fatal formic counterpart of the Capuan baths that enervated Hannibal's all-conquering Carthaginians? Certainly, all the battlefield proofs indicated that not one warrior issued from the portals of the Sala city to fight for home and country, not even when the surviving working girls rallied about the city gates and died there practically to the last woman. Over all that heaped field of dead, where worker clung to warrior and warrior to worker, there was no sign that even so much as one warrior had come forth and laid jaw to enemy soldier.

Next day the underground city held secret from us what may have occurred when the conquering invaders poured

into its depths. Within they must have "put to the jaw" every living inhabitant they came across. Queen, drones, courageous worker and cowering warrior doubtless suffered an equal fate. Then, the battle won, the city theirs, the invaders must have gathered mushroom gardens, orange fertilizer, and whatever else they considered of value, and returned in long triumphant column to their own nest.

When dawn broke palely across the shadowed patio and sala, the field was again quiet after the storm of battle and plundering, and all but deserted by the living. Only the ghastly "sweeping compound" of heaped bodies remained, worker and warrior locked in the embrace of death. Legs, hands, and dismembered torsos were everywhere. Scattered among them were a few wounded, pitifully struggling, less fortunate than those who had already died. A worker, half her legs gone, a warrior's head clinging to one of the remaining members, feebly tried to right herself and crawl away. A soldier, dreadfully battered, writhed in futile striving to escape the grasp of workers whose jaws were forever closed by death. Another dusty, bedraggled soldier, her abdomen nipped off, crept miserably about waiting to die. Others, warrior and worker alike, lay there, mangled in every imaginable way. In this the workers had a grim advantage. Though their dead far outnumbered those of the invader warriors, their wounded were fewer. Jaws built for fighting did their work better than those prepared by nature for the peaceful occupation of plant cutting. Altogether, the wounded of both sides were few. No quarter could have been asked nor offered in this battle between cousins.

A few warriors were going over the field when we came to investigate. These must have been survivors of the Sala tribe now tardily on the surface. They,



LYNN
BOGUE
HUNT

THE BATTLE IN THE SALA

"The workers are driven back and all the sala between the door and the city gates becomes a battlefield, a swirling maelstrom of tossing bodies, writhing legs, and slashing jaws"

however, seemed to pay not the slightest attention to the dead or wounded. Also one or two workers were wandering about in a dazed sort of way, still dust covered as evidence that they had done their share of fighting on that awful night. They walked past the military patrols without being noticed nor did they pay any attention to the soldiers. They moved slowly with a manner of utter weariness and despair. About the gates of the city stood several more soldiers, quiet and dispirited. The future for these survivors of the catastrophe must have been quite hopeless. They had been robbed of everything to the last vestige of their mushroom store, so that starvation confronted them. Undoubtedly their queen had been slain in the general massacre, and with her had perished the head and the vital force of the tribe, the very city itself. Nothing remained then for the miserable little group of survivors but to perish also.

We left things as they were for twenty-four hours to see if additional survivors might appear from below ground, and if they would make any disposal of the dead, but in the evening no bustling workers sallied forth as had been their wont, and next day found the field still heaped with slain. Only a few despondent military patrols appeared at the portals between the bricks. We swept up the battlefield that morning. An occasional soldier came from below ground that day, and the succeeding night a half-dozen workers appeared and crawled aimlessly about. Then they also disappeared. Whether the handful of survivors migrated from the ill-fated city to attempt to found another on what they had preserved from the disaster, or whether they had merely retired to the depths to slowly die, we could not tell, but during the month of our stay in Santa Cruz after this catastrophe, the Sepi city of the Sala remained as dead as Pompeii.



ACROBATS OF THE MONKEY WORLD

The Antics and Marvelous Vitality of a Troop of Captive African Monkeys

By W. HENRY SHEAK

Naturalist and Lecturer

RECENTLY I had the good fortune to have under my care for about two months a collection of nearly fifty mangabey monkeys, one of which was of the white-crowned species, *Cercobus bunulatus*. She was one of the most delightful pets I have ever had, as gentle as a kitten and as affectionate as a human child. She seemed to take delight in my presence. Much of the time we had her tethered to a cage of mona monkeys, and the top of this was her headquarters. Whenever I came within reach, she would climb on my shoulder; when I stopped to feed the monas, she would come and sit on my knee, or snuggle up into my arms, making it difficult for me to go on with my work. A favorite approach was to creep under my arm. She was a shameless beggar, always teasing for something to eat whenever I was preparing feed. She would "talk" to me by the hour in a low crooning voice when we were alone together in the room. My clothing was a source of great curiosity to her, and she never grew tired of minutely inspecting my various garments, looking over them as one monkey looks over another.

All the other monkeys in this collection were sooty mangabeys, *Cercocebus fuliginosus*. This is a large species, dark slaty-blue in color, and with the singular habit of carrying the tail always thrown forward over the back when standing or walking, as is well illustrated in the photograph showing the monkey perched on my shoulders.

The sooty mangabey is an acrobat *par excellence*. He is good-natured and friendly, especially when taken young.

He is the one monkey in the great African rain forest that will not bite when first caught. Of course there are exceptions to the rule; some of the old males become surly and will attack. But no monkey makes such an ideal pet as the mangabey, not even one of the capuchins of South America. Always active and playful, he is a model monkey for exhibition.

I had thirty-six of my sooty mangabeys loose in an upstairs room. Instead of being afraid of me and crowding into a far corner when they heard me coming, as did the green monkeys in an adjoining room, they would gather about the door, eager to see what I was bringing them to eat, and ready to pounce upon the buckets the instant I set them down. One specimen, who was unusually tame and friendly, would jump and grab hold of the rim of the bucket, when it was still in my hand, and climb inside of it. Often I would sit over the bucket and hand out the bread or vegetables to them. Each would come and take his share out of my hand. Sometimes, with both hands full, a monkey would walk away on his hind feet in an upright posture. But more often, with a potato or other vegetable in each hand, he would walk across the floor, placing the potato in his right hand on the floor at each step, while he carried his left hand with its potato well away from the floor.

Often when I was thus seated over the bucket, the pet I mentioned in the last paragraph would come and crowd in between my legs and help himself to any choice bit the vessel might contain. He frequently sat on my knee while eating, sometimes even on my shoulder. He got to be a trouble maker. He would



Photograph by N. H. Hartman

SHELLED CORN FOR DINNER

Nibs, the mischievous member of Mr. Sheak's troop of sooty mangabey monkeys, often would perch on his master's knee while feeding

start a row with one of the other mangabeys by snatching his feed or biting his hand or foot, then run and jump into my lap where he was safe from pursuit. One afternoon I was stretching a rope across one corner of the room, as a perch or swing, making one end of it fast to a board nailed across the window. Nibs started the usual fight, ran and jumped into the window, and snuggled in between me and the glass. Like all bullies he was a coward, and while he did not hesitate to attack any of his fellows as long as I was in the room, he always ran to me for protection. Even when two other monkeys got into a squabble in a far corner, he would run and jump into my lap with a scream of fear.

Another mangabey had been a pet in a family where there was a small boy and

two older girls. If the monkey whimpered, one or another would hurry to him, pick him up, and get him something to eat. So whenever he caught sight of me he began an incessant chatter, and kept it up, until I satisfied his wants. I always had to attend to him first—before I did anything for the others. One Sunday morning he was tied outside on a window ledge. I was sweeping away some straw that one of the chimpanzees had thrown off the roof, when I happened to come near this mangabey. He caught me by the hair and began to look over my head. Deliberately and carefully he worked, all the time holding me by the left ear with one foot, the great toe and other toes being just like thumb and fingers. When he was through with one side, he would give me a yank by the hair and pull me

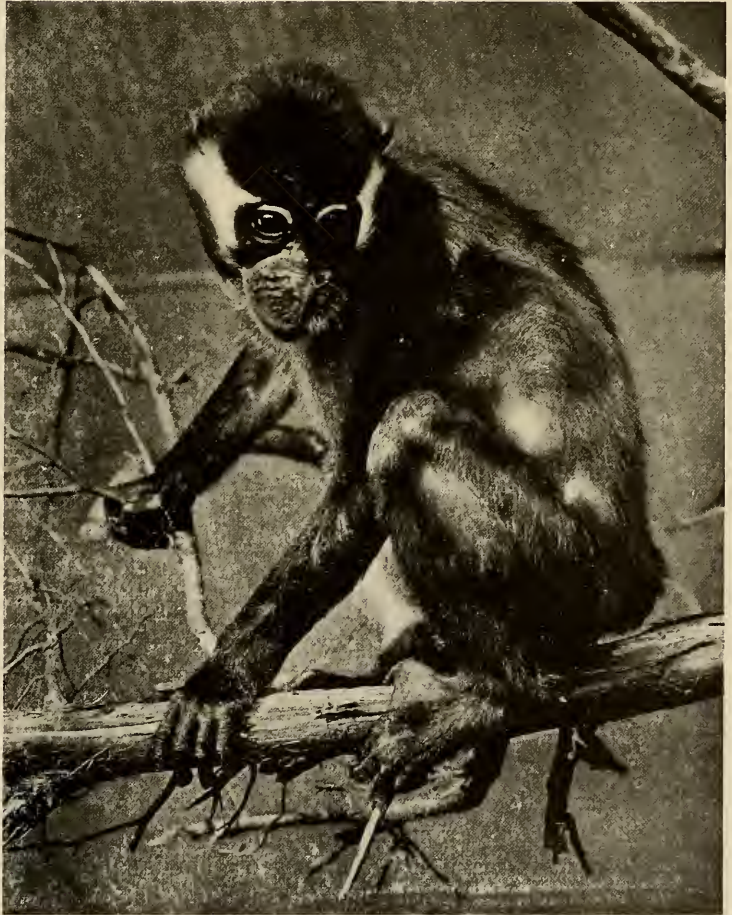
around to where he wanted me. There were no "cooties," but every now and then he found something which went into his mouth and seemed to be to his liking.

Among the sooty mangabeys was an unusually fine large specimen which we called Max. Max was the most active monkey I ever saw. He was snatching and grabbing at things from morning till night. He was never still a minute. At first we had him in a small cage surrounded by other similar cages. I had great trouble in feeding and watering the other monkeys, be-

cause Max was always snatching what I wanted to give them. Before I could get a piece of bread into an adjoining cage, he would have it. When I attempted to put a pan of water into the cage above his, he would snatch it and spill the water. If I succeeded in getting the pan into the next cage, the chances were about two to one that with his long arms he would be able to reach it and upset it. Even his own food he seemed to enjoy more when he could snatch it out of my hand, than if he let me put it in the cage. One day, after I had divided my own lunch with him, he snatched out of my hand a paper bag containing a big piece of

bologna, which he proceeded to eat. At this I was surprised, for, aside from the baboons which are largely insectivorous in their diet, none of the monkeys are carnivorous to any appreciable extent. Then, too, bologna is a highly artificial product. Later I offered some of it to both the Guinea and Galada baboons, but they refused it.

This mischievous mangabey was strongly tempted by the rubber band I wore about my shirt sleeve. His eyes were very keen and he never failed to see it, no matter how thread-like it was. He



From Elliot's "Review of the Primates"

THE WHITE-COLLARED MANGABEY

This monkey (*Cercopithecus torquatus*) of west Africa lives in the forests of southern Nigeria, Cameroon, and Gaboon. It has rather a shrill call, and frequently descends to the ground to feed

almost always got it, too. One morning he was chained on top of a large box-cage. I was cleaning a smaller cage near it, and had to get down on one knee to use the scraper. Max climbed on to my back, got astride my neck, with his long legs hanging down nearly to the floor, and tried to untie a handkerchief I had about my throat. Another time, when I was standing, he climbed up and got astride my neck. He had a very exalted opinion of his own importance. He seemed to entertain the conviction that, instead of being subject to me, he was the master and I the slave—that I existed for the sole and only purpose of serving him.

One of Max's favorite performances was to rub his face with his feet or hind hands, just as a laboring man rubs his face with his hands in washing after a day of dirty work. He always used both feet, going over his entire face, carefully and thoroughly. It was an interesting piece of acrobatic work, and bordered on the realm of the contortionist.

A certain hot morning in August I was watering my charges before cleaning the cages or feeding. Max was still in his big box-cage. Bad as he was inside, he was much worse on the outside because he would climb all over me and appropriate anything that struck his fancy. So I did not want to take him out till I had cleaned the cage. There was no opening at the bottom of the cage and I had no pan that would go between the wooden bars. If I opened the panel that served as a door, he would push his hands, if not his head, through the portal, and I would have difficulty in closing it. So I got a drinking glass full of water and held it out to him. This was a puzzle. He did not know what to make of it. I showed him it was water by letting the fluid trickle over the side. He was thirsty and drank two or three swallows. But his curiosity was stronger than his desire for drink. He got back, looked at the glass from one

side, then from the other. He put his hand against the glass and felt of it. He never before had seen a drinking vessel through which he could see the water. After examining the glass with his fingers, he put his hand down into the liquid. He looked at it again from various angles, after which he took a few more sips. Once again he studied the glass from different sides and felt all over it and inside of it. By this time he had lowered the water almost half way. Finally he tried to drink through the side of the glass on a level with the water surface.

One evening Max had gone around a post of the balustrade inclosing the flat roof of the porch, and wound his chain about it till he could not quite reach the pan of water I had placed on top of his big box-cage. Seeing he was in a dilemma, I did not move the pan nearer, wondering how he would solve the problem. He did not make any frantic efforts to reach the pan, as I expected he would. Neither did he hesitate a minute, but went back to the post, followed the chain once around, then came and drank the water. The species is marvelously intelligent and quick in grasping a thought.



The African green monkeys and their allies (*Cercopithecus*) might well be characterized as activity personified. They so abound in vitality that when confined to a cage they are like a boiler under high pressure of steam. I have seen the green monkey take a position on the floor of his cage, or on a broad, flat perch, jump several inches into the air, come down on his hands, rebound, alight on his feet, spring again into the air, strike once more on his hands, and keep up this springing, rocking motion for fifteen or twenty minutes with the regularity and precision of the swing of a pendulum. His muscles act like elastic steel springs.

The vervet has a similar method of

relieving his pent-up energy. Without touching his hands to the floor, he will jump with his hind legs, well into the air, and repeat, time and again, with increasing rapidity, until the on-looker becomes fairly dizzy. The secret seems to be that in the native free state they live lives of such intense activity, that when brought into confinement they are compelled to invent some method of exercising their muscles and working off excess vitality. They are all primates of slender, graceful build, with attenuated limbs and bodies, as well as long tails, adapted to seeking their food in the tops of tall trees. They must be alert of mind, stealthy and quick of movement, to escape their numerous enemies, such as the leopard and the serval.

The mangabeys are a detached offshoot from this group. Buffon so named them, after a locality in Madagascar, under the delusion that they came from that great island, the central home of the lemurs. They are not only not found in Madagascar, but are confined largely to western Africa, and do not range very far to the south. They are given a genus to themselves, called *Cercocebus*, and there are five or more species. They are distinguished by peculiarities of the teeth; by the backward direction of the hairs of the crown, which can be observed plainly in the large illustration accompanying this article; by having the face more lengthened, the whiskers small, the eyebrows very

prominent, the eyelids an ashy-white, and the size somewhat greater than in the typical *Cercopithecus* monkeys. They are often called "white-eyelid monkeys."

But like the typical members of the group, they are slender of form, have long limbs and tail, and are extremely agile. The general color is dark or blackish. The black mangabey is the *Cercocebus atterimus* of the zoölogists. He may be known by his very dark slaty color, deepening to black in some places. The collared mangabey (*C. torquatus*) has a well marked ashy-gray band or collar about the throat and nape; also the cheeks and chest are white. The white-cheeked mangabey is *C. albigena*, in which the forehead is also white or ashy-gray, and the underparts whitish.

I have said that one of the distinguishing features of the mangabeys is the backwardly directed hair on the top of the head. But the white-crowned mangabey (*C. lunulatus*) is an exception. The hairs on top of the head are not only of a light ashy-slate color, but are longer, erect, though somewhat compressed or flattened,

forming a distinct crown, not unlike that of the bonnet macaque, an Asiatic species. The hair of the entire animal is more soft and furlike than in the other species, and is slightly tinged over the body with a soft slaty-brown. At least two other species (*C. albigena* and *C. atterimus*) are also provided with crests.



MAX, THE BIG SOOTY MANGABEY MONKEY, STANDING ON MR. SHEAR'S SHOULDERS



"GEOLOGY POINT"
BEAR MOUNTAIN

TRAILING NATURE

How Nature Trails Are Operated at Bear Mountain, New York, by the American Museum in Coöperation with the Commissioners of the Palisades Interstate Park

BY WILLIAM H. CARR

Assistant Curator, Dept. of Education, American Museum

A HOARSE, prolonged whistle echoes up and down the narrow, rock-lined Hudson gorge. It is eleven o'clock in the morning and the first crowded Dayline boat is groaning to a protesting stop alongside the Bear Mountain dock. Before the day is over, many more boats will pause here long enough for some 40,000 persons to walk ashore in the hot summer sun. These people, of many nationalities, have come forty miles up the river from New York City to enjoy a breathing spell in the open air.

Like veritable sheep, they struggle up the steep, narrow path that leads from the river level to the cliff top, above. Here they come, a steady stream of perspiring, tired humanity, taking advantage of what, to them, must be an out-of-door Utopia—the beautiful Harri-man section of the Interstate Park! The head of the line reaches the upper level and pauses to look upon the rounded, quiet mountains. Just ahead is the covered ramp that leads over the bear dens to the Inn grounds.

It is when they have nearly reached the bear pit, that some of the crowd may notice a modest little sign announcing:

THE BEAR MOUNTAIN NATURE TRAILS
AND TRAILSIDE MUSEUM
THIS WAY

"Elsie," the disdainful black bear of Bear Mountain, is perched high up in the branches of an oak tree, sound asleep. Her black muzzle rests on the tree trunk, and she pays not the slightest attention to what is going on about her. Though "Elsie" is not interested in the people, we are. It is for them that we have labored for the past two years. Many persons who are "nature minded" and many who are not, now leave the throngs, and we know that presently they will pass our first sign and stop before the "Nature Trail Bulletin Board," beyond. A keen-eyed young man, his wife, and his little boy, have stopped a moment to catch their breath after the long climb.

"Nature Trails," reads the man, vaguely,— "What are they? Where is

the 'Trailside Museum,' anyway? I don't see it!"

The bulletin board is there to answer him. Nevertheless, we hear his query and walk over to explain. There is nothing that can equal a direct, personal contact, and we always like to make as many of them as possible.

"The Nature Trails," we tell the man, "are operated here by the American Museum of Natural History in coöperation with the Commissioners of the Palisade Interstate Park." We then indicate the first introductory label, which reads:

SIGNS ALONG THE TRAIL

How many of us are able to read, unaided, the 'signs' of Nature? Let the guiding labels take the place of a naturalist friend who has an interesting story to tell you as you follow the trail

"I see," says the father; "We go along and read a lot of labels that tell about things—about trees and rocks. Is that it?"

"You are right," we answer. "The labels are spaced about twenty feet apart

and they tell you much more than just the names. The best way is for you to follow the trail and read about the things that interest you."

"How about snakes," asks the man, as though he were in a department store. "Have you any? Junior wants to see a rattlesnake."

"We have no rattlesnakes just at present," we answer; "but there is likely to be one along any day. How would a copperhead do? We have a mother and four babies with grass-green tips on their tails!"

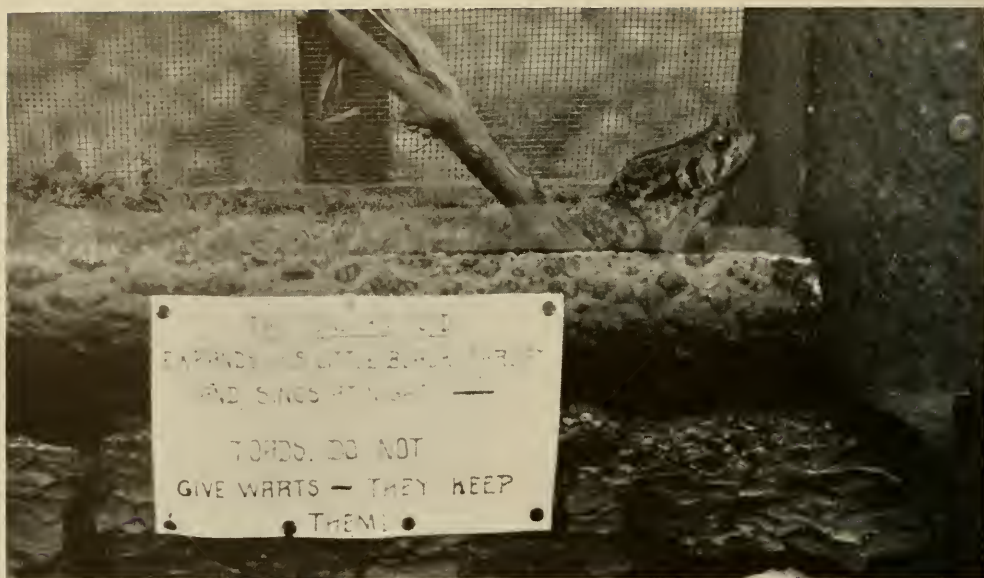
Junior is immediately anxious to see the babies with green tails. He forgets all about rattlesnakes in his enthusiasm.

A sizable crowd now finds the trails and pushes on past us. Nature Trails require no guides; nevertheless, we think it worth while to accompany the little family on their way to the Trailside Museum. Junior and his father are primarily interested in the copperheads, yet they pause frequently to read labels as they go along. The woman finds one on the chestnut oak.



AT THE BEGINNING OF THE TRAIL

An attractive bulletin board tells the interested visitor "What to look for this week"



“TOAD HOUSE”

A home for transient toad residents is built in a tree at the side of the trail and constructed so that visitors may become better acquainted with its occupants

“Is there a tree here that is just a plain chestnut?” she asks.

Her question is answered automatically, for she comes upon another sign on a small oak tree that says,

THE CHESTNUT OAK LEAF, THOUGH
DIFFERING SOMEWHAT FROM THE
SHAPES OF THE AMERICAN CHESTNUT
LEAF, RESEMBLE IT, THUS THE NAME
‘CHESTNUT OAK’

Underneath this label is another with a drawing of both leaf types. The legend here advises that,

THERE ARE SOME TRUE AMERICAN
CHESTNUT SPROUTS NEAR THE SWAMP
TRAIL. LOOK FOR THEM

We soon pass the granite ridge and have nearly reached the Museum. The three visitors have read perhaps thirty labels and have missed as many more. Junior discovers a bird’s nest in the midst of a clump of high-bush blueberries.

“What’s this, Daddy?” he shouts.

Daddy pauses and looks. It is simple

enough for him to answer; for just in front of the deserted nest is a small sign upon which is mounted a colored drawing of the bird that made the nest. The caption reads, “This is a last year’s catbird’s nest.” The nest is wired to the branches so that it cannot be dislodged. However, the wires are concealed and do not spoil the picture.

“What is a catbird, Daddy?”

“I don’t know,” says Daddy; “look at the picture.”

“I see,” says Junior; “but why do they say ‘catbird?’”

“Probably because cats like to eat it,” cheerfully returns father, with a happy burst of inspiration.

“You’re wrong!” announces his wife, who has discovered another label. “This sign says that it is named a ‘catbird’ because one of its calls sounds like a cat mewling.”

“Fair enough,” says father.

Presently we arrive at the Trailside Museum, the focus point from which all of the trails radiate. It is constructed of

worn glacial boulders, retrieved from a near-by hillside. It looks as though it had always been there.

"What a lovely place!" the wife exclaims. "Let's go in!"

Once inside, Junior, forgetful for the moment of his snake quest, locates two microscopes on a green-topped table in front of a window.

"Daddy, come here!" he cries. "What are these things?"

Daddy is engrossed with a miniature model of a beaver pond, and is reading a label that tells him to "see the live beaver in the pond below the bear dens" before he goes home. Thus Mother walks over to the table to aid that eternal little question mark, her son. Here, once more, she finds labels that tell a story. One of them reads:

THESE MICROSCOPES ARE FOR YOUR USE. YOU ARE INVITED TO GO WITH THIS LITTLE ENAMEL PAIL TO THE POND, JUST OUTSIDE, DIP THE PAIL FULL OF WATER, RETURN HERE, AND, WITH THE AID OF THIS MEDICINE DROPPER, EXAMINE YOUR FIND BENEATH THE MICROSCOPE

Following his mother's instructions, Junior takes the much used little pail and is soon back with nearly as much water on his clothes as is in the pail!

Mother extracts a dropper full of water from the pail, places it on a glass slide beneath the lenses, and in a moment, she, too, is calling for father. She has seen something that she never saw before. Responding to her call, father comes and is soon looking excitedly at the antics of a tiny "water flea" that through the microscope looks large indeed!

In the meantime, the restless Junior is pleading for a "look." However, he has to wait until his parent has identified the "flea" by means of the photographic chart that is near by.

At last Junior gets his chance, and while he is squinting at the now discouraged little "flea," father looks on and says: "I should think you would be afraid to let people use these instruments. It's a wonder they aren't broken!"

We explain that although many hundreds of persons have used them, not once have they been injured!

"Why do you call this place a Museum?" queries the man. "There are no stuffed birds or animals, here!"

"This is no place for mounted animals," we answer. "There is no room, and if there were, we would not use them, for this is an out-of-door museum. It is a museum without specimens. All you will see here are models, instruments, charts, and living things. That is the object of



A WINDMILL LABEL

The geology of Bear Mountain is not overlooked by the Trailside Museum. The label under observation in this picture tells about the glacier that once covered the district

this Trailside Museum."

"Good idea," volunteers the father. "Something different always pays. There are plenty of museums in the city where they have stuffed things with glass eyes."

An hour soon passes, and still the "sights" in the small building have not been exhausted. Junior finds a hog-nosed snake in a glass cage. He reads the sign which says,

.....
AN OPOSSUM OF THE REPTILE WORLD
.....

We take the snake out and demonstrate its "possum playing" capabilities. Junior, despite his mother's pleas to the contrary, picks the hog-nose up and handles it, curiously studying its actions. As soon as his mother observes that there

is no harm done and that the reptile is as harmless as we have pronounced, she plucks up courage to touch first, and then to hold it very gingerly, while her husband admiringly looks on.

Junior is now reminded of the copper-heads. We lead him to the green-tailed babies and tell how they were discovered in a boys' camp museum not far away. Many are the snake myths that we explode in answer to the father's questions. Of all maligned creatures, snakes are no doubt in the front ranks. The ways in which they are misrepresented are without number.

Outside, upon the trail once more, we pass the self-explanatory geology stone wall, where labeled rock specimens tell of the story beneath our feet. We reach

"Geology Point" overlooking the Hudson and stop for a moment to look through the trees to the scenes beyond. Across the river, "Anthony's Nose" rises against the blue sky line, a huge rounded dome of tree-covered rock. Bear Mountain Bridge appears and casts its graceful black shadow on the motionless water far beneath. Two crows down by the river edge "caw" nervously as a train approaches through the tunnel near by and comes roaring out to fly down the glistening steel rails seventy-five feet below us.

Junior, in the meantime, has done some exploring on his own account. He rushes up and exclaims: 'Daddy, come with me! I found some skunks!'

Back we go to the cages near the turtle pond, where two little black and white



ALONG THE TRAIL

Labels, which are spaced about twenty feet apart, give much information besides the names of objects. Arrows on this revolving table indicate many interesting scenic features about "Geology Point"



THE AMPHIBIAN TABLE IN THE TRAILSIDE MUSEUM

Salamanders, tadpoles, and young toads tell their own life stories with the aid of Museum labels

animals have attracted a good-sized crowd that stands looking at them with mixed emotions. We walk around to the back of the cage and take out one of the skunks, so that Junior may stroke its fur and see it at close range. When we walk toward the people, we notice that most of them fail to hold their ground. They retreat to a respectful distance.

"This is a tame skunk," we tell them. "His name is 'Sachet.'"

The crowd, however, is not reassured. The spectators make no advances until finally Junior takes "Sachet" in his arms and smooths the sleek fur gently with one hand. Then the questions come thick and fast.

"Why doesn't he *do* something?" asks one boy.

"Because he doesn't want to," suggests another.

Eventually, many hands come haltingly out to touch the harmless "Sachet," who, though in full possession of all his weapons, refrains from using them due to the fact that he is not in the slightest alarmed.

Like his brothers in the wild, he never becomes offensive unless actually injured or very much frightened.

Before the little exhibition is over, the skunk has gained new friends. We put him back with his sister and watch him curl up and go to sleep. Perhaps there is no other small animal in the world more independent than the skunk unless it be the porcupine! This independence stands "Sachet" in good stead upon the Nature Trails, for he is never annoyed when visitors refuse to take a serious interest in him. He regards all comers with an equal indifference.

"I should think," says Junior's father reflectively, as we walk on toward the snake cages, "it would be quite an undertaking to run a nature trail like this one."

"Well," we return, "it is a good bit of work, but like many another educational projects, the result is more than worth the effort."

"The building of a nature trail," we continue, "is something like the building of a fire. The more carefully the kindling

is laid, the more readily will the wood above burn when once the match has been struck. In the instance of the nature trail, Nature herself has provided the kindling in the way of innumerable out-of-door exhibits. It remains for the trail builder to use that kindling in such a way that he for whom the work has been done may apply the match of interest and see the flame of knowledge."

"There probably is never a lack of fuel!" says the man, understandingly.

"No, there never is," we agree. "That is the least of our worries, yet we must constantly remember that it is impossible to tag and label trees, flowers, and rocks in the open as one would in a museum. We try to make invitations of the signs along the trail. They aim toward the informal teaching of facts as well as of ideas."

At this point in our conversation, we are interrupted by Junior who has deserted us again. He hurries his father on to see "Josephine, the Second," a dignified, great-horned owl, who perches importantly in her cage.

"Daddy, this sign says that owls *do*

see in the daytime! Did you know that?"

Before father can answer, there comes from the docks a loud interrupting whistle. It is a warning that leaving time has come.

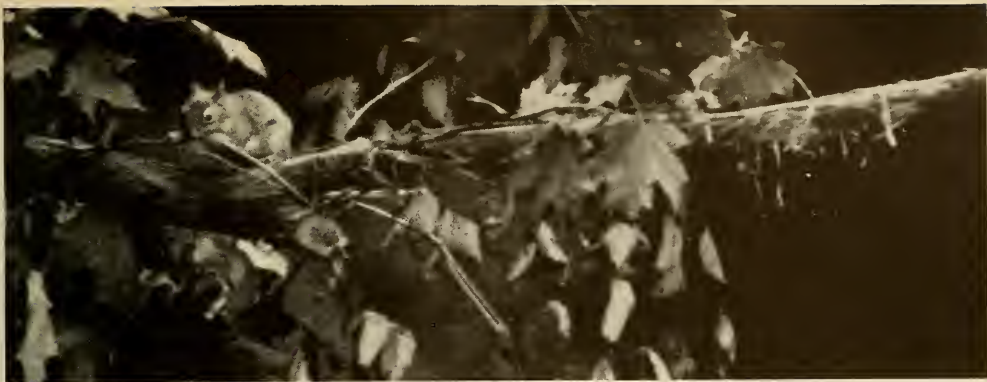
The family misses seeing the hidden label trail, the well without water, the historical trail, "Virginia," the red fox, the elk and the deer, and numerous other things. The whistle calls them again, and with a "good-bye," a "thank you," and a promise to "come again," they walk off toward the waiting boat. Junior calls, as he goes down the hill, "I'm coming back as soon as you get a rattlesnake!"

Tree shadows are lengthening on the open field as we go on up the trail toward the cabin. We pause for a moment beside the active ant hill with its descriptive signs and its protective fence. An elderly gentleman is here regarding the signs. He turns toward us with an expression of real appreciation in his eyes, associates us somehow with the work, and says, "I think this is great! I have been all over these trails and I want to thank you people for giving me an interesting day!"



BEAR MOUNTAIN TRAILSIDE MUSEUM BUILDING

Drawn by Marion Dergner Carr



Maple sugar.—From the bark the squirrels get their vitamins and a little maple sugar, much diluted

THE RED SQUIRREL FARM

A Palatial Sanctuary for Squirrels that Is the Most Unique in the World

By ROBERT T. HATT

Assistant Curator, Mammals of the World, American Museum

HALF hidden among the peaceful rolling hills of Westchester County, New York, lies a farm that is unique not only in the County but in the world. Here in a large and rambling house its owner has assembled a collection of all things squirrel that has doubtless never been equaled for any other group of animals. One first sees evidence of this when one turns into the estate from the highway and passes between two stone pillars that bear at their top a frieze of painted red squirrels, which mutely let the visitor know that this is the Red Squirrel Farm.

One drives along a wooded lane until the trees recede. Down an apple-bordered drive appears the great house whose mission is evident at first glance. The two upper stories are masked by a great maze of outdoor cages and the forest of branches within them. One at first sees little room for human habitation and, in fact, it seems more likely that the squirrels share their home with Dr. Lillian Delger Powers and her husband than that they have given over much of their home to the squirrels.

To understand this house one must know those who have built their lives into it. It is difficult to dissociate Doctor Powers from her squirrels, yet she is as versatile as she has been thorough, and she may claim distinction not only in her scientific study of squirrels but in her profession as a psycho-analyst. Twenty-four years ago, traveling in Ceylon with her husband, she first became interested in squirrels. One day, while they were driving along a dusty road, a small half-clad native boy held up to them a young palm squirrel in expectation of receiving a copper for exhibiting his captive. Through sympathy for the squirrel they gave the boy a sum of money sufficient to give them title to the creature, which they took back to their hotel. The nights in Kandy were chilly and the baby squirrel was doubtless undernourished. As a result, in the morning the young one was cold and still. Though they had at first taken little interest in the captive, their neglect made them remorseful. Fortunate it was for the little squirrel that both were skilled doctors. They worked over the

inert body as though a human life were at stake, and eventually, with the aid of hot-water bags and massage, the tide of life came back, the little one opened its eyes and won their hearts.

Afterward they settled down near a German seaport. In Germany, squirrels are considered great pets and here Doctor Powers started her collection. Sailors soon learned of her interest and brought squirrels from all over the world to her, and as the collection grew so did her interest. Noted artists were commissioned to make portraits of her squirrels. Some worked in oils, some in bronze, and some in wood. Drawings and photographs supplemented the collection. Some of the pictures shown on these pages were made then. Old sculptured squirrels, tapestry, paintings, stained glass, silver, porcelain, any art work showing squirrels was added. And the artisans about the country were not slow to turn their hands to the task of making objects

showing squirrels, which they knew would find a ready market.

Later Doctor Powers moved to New York, where she lived for several months, and then, in search of more suitable surroundings, moved to her present paradise of squirrels. Because the American reds and the German reds were at that time more numerous than all the other species, the farm took its name from the party in the majority.

The guest sympathetic with animals is welcomed warmly. When you first enter the house, you may well be bewildered, for the walls are literally covered with squirrel canvasses. Windows contain stained glass squirrel panels. Sculptured squirrels are legion. Then, from the floor above, you hear strange sounds descending. Two squirrels are running exercising wheels and another is scolding vociferously. In a moment you ascend the stairs to the labyrinth of screen walls that divide the immaculate



COMRADES

Two gray squirrels rest between "shots" in the making of a film



RED SQUIRREL FARM

With 150 squirrels inside and perhaps 50 more outside, the hub of the squirrel world might well be here

linoleum floors into large compartments or, more appropriately, apartments. You put in your pocket, from the ever ready tray, a handful of cracked pecans and pine nuts to show your good will to those squirrels you are to meet. Then you follow into one of the compartments and close the door carefully behind you. Several squirrels come near and look down at you from the interlacing branches above. They run over the screen walls near your shoulder. If you whistle to them or move toward them suddenly, you are not likely to make friends with many. If you move slowly, talk quietly, and call them with a low "*tchu-u-k*, *tchu-uk*," you may soon find one on your shoulder looking for the expected nut and showing a delightful confidence. Not all are so confident or friendly, however. Some squirrels come quickly to any visitor, some trust only Doctor Powers and their keeper. One squirrel is so

aggressive that even his keeper must lock him in his nest box each time he wishes to clean the cage, for an angered squirrel's bite is not a pleasant thing.

Not all squirrels get along well together and those of bad reputation are isolated. It is sometimes possible to find three species of tree squirrels, a cockatoo, and some flying squirrels all living together in peace. There are fights from time to time in almost every cage, but no more than there might be among the members of one family. Each one knows his own bed and goes to it at about the same time every night to sleep.

When a squirrel first arrives, it is isolated for a time until it gets used to its surroundings and its neighbors. Then it may be put in with a few other squirrels. They get acquainted with one another in a short time (not always without a fight to force recognition of



A PAIR OF NUTCRACKERS

Nuts on the farm are not opened for the squirrels. If they did not have hard-shelled nuts to gnaw through, their teeth would soon grow so long that they would be beyond use and their owner would starve, a martyr to the efficiency of his own chisels

mastery) and then may be moved again. A few squirrels that are favorites are moved every day to keep alive their interest. Though each large compartment has a passage leading to an outside screened balcony where the squirrels enjoy the rain, the snow, and the sunshine, they like a change of scenery, as do humans. Eighteen years is a long time to spend in one abode, no matter how large and fine. A privileged few have crossed the ocean several times with Doctor Powers, but most of them, of course, must stay at home when she is forced to be away. Young ones born within the house must early be taken from their mother or they become too wild. Trust, it seems, is in part born of dependence on food.

As one always finds with pets, every animal is possessed of an individualism all its own that anthropomorphically we call personality. Thus the collection is

one not merely of squirrels of many hues and sizes but one of so many different friends, not one of whom reacts the same as does another.

Every squirrel bears a name. I suspect, though, that Doctor Powers has often been troubled to find a new one, with an average stock of one hundred and fifty individuals. There is Gunga Din, the friendly giant of the house, who traveled all the way from Malabar, and his compatriot, Cleo, a charmer with most engaging manners. One offers Gunga Din a half banana and he hangs by his toes and eats it at his leisure.

In the pocket of an old coat hanging behind a door you see something move. Gently introduce your hand and lift out Ultimo. Ultimo was born very late one season to a proud mother flying squirrel. But Ultimo was such a tiny runt that there was little hope of his surviving. Tender care and special feeding pulled

him through and now he is as fine a little fellow as ever glided across a room in this house of wonders. His fur is like thistle-down for softness, his eyes like great ebony hazlenuts, and his tail like a feather.

Curly, the most human of any, is of good gray American stock and shows great devotion to Doctor Powers. Every day they play together and Curly's favorite gesture is a gentle kiss with his sharp teeth which he will never use to hurt one. Topsy Turvy over there is running her wheel like a conscientious lady doing her daily dozen. Sampson and Delilah were a faithful couple, and when Delilah died one night of fright after a subway ride in my coat pocket, her husband was grief stricken and called loudly night and day until he got back home. Then there are Tinker-Bell, Carola, Gabriello, Ariel, Puck, and Mustard.

Tico, a Prevost squirrel, takes first place in brilliant coloration. His back and tail are sable black; his cheeks and chin are gray. All his underside and his arms are washed with a reddish chestnut and between the red and black lies a band of hair as white as snow.

The squirrel's whole apartment is his gymnasium, but he is given added pleasure with an exercising wheel. Every compartment has one or more and they are almost constantly in use. During the day the big squirrels use them and in the night the tiny flying squirrels keep the wheels rolling. With squirrels it is a great sport. They will run furiously for a few minutes, leap out and back in again while the wheel goes on. Sometimes another squirrel leaps in, another and another, all becoming one swirling, leaping mass of fast-moving fur. Then one jumps out, and another, and another. The squirrels may turn around



A EUROPEAN RED

The great graceful ear-tufts grow on the common squirrel of Europe. None of our squirrels equal them, in this, though some try hard in winter to be good rivals



THE ROAD WITHOUT AN END

A rat in less than three years ran his wheel 5447 miles. A squirrel doubtless runs the circumference of the earth, if he lives to ripe old age

and race the other way. Perhaps one will try to keep pace on the outside of the moving drum, but rarely with success. I always think when watching them of the work that could be done if all this energy were harnessed.

Food is a pleasure to the squirrels and a problem to the owner of this "Ritz Squirrelton." Nuts of every sort, pine cones, vegetables, fruits, seeds—fully 57 varieties come to every squirrel. Then each must have his cod-liver oil on schedule to keep in best condition. Not every one will eat alike. Some that in old age—due to a bad early life—have lost their teeth, can take only soft food. It is a tribute to Doctor Powers that she can keep such poorly equipped squirrels in good health.

With all this easy life, every want but complete liberty supplied, no enemies about them, shelter in all weather, it would seem that the squirrels would never wish to leave, and this must be

the case, for on rare occasions when venturesome spirits wandered away from their paradise, they soon found their way back. Doctor Powers once opened a little window in the roof of a screened balcony occupied by a group of flying squirrels, thereby giving them the opportunity to come and go. For a long time they went out at night and came back in the early hours. After awhile they located in the neighboring trees and only returned to the house to secure supplies. One of them still comes back to the house every night to run her exercising wheel. A Chinese squirrel gained liberty several years ago, went out and saw the world, and then apparently decided that there was no place like home and came back. Several gray squirrels were given the privilege of going and coming as they pleased. They make free use of this opportunity. Some come back to sleep in the house, others nest outside but come in to dine. One

sees the wild squirrels outside trying to get in more often than the squirrels inside trying to get out. Other animals sometimes are housed with the squirrels; guinea pigs, tree shrews, parrots, cockatoos and pheasants, but they are passing fancies.

If this great colony were just a hobby, giving pleasure to but one person, it might be hard to justify. But this has never been the case. Doctor Powers' collections have formed the bases for several scientific works; her records have all been carefully made and are remarkably complete. At this writing she is engaged on her first book, which promises to be a splendid story.

Perhaps it is not strange that it occurred to her to use her squirrels in moving pictures. It is remarkable, though, that even with all her resources she was able to make successful plays in which

every actor was a squirrel. The squirrels probably knew no more about what they were acting than many Hollywood stars, but they did lend themselves willingly to the task. One little red squirrel became so thoroughly absorbed in her work under the strong lights that when her task was done she died of exhaustion but, as a good actor, waited for the final curtain. From her long labor Doctor Powers made six film stories which have been shown in the large theatres and museums and now are on the eve of achieving popularity in the home film libraries. They were all titled by a professional humorist who was partly in control, and have proved popular with all audiences. We find such titles for the plays as "The Romance of Curly Squirrel," "The Family Album," and "The Diary of A. Knutt." The leading comedienne of the films was a small red



ADOLESCENCE

All eyes and hands and feet, but accepting the commensalistic life of the Squirrel Farm as though it were the only one

squirrel named Hepsy, who continually tried to bury nuts in a tumbler of water and vigorously pushed them down beneath the surface as rapidly as they arose. One sees, too, the flying squirrels whose instinct to hoard food is so strong that they usually fill up their nest boxes so completely that they themselves cannot gain entrance.

In Scandinavian legend the squirrel was the messenger of the gods, carrying news to them of what went on upon the earth among the other animals. The legend does not tell us what the other animals thought of the squirrel. In the Red Squirrel Farm the squirrels keep their secrets to themselves. Among the Indians of New Brunswick a legend had it that the squirrel was an enormous creature and bore the name Miko. One day the Great Spirit asked an old man of the tribe what he most desired. The patriarch considered for a moment and

then answered that more than any other thing he wished to have Miko reduced in size. Thereupon he received the divine mandate and went forth to the forest where he met the bold, bad squirrel. The old man raised his hand and Miko shrank to his present small proportions. To this day he has been querulous at the sight of man. Many of us have tried to overcome this fear and often, in our cities, some squirrels do become fairly tame.

All who have taken wild squirrels, though, and tried to make them members of a household, will know that Doctor Powers has done the all but impossible. Gentleness, quietness, perseverance, and some ingenuity, have been factors in her success in taming squirrels. She has made friends of creatures others keep as wild animals or kill.

Lucky is the squirrel who lives his life in the shelter of the Red Squirrel farm.



HEPSY, THE COMEDIENNE

Hepsy's instinct told her that all these fine nuts should be buried to provide against a future famine, but why the nuts would not stay under water when put there she could never understand

JONATHAN DWIGHT

1858-1929

By FRANK M. CHAPMAN

Curator-in-Chief, Division of Zoology and Zoogeography, American Museum

AFTER a prolonged illness, Dr. Jonathan Dwight died at his home in New York City on February 22, 1929, in the seventy-first year of his age.

Doctor Dwight was a research associate of the department of birds in the American Museum, and for the last twenty-five years the Museum has been his ornithological home. Here his collections were deposited, here he conducted his studies, and here, as a member of our staff, he shared in our counsels. His large and, in certain respects, unequalled collection of American birds, with the exception of a representative series bequeathed to the Museum of Springfield, Massachusetts, he left to the American Museum. Brought together with judgment and discrimination, it has exceptional scientific value. But as we refer to it, we will find that specimens alone cannot give us that special, authoritative information which Doctor Dwight always so generously held at our disposal.

Doctor Dwight was born in New York City in 1858 and lived here all his life. He was graduated at Harvard in 1880 in the same class with ex-President Roosevelt; and at this period both young bird students attended meetings of the Nuttall Ornithological Society of Cambridge, the local organization, which in 1888, gave birth to the American Ornithologists' Union.

Some years later Doctor Dwight took up the study of medicine and, in 1893, graduated from the College of Physicians and Surgeons. He practiced medicine for a short time from his then home at No. 2 East Thirty-fourth Street, and from 1894 to 1904 was assistant surgeon in the department of laryngology in the Vanderbilt Clinic. But his ever increasing interest in the study of birds and the attention demanded by his growing collections finally induced him to abandon medicine and devote himself exclusively to ornithology. Doctor Dwight's special field in this branch of zoology was a study of the laws underlying plumage changes and of the methods by which these changes were effected. It was characteristic of him to select a difficult problem, carefully lay his plans for its conquest, and then patiently, persistently, and with the utmost care proceed with his investigations. Quality, not quantity, was his motto. All that he did was well

done. He was a pioneer in the study of the molt of birds; he formulated and helped us thoroughly to understand the laws governing the sequence of plumages. He combated, vigorously and effectively, the theory that pigmental change occurs in the mature feather, and demonstrated that the alleged cases of change in the colors of birds' plumage without molt were actually due to new feather growth or to wear in the old feather.

Doctor Dwight never fired until he was ready. But, when he did train his guns, victory was virtually assured. He did not become the leading authority on his subject without years of preparation. The earlier collectors of birds wanted only specimens in perfect plumage. During the molting season they either did not go afield or discarded specimens in worn or incomplete plumage. These, however, were the very birds that Dwight wanted. They told the story he was trying to put in words. But such specimens are not easy to acquire. When molting, birds are quiet and retiring. A special effort was therefore needed to secure the material essential to his studies. No small part of it he collected himself. After it was assembled, the technique required for its interpretation called for that tireless spirit of investigation with which Dwight was so abundantly blessed. Nearly thirty years have passed since his more important work on birds' plumages appeared.¹ It blazed a trail which has become a main traveled road.

The subject was endless, and Doctor Dwight treated it both objectively and philosophically. In "The Gulls of the World,"² his last important work, Doctor Dwight's special knowledge of plumage change was brought successfully to bear on problems in systematic ornithology which had long puzzled his predecessors.

If Doctor Dwight had not done so much for others he might have done more for himself. An Associate Founder (1883) of the American Ornithologists' Union, he was elected a Fellow in 1886, and up to his final illness never missed

¹"Sequence of Plumage and Moults of the Passerine Birds of New York." *Ann. N. Y. Acad. Sci.*, XIII, 1900, pp. 73-360.

²The Gulls (Laridæ) of the World; Their Plumages, Moults, Variations, Relationships and Distribution. *Bull. Amer. Mus. Nat. Hist.*, LII, 1925, pp. 63-401; 334 figures; 10 colored plates.

attendance at the annual meetings of the Union. His devotion to the affairs of the Union was further expressed in the long period (1903-1920) during which he served as its treasurer.

To the National Association of Audubon Societies he also gave freely of his time. He was a director (1908-1929) and member of its executive committee from 1910-1929, and its treasurer from 1908 to 1929. The Linnæan Society was his especial charge. He was elected one of its first members, and for years rarely was absent from its meetings; while from 1901 to 1921 he filled the office of president. It was, therefore, particularly appropriate that he should receive the medal of this Society, which was awarded him on February 19, 1929.

For seven years (1889-1896) Doctor Dwight was a member of the Seventh Regiment of the

National Guard, and at this time won distinction as a rifle shot. He was twice married,—in 1901 to Georgina Gertrude Rundle, who died in 1903; in 1914 to Ethel Gordon Wishart Adam, who survives him.

Doctor Dwight wrote his name for all time in the annals of the science of birds, but it is engraved far more deeply in the hearts of his friends. He was a lovable man; gentle, kindly, considerate, and courteous. He inspired confidence that never was misplaced. He was responsive and sympathetic, a friend to share one's sorrows as well as one's joys. His own standards were of the highest and he adhered to them, but such was the generosity of his nature that he never sat in judgment on his neighbor. Never did I hear him speak ill of others; never did I hear others speak ought but good of him.

WHO'S WHO IN "NATURAL HISTORY"

Dr. Roy Waldo Miner, curator of marine life at the American Museum, has devoted many years to the study of marine life along the New England coast; he has taken part in several expeditions to Porto Rico and the Lesser Antilles, and more recently visited the Bahamas, where, with the aid of the Williamson submarine tube he descended to the floor of the sea, obtaining photographs and specimens from the living coral reef at Andros. The results of the expeditions and studies have crystallized especially in many exhibits for the Darwin Hall including the recently completed Rotifer Group, and the great Coral Reef Group now under construction for the Hall of Ocean Life.

In "Outposts of the Sea" Doctor Miner touches briefly upon one of the great acts in the drama of evolution, a theme which will be developed in greater detail in a volume under preparation.

James L. Clark, author of "By Motor from Nairobi to the Nile," is assistant director of the American Museum, in charge of preparation—that is, in charge of the preparation of all material used in the exhibits of the Museum. Articles by him have appeared often in *NATURAL HISTORY*, and his book, *Trails of the Hunted*, recently published, tells in detail the story of his twenty-five years of work in the field and in his studio. Mr. Clark is a sculptor as well as a taxidermist, and his hunting has taken him to Africa three times, across Asia once, and many times he has been in the field in North America.

In July, 1928, **Mr. Sidney Tyler**, who has written "Children of the Orinoco Plains" for this issue of *NATURAL HISTORY*, financed the Tyler-Duida Expedition sent out by the American Museum, and accompanied the expedition to Mount Duida, which lies in Venezuela far up the Orinoco River. He was to be historian and photographer of the trip, but having arrived at Mount Duida, he was forced to accompany another member of the expedition, who became ill, to the jungle headquarters of a physician who also was exploring on the upper Orinoco. During this difficult journey Mr. Tyler was himself taken sick, and the physician, while permitting Mr. Tyler's companion to rejoin his party on Mount Duida, advised against Mr. Tyler's return. He consequently came back to the United States, but is now once more on the Orinoco River—this time with Dr. Herbert Spencer Dickey—in an effort to discover the source of the Orinoco, which is the only large river in the world the source of which is still unknown.

About a year ago the editors of *NATURAL HISTORY* received a large envelope from **Mr. David Locke**, mailed from Corpus Christi, Texas. The enclosures were the manuscript of an article entitled "Seeds of Disaster" which appears in this issue of the magazine, and a letter asking whether the author was correct in his surmise as to the cause of the tragic death of the ant colony he had so carefully watched while living in the town of Santa Cruz de la Sierra, Bolivia. The editors, being unable to answer the question,

submitted the article to Prof. William Morton Wheeler of Harvard, who is also on the staff of the American Museum, in order to get the opinion of this outstanding authority on ants.

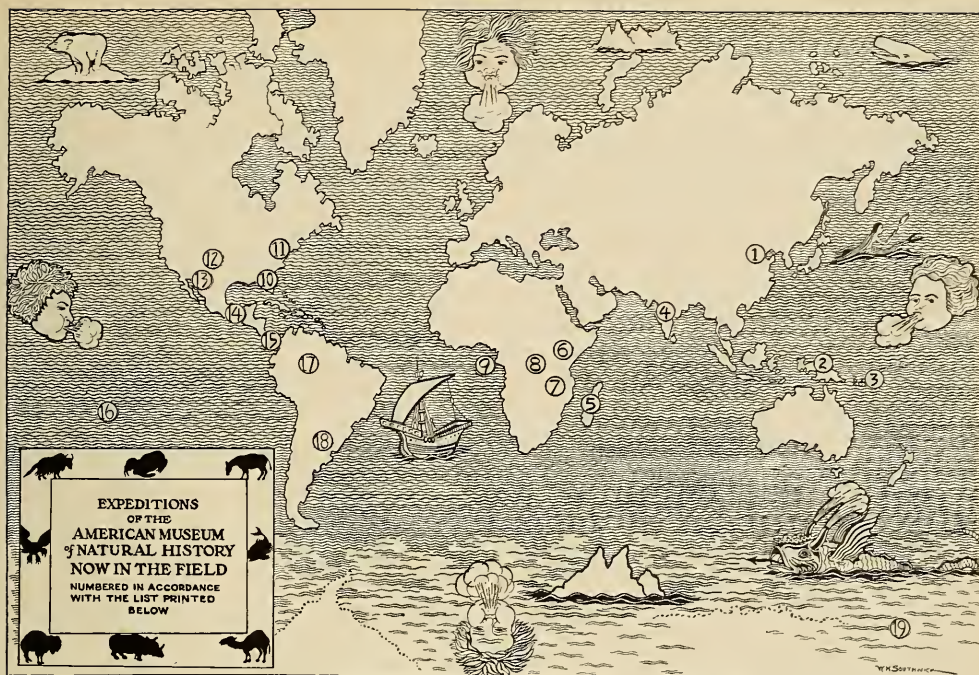
Even Professor Wheeler, however, could not be certain whether Mr. Locke's surmises are correct. Such a tragedy is not a matter of record, but it may be that Mr. Locke's conclusions are correct. In any event, Mr. Locke,—as well as the editors of *NATURAL HISTORY*—are endeavoring to find out what *did* happen if Mr. Locke's surmises are not correct. If any of the readers of *NATURAL HISTORY* can positively bear out or confute Mr. Locke's surmise, the editors would appreciate hearing from them.

W. Henry Sheak, who has contributed "Acrobats of the Monkey World" to this issue, was graduated from the old United Brethren College at North Manchester, Indiana, with the Bachelor of Literature degree, but his student days have stretched from the cradle down to the present hour. He prepared for the ministry, but has spent most of his time in writing for newspapers and magazines, in the study of natural history, and in lecturing on animals. He created a sensation in the church and among the newspaper fraternity by joining a circus, where he earned the title of Circus Chaplain. He has traveled with Barnum and Bailey, the Ringling Brothers, John Robinson, and several exclusively animal shows. He has studied in all the great zoological gardens and natural history museums of America, and has spent much time in original research in field and forest.

In Japan an important part of the education of the cultured classes is a thorough knowledge of the ancient literature and traditional dramas of that country. The *No* plays and songs are famous among these, and **Mr. S. Ichikawa**, author of "Masks and Dramas of Old Japan," who has made a special study of them, gives a brief outline of their history and development. Mr. Ichikawa is in charge of the care and arrangement of the Japanese and Chinese Halls at the American Museum, and recently accomplished the restoration of the mosaic disc found at Chichen Itza.

Previous to his connection with the American Museum as assistant curator in the department of education, **William H. Carr** had much experience in establishing outdoor museums for the Boy Scouts and similar organizations. He also was editor of *The Camp Naturalist*, a periodical devoted to camp life. For the last three years Mr. Carr has been resident naturalist at the Bear Mountain Nature Trails in Palisades Interstate Park. Here, during five months of each year, he has been developing the Trails and the Trailside Museum that are being operated by the American Museum in coöperation with the Commissioners of the Palisades Interstate Park.

A day at the Nature Trails is described in Mr. Carr's "Trailing Nature."



1. Central Asiatic; 2. Beck, New Guiana, for birds; 3. Whitney South Sea, Solomon Islands, for birds; 4. Vernay-Faunthorpe for Asiatic mammals; 5. Madagascar for birds, mammals, and fossils; 6. Sanford-Legendre, Abyssinia for mammals and birds; 7. Straus, Nyasaland for birds; 8. Tanganyika for birds and mammals; 9. Thorne-Correia, Sao Thomé for birds; 10. Wm. G. Hassler, Florida for reptiles; 11. Chester A. Reeds, Lake Passaic varves; 12. Bernheimer, Southern Utah, for fossils; 13. Frick-Rak, Sante Fé, for fossils; 14. Vaillant, Mexico, for archæological finds; 15. Benson, East Panama, for birds; 16. Shapiro, Polynesia, physical anthropology. 17. Tyler-Duida, Venezuela, for birds and mammals; 18. Naumburg-Kämpfer, Southeastern Brazil, for birds; 19. Byrd, Antarctic

IN THE FIELD OF NATURAL HISTORY

Expeditions — Scientific Research — Conservation
Books — Meetings of Societies

EDITED BY A. KATHERINE BERGER

EXPEDITIONS

THE SEVENTH BERNHEIMER EXPEDITION of the American Museum left New York on May 15. It will explore three different localities in the Montezuma Creek region of Southern Utah, where one of Mr. Bernheimer's guides has located dinosaur bones of major size. Mr. Barnum Brown, the Museum's curator of fossil reptiles, is accompanying the party, and will remain on the ground for some time. The expedition will then proceed westward in quest of new archæological data. Earl H. Morris, archæologist at the Carnegie Institution, is also with the expedition.

TYLER-DUIDA EXPEDITION.—G. H. H. Tate, leader of this expedition, has returned to New York, thus bringing to a close a most successful collecting trip for birds and mammals of that previously unexplored territory of South America.

THE SANFORD-LEGENBRE ABYSSINIAN EXPEDITION has informed the Museum by cable of noteworthy success in collecting a group of nyala. Complete material has been secured, comprising males, females, and young. The largest bull secured had horns 40 inches along the curve. Among other specimens secured for the Museum collections are the Abyssinian red wolf, the black bushbuck, Abyssinian duiker, oribi, and klipspringer. The expedition expects to go to the Omo River and later to the Kaffa Forest to try for Museum desiderata.

MR. WILLIAM J. MORDEN, field associate in mammalogy, American Museum, and Mr. George Graves, who is now on an expedition to the Arctic, are to head an expedition that will spend the winter of 1929-30 in Siberia in search of long-haired Amur River tigers. Mr. Morden

will leave in August for Turkestan in order to collect the saiga antelope, and will be joined in November by Mr. Graves. Together they will collect in the Amur River district during the winter. *NATURAL HISTORY Magazine* will publish further details of the expedition in the next number.

ASTRONOMY

The Amateur Astronomer, official journal of the Amateur Astronomers Association, made its initial appearance the latter part of April. It will be published on the 15th day of each month, except in July and August, under the editorship of Dr. Clement S. Brainin of the department of astronomy, Columbia University, and it is expected that it will prove of the utmost possible service and interest to the members of the Association.

A supplement issued with this first number bears a facsimile of the highly appreciated original letter of greetings sent by Prof. Albert Einstein to the Association on April 8, together with the following translation:

Science must set itself not only the task of ever making progress. In the first instance, made possible by the daily work of the community at large, science should in turn bring to the community both enjoyment and edification. In this sense, I wish your undertaking every success.
—A. EINSTEIN

A map of the night sky for April and May also appears in this issue.

AT ITS APRIL 17TH MEETING, the Amateur Astronomers Association presented a scroll to Mr. Worcester Reed Warner, electing him to honorary membership in the society, in recognition of his outstanding service to Astronomy. Most noteworthy among his achievements are the designing and constructing, on three successive occasions, of the largest telescope in the world, namely, the 36-inch Lick Refractor, the 40-inch Yerkes Refractor, and the 72-inch Vancouver Reflector.

Mr. Warner was also the speaker of the evening, the subject of his address being "A Starry Night at the Lick Observatory."

DR. W. H. STEAVENSON, F.R.A.S., of London, will give an illustrated talk on "William Herschel, the Father of Amateur Astronomy," on Wednesday evening, June 5. This will be the first time the Amateur Astronomers Association will have the pleasure of being host to a guest speaker from a country other than the United States.

EDUCATION

THE SECOND ANNUAL CHILDREN'S FAIR.—In coöperation with the American Museum of Natural History and School Nature League, the American Institute will hold its second Children's Fair at the Museum next October.

The first fair was attended by more than 36,000 children and adults. A total of 130 awards was given for the best exhibits and 3000 children participated.

The annual Institute Children's Fair is "designed to focus attention on the sciences and to foster a scientific interest in agriculture, gardening, nature study and conservation," among New York school children. All pupils under eighteen years of age residing in any of the five boroughs of Greater New York are eligible to exhibit.

Individual entries this coming fall will include homemade terraria, exhibits illustrating biological principles, exhibits relating to geology, and living as well as mounted insects. There will be a special section devoted to astronomy, including displays showing changes of the seasons and their causes, phases of the moon, studies of the various constellations, and homemade telescopes.

Entry of models and apparatus relating to the physical sciences and inventiveness in the city home will be encouraged for the purpose of stimulating the ingenuity of New York City children. Another new feature of this year's fair is the entry class called "Chemistry in the Home."

Camps, public and private schools, and parks will be allowed to exhibit as organizations. These displays will appear under the following classes: Gardens, Conservation of Forests and Wild Flowers, Conservation of Birds and Animal Life, Park and Roadside Conservation, Conservation in Industry, Conservation of Health, Biological Principles, Plants, Economic Crops, Plant and Animal Life for Classroom Use.

ART STUDY IN THE PUBLIC SCHOOLS.—The largest and most ambitious public display of art work done in the regular classes of the New York public schools was on exhibit at the American Museum for three weeks, beginning March 25. The contributions were grouped in three sections senior high, junior high, and elementary schools—each individual high school having its own wall space.

Drawings and paintings on paper and canvas were displayed, as well as pottery, sculpture, wall hangings, and shop work which showed particularly the influence of art study on mechanical operations.

Miss Edith L. Nichols, assisted by a corp of helpers, was in charge of the exhibit.

THE JAPANESE ASSOCIATION held an art exhibit in the Education Hall of the American Museum from April 22 to May 10. All the exhibits were made by children in Japanese elemen-

tary and junior high schools, and were sent here under the supervision of the Japanese government for the purpose of increasing international good will by giving American children an opportunity to compare their work with that done by Japanese children.

On May 5 (Boys' Day in Japan), Japanese children dressed in native costume gave an entertainment at the American Museum which included Japanese songs, a one-act play, and special motion pictures on Japan. The children in the audience were presented with rice cakes.

CRIPPLED CHILDREN GUESTS OF THE MUSEUM.—One of the annual activities of the School Service Department of the American Museum is acting as host to groups of crippled children, both in and out of school. Private cars or buses bring the children to the Museum, where special wheel chairs are provided to take them through the exhibition halls.

One group of about 20 children, who are not able to attend school, visited the Museum on April 18. After a tour of the halls, luncheon was served to them in the Hall of Birds of the World. For some of these children, this outing was their first trip from home this year. One child, ten years old, had never been away from home before.

Another group of 400 crippled children were guests of the Museum on April 25. They were entertained with a motion picture of animals that live in the vicinity of New York.

BAKER MEMORIAL PROFESSORSHIP.—The Board of Regents of the University of the Philippines has established a Baker Memorial Professorship in the College of Agriculture in memory of Charles Fuller Baker, who was dean of the College of Agriculture from 1917 until his death in July, 1927.

This professorship provides for the services in the college of a man from abroad, who shall be in residence in the college eight months at least and shall carry a teaching load of five hours a week. It is the purpose to secure men who are specialists in the different sciences allied to agriculture. This professorship in honoring Dean Baker provides for incalculable benefit to the college which in itself is a fitting tribute to a man whose services to the institution were so valuable.

THE JUNIOR ASTRONOMY CLUB has shown a phenomenal growth in the two months of its organization, and announces an active membership of more than 750 boys and girls. A monthly paper, *The Junior Astronomy News*, is being published, the board of editors and contributors all being members of the club.

The section for the children of members will

meet Friday, June 28, at 3 o'clock, and the general section Saturday, June 29, at the same hour. At both of these meetings sun spots will be the study topic, with an introductory talk by Dr. Clyde Fisher, who will also have charge of the observation with the telescopes. The June meetings will mark the close of club activities for the season. Meetings will be resumed in September.

The groups were organized by Miss Elizabeth A. Eckels, staff assistant in the Museum's division of education.

BRAZIL SUMMER SCHOOL.—Brazil is offering for the first time a summer school from June 29 to August 27, for North American vacationists, whether students, teachers, internationalists, or professional men. The summer school is under the supervision of the Brazil Research Institute, a subsidiary institution of the Instituto Historico e Geographico Brasileiro, and leading scientists and scholars of Brazil will give the lectures, all in English except that on tropical biology, which will be given in French.

The subjects covered by the lectures are Physical Geography and Topography of Brazil; the Political and Social Development of the Brazilian People; the Historical Evolution of Brazil from the Period of Colonization to the Present Economic and Industrial Status of Brazil; and Tropical Biology as Observed in Brazil.

A special tour has been arranged to leave New York, June 29. Full information may be obtained from the Institute of International Education, 2 West 45th Street, New York City.

EXPERIMENTAL BIOLOGY

TO CUBA FOR REPTILES.—Mr. C. Ralph DeSola, who was a member of the New York Zoological Society's recent expedition to the Galapagos Islands, is traveling in Cuba in the interest of the department of herpetology and experimental biology of the American Museum. Reptiles have always proved difficult material in the laboratory because of their requirements of temperature and ultra violet. There are in the West Indies a number of nocturnal lizards which have proved particularly hardy, as they often arrive in shipments of bananas or other produce from the tropics. The life histories of these species are known only in part and Mr. DeSola hopes to work out their life cycles while obtaining a series alive for the American Museum. A wide knowledge of reptiles, and a perfect familiarity with the Spanish language make Mr. DeSola well qualified to carry on these studies.

METAMORPHOSIS IN AMPHIBIA.—One of the recent achievements of the Museum's new department of experimental biology was the demonstration that *Cryptobranchus*, an aquatic salamander, which never metamorphoses completely, could be made to metamorphose in part by means of thyroid treatment. In continuing these observations on the processes of metamorphosis in amphibia, Mr. Wm. G. Hassler of that department, left late in April for Florida to collect numbers of another aquatic species,—*Siren*, for similar investigations. If *Siren* and *Cryptobranchus* could be induced by any experimental treatment to metamorphose completely, they would change into a type of animal which has never been seen by man, for the metamorphosed form of no true perennibranch has ever been obtained either in the laboratory or in nature.

Incidentally, the eggs of *Siren* have never been described, and Mr. Hassler hopes to work out the life history of the form. A quarter of a century ago the importance of larval stages in indicating relationships attracted the attention of many zoölogists. Many ichthyologists, including the late Dr. Bashford Dean, made important discoveries in studying the life histories of fishes. Very recently, to a large extent through the efforts of the herpetological staff of the Museum, the importance of life history data in demonstrating the relationships of amphibia have been brought to light. The field work which Mr. Hassler is undertaking is, therefore, of interest from several standpoints.

AMPHIBIANS AND REPTILES

COURTSHIP OF SALAMANDERS.—Dr. G. K. Noble attended the recent meeting of the American Society of Herpetology and Ichthyology held April 9-10 at Ann Arbor, Michigan. He presented a paper on the courtship of the common two-lined salamander, which had not been hitherto described. Of special interest was the description of a series of distinctive glands scattered over the body of the male and apparently serving to attract the female. The two-lined salamander produces stalked spermatophores which are carried within the cloacal lips of the female for long periods.

THE BREEDING OF THE SLIMY SALAMANDER.—It will be of interest to local naturalists to know that the eggs of the common slimy salamander, *Plethodon glutinosus*, have at last been found. Dr. G. K. Noble and Mr. B. C. Marshall in a recent number of *Novitates* describe the eggs of the common species for the first time. They were found in caves far underground. Development is direct and the young salamanders never enter

the water at any stage of their life history.

CHINESE AMPHIBIA.—Dr. Alice M. Boring of Yenching University, Peking, China, has recently spent several weeks studying the Museum's extensive collections of Chinese amphibians. After her return to China, this summer, Dr. Boring will instruct her students in the taxonomy of Chinese frogs and toads, in addition to working on special problems herself. It is hoped that the study of Chinese herpetology will receive considerable stimulus as a result of this initial effort.

FROG PHOTOGRAPHY.—Mr. Wm. G. Hassler and Mr. E. J. Farris, of the department of herpetology and experimental biology, have succeeded by the use of flares in taking the first motion picture of breeding frogs ever made in nature at night. Several excellent shots of wood frogs and other species were obtained. The picture was shown at a recent meeting of the Linnæan Society when Mr. J. A. Weber, Mr. Hassler, and Doctor Noble discussed some of the local herpetological problems of interest to the New York field naturalist.

BIRDS

THE GREAT WHITE HERON, subject of Mr. Jansson's striking cover design for this issue of *NATURAL HISTORY*, should not be confused with the great white egret. Both are herons, both are white, but there the resemblance ends. The egret is a much smaller bird that during the breeding season bears aigrette plumes growing from its back. It breeds from the more southern United States southward to Argentina, inland as well as along the coast.

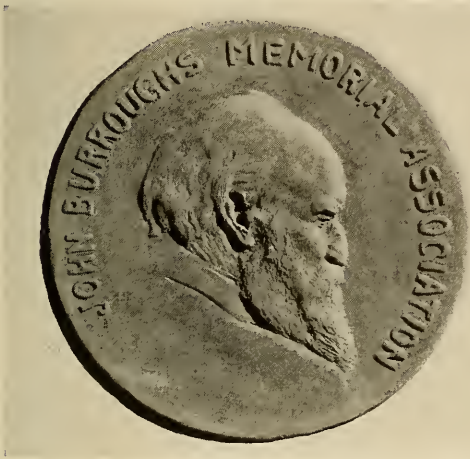
The great white heron is as large as the great blue heron. It bears no aigrettes, and in the United States it is known to nest only in the keys and on the coast of southern Florida. There it was discovered and, in 1835, named by Audubon. Since then it has been an open question whether *Ardea occidentalis*, as Audubon called it, was a distinct species or a white color phase of the southern great blue, or Ward's heron. The belief that they were one and the same species was supported by the fact that they interbreed, producing young like both parents, as well as others intermediate between the two. The latter was described by Professor Baird as Wuerdmann's heron (*Ardea wuerdmanni*). We have in the American Museum three young herons which I found in a nest on Clive Key, southeast of Cape Sable, on March 27, 1908. Two are in the grayish plumage of Ward's heron, the other wears the pure white of the great white heron. One of the parents was of the last-named species, the other

was probably a specimen which unfortunately I collected as I landed on the key before I knew that birds were nesting there. It is a Ward's heron with some of the characteristics of Wuerd-mann's heron.

In the succeeding years additional data have accumulated and a consideration of them, in connection with his own experiences, has led Mr. Ernest G. Holt, in a paper published by the

he himself set a high standard in nature writing. His great legacy to mankind is his books, and he has succeeded in putting himself in his books as few men of letters have done.

The first medal awarded went to William Beebe, nature essayist; the second to Ernest Thompson Seton, biographer of the animals; the third to John Russell McCarthy, poet of the outdoors. This year the committee found no



THE JOHN BURROUGHS MEMORIAL ASSOCIATION MEDAL
Awarded to Dr. Frank M. Chapman

Cleveland Museum of Natural History, in 1928 (*Scientific Publications*, Vol. I, No. 1) to express his belief that Ward's heron and the great white heron are distinct species which hybridize. The evidence supporting this view is presented at length and seems conclusive.

It is a matter of especial interest that a large part of the breeding range of the great white heron is contained in the proposed new Everglades National Park, the characteristics of which are described by Mr. Ernest F. Coe, in *American Forests and Forest Life* for March, 1929. The case illustrates the extreme importance of conserving this unique area, where members of forms of animal life once common in Florida are now making their last stand.—FRANK M. CHAPMAN.

HONORS

Three years ago the JOHN BURROUGHS MEMORIAL ASSOCIATION inaugurated the policy of awarding a medal to the author publishing, during the year preceding the annual meeting, the best piece of nature literature, either prose or poetry. This was felt to be a most fitting function of the Association, since John Burroughs' great work was that of a literary naturalist. From *Wake-Robin*, written in the Eighteen-Sixties, to *The Last Harvest*, published posthumously,

outstanding production of our nature-writers. Therefore, it was voted that the time-limit be waived, and that the award be made to DR. FRANK MICHLER CHAPMAN for his nature writing of the past years, without specifying any particular book.

It will be of interest to state that the committee learned, after voting the present award, that Doctor Chapman has written a book during the past year upon the wild life of Barro Colorado in Gatun Lake, Panama Canal, of a kind that the association feels would have been approved by John Burroughs. The book has just been completed, but has not yet been published. Had this book been actually in print, it is probable that the award would have gone to Doctor Chapman without the suspension of the time-limit requirement.

Dr. Clyde Fisher, president of the John Burroughs Memorial Association, made the presentation. On account of the unavoidable absence of Doctor Chapman, Dr. Robert Cushman Murphy received the medal on his behalf.

RAY LYMAN WILBUR, Secretary of the Interior, has invited Dr. Clark Wissler, curator-in chief of the Museum's department of anthropology, to serve as a member of the advisory committee of seven to consider the educational and recreational use of national parks and monuments.

Doctor Wissler has also been elected a member of the National Academy of Sciences.

At the annual meeting of the American Society of Mammalogists, held in Ann Arbor, Michigan, April 9-13, 1929, PRESIDENT HENRY FAIRFIELD OSBORN was elected an Honorary Member by unanimous vote of the Society. This class of membership has been voted to but few scientists, and is given in recognition of outstanding and meritorious contributions to mammalogy.

IN RECOGNITION of the splendid practical assistance given to Mr. Arthur Vernay and Col. J. C. Faunthorpe in securing specimens of Indian game for exhibition in the American Museum, His Highness, the Nawab Sahib of Junagadh State, Maharaj Kumar Sadul Singh of Bikanir, Rájputána, and Major F. Tinley, M.C., have been elected to Honorary Life Membership in the American Museum.

HISTORY OF THE EARTH

PRE-CAMBRIAN EURYPTERIDS.—In a recent letter, Prof. T. W. Edgeworth David of the University of Sydney, Australia, writes to Prof. Henry Fairfield Osborn concerning the finding, last year, of a "Lipalian" fossil marine fauna of Pre-Cambrian age in the hills around Adelaide, South Australia. Doctor David states that the strata containing this fauna range from 8000 to 14,000 feet in thickness, and that they lie below the base of the lower Cambrian rocks. The fauna is wonderfully interesting; its outstanding feature being the enormous dominance of large Eurypterids of an archi-eurypterid type. He remarks that they were so abundant in a bed of limestone five feet in thickness that fragments, small and large taken together, occurred at the rate of about 2000 for each square foot. This is a large number for a single bed. This bed, however, is but one of many, in a thickness of 6000 feet, which carries this very primitive fauna.

In 1906, Dr. C. D. Walcott, late secretary of the Smithsonian Institution and former director of the U. S. Geological Survey, recorded fragments of plates and pieces of small limbs of what he held to be Eurypterids, naming the form *Beltina danai* from the Pre-Cambrian Proterozoic Belt Series of Montana, U. S. A. Since Eurypterids are abundant in Silurian and Devonian rocks, most palæontologists questioned Walcott's determination of these crustacean remains as those of Eurypterids, but Professor David states that the evidence which has lately been collected in South Australia is absolutely conclusive that in Pre-Trilobite times the seas of this part of the world, and probably the whole world over, were dominated to an extraordinary extent by primi-

tive Eurypterids about one foot to two feet in length.

Professor David published a preliminary paper on these remarkable fossils in 1928. Within a short time he hopes to contribute one or more additional articles to the *Journal of Geology*, Chicago, on this very ancient marine fauna. All geologists welcome Professor David's astonishing find. May it provide material for another chapter to his new book, *Geology of Australia*, which recently appeared.—C. A. REEDS.

DISTINGUISHED GUESTS

DR. C. C. WU, Chinese Minister to the United States, Madam Wu, and their party, were guests of the American Museum on Sunday afternoon, May 5. Director and Mrs. Sherwood, Mr. Douglas Burden, Prof. Charles P. Berkey, Mr. Barnum Brown and Mr. Pindar received the visitors and conducted them on a tour of inspection through the exhibition halls. Particular attention was given to an examination of the Museum's educational activities in coöperation with the public schools system of New York City. After the inspection, the party gathered in the Members' Room for tea.

MAMMALS

CURATOR H. E. ANTHONY attended the annual meeting of the Mammalogists at Ann Arbor, Michigan, as a representative of the American Museum of Natural History. He gave a lecture on the evening of April 12, entitled "A Cross-section through the Sudan," which was an account of the Taylor-Sudan Expedition.

THE MUSEUM ACQUIRES A 1500-POUND MANATEE.—Mr. Paul Moore, Jr., of Convent, New Jersey, recently presented to the American Museum a large manatee, estimated to weigh 1500 pounds. The specimen came from Lake Worth, Florida, where it was struck and killed by the propeller of a speedboat. According to Captain Lockwood, three large manatees, resting on the bottom of the channel, had risen, startled, to the surface of the water. One of the creatures struck the propeller and its back was ripped open, causing damage to the boat.

MARINE LIFE

THE CONSTABLE COLLECTION OF SHELLS.—By the will of Mrs. Frederick A. Constable the valuable and important collection of shells gathered by the late Frederick A. Constable during the years 1889-1897 was bequeathed recently to the American Museum. This remarkable collection includes a wide diversity of species noted for rarity and beauty, numbering many thousands. Its value may be conservatively estimated at the

present time as at least \$30,000. Selections from the collection were recently on temporary exhibition in Education Hall and have been permanently placed in the Hall of Ocean Life, where they may be seen by the public when that hall is completed.

SCIENCE OF MAN

RACIAL SURVEY OF THE POLYNESIAN ISLANDS.—Several years ago the American Museum agreed to coöperate with the Bernice P. Bishop Museum of Honolulu in a study of the Polynesian race. The home of this interesting people ranged from New Zealand on the south to Hawaii on the north, occupying the intervening islands, Samoa, Tahiti, etc. This study was begun several years ago by the collection of bodily measurements, plaster face casts, and photographic studies of native Hawaiians. Similar data from Samoa and the Marquesas were collected by the staff of the Bishop Museum. Dr. Harry L. Shapiro of the American Museum is now on his way to Tahiti to complete this survey of the Polynesian race, and to make a final analysis of the data with a view to determining the origin of this interesting people. A full-sized figure of a Hawaiian man, cast from life, is on exhibition in this Museum. Like other Polynesians, the Hawaiians are tall, well proportioned, with smooth dark brown skin, handsome features, and pleasing in manner.

PRE-COLUMBIAN SAND-DUNE BURIALS IN HAITI.—When Columbus discovered the West Indies, he found there a well developed race of Indians, practicing agriculture and well skilled in pottery and other primitive arts. Recently, Mr. John J. Naugle of New York City called the attention of the American Museum to a number of sand-dune burials near the city of Santo Domingo, upon what is usually known in this country as the Island of Haiti. These burials seem to have been made before the time of Columbus and during a period when the heads of infants were artificially flattened to give a sloping forehead. With the assistance of Mr. Naugle, it was arranged to send Dr. Harry L. Shapiro to explore these sand dunes. In Santo Domingo, Doctor Shapiro was the guest of Mr. Thomas Howell, upon whose plantation the graves had been discovered, and due to Mr. Howell's generous hospitality, he was able to make trial excavations in several places. These diggings yielded a quantity of pottery and some skeletons. One unique find was a bone image of excellent workmanship, evidently representing a god. The Museum is very grateful to Messrs. Naugle and Howell for the opportunity to collect this interesting material.

OTHER MUSEUMS

DR. HERBERT SPENCER DICKEY, who has spent twenty-seven years in South America, left New York, April 25, on an expedition in the interests of the Museum of the American Indian, Heye Foundation, to discover the headwaters of the Orinoco River and to explore the wilderness of the upper Orinoco Valley. This territory, consisting of 3800 square miles, has never before been trodden by white man. Doctor Dickey will also seek a tribe of white Indians which, it has been reported, exists there.

Sidney F. Tyler, Jr., who sponsored the American Museum Tyler-Duida Expedition, and C. F. Polsten, topographer and radio operator, will accompany Doctor Dickey. The party expects to be away at least six months.

MEETINGS OF SOCIETIES

THE FIFTEENTH INTERNATIONAL GEOLOGICAL CONGRESS will be held at Pretoria, South Africa, from July 29 to August 12. The American Museum will have as its representatives at this congress Dr. Robert Broom and Prof. Charles P. Berkey.

THE FIFTIETH ANNIVERSARY of the appointment of Clarence King as first director of the Geological Survey was celebrated at Washington on March 21. Among the distinguished speakers for this occasion were Secretary of the Interior Ray Lyman Wilbur, who spoke on "Science in the Government," and Prof. Henry Fairfield Osborn, whose subject was "Thomas Jefferson, Pioneer of American Paleontology."

DR. F. O. COLVILLE represented the American Museum at the Fourth Pacific Science Congress which was held in Java during May.

MEMBERS' DAY

In order that its members might become more familiar with the great institution of which they are a part, the American Museum on April 24 inaugurated a Member's Visiting Day. Four hundred and fifty members and their guests availed themselves of the opportunity—many coming to the Museum from distant points. A reception committee composed of members of the Museum staff, conducted the visitors in small groups through several laboratories, the preparation department, and exhibition halls not yet opened to the public.

Following this tour, Director Sherwood greeted the members in the auditorium and showed a motion picture of Museum exploration. Dr. G. Kingsley Noble spoke on current research problems and the practical application of research work.

Tea was served in Education Hall where the Japanese School exhibit had just been opened.

So great was the appreciation of the guests that the Museum is planning to establish an annual Members' Visiting Day.

NEW BOOKS

Our Face from Fish to Man. By William K. Gregory. pp. 295. With 118 illustrations. Putnam's, New York. 1929.

The story of the changes which our face has undergone since our early ancestors swam the coastal seas has been enchantingly and convincingly narrated by one who is better qualified than any other man to write this history. This story, documented in the rocks and in our very faces, has been pieced together for the layman into language free of all the puzzling intricacies of the original record. Skin-deep beauty is peeled away to show the true family characters that are

hidden just beneath the surface. Flesh and bones, smiles and tears, all help to round out the picture. The skeleton of the book is bone, but the text is not "bone dry." Illustration, though in some cases abstract, is unusually complete, and well fitted to the book. Doctor Gregory has dedicated his work to Prof. Henry Fairfield Osborn.

—R. T. H.

ERRATUM

In "Our Contributors" column of the January-February issue, it was erroneously stated that Prof. and Mrs. T. D. A. Cockerell had developed a new species of sunflower. The facts are that Mrs. Cockerell found close to her home a "sport" with reddened rays, in no sense a species. Starting with this, crosses were made with the various cultivated sorts, giving a wide range of horticultural varieties, which are still to be obtained from Sutton in England and other seed firms.

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JULY-AUGUST
1929

The Journal of The American Museum of Natural History

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Editor



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A JAPANESE SAILBOAT IN THE SHADOW OF FUJIYAMA

Despite the fact that the Japanese and Chinese have been adept sailors, they have played no great part in the modern development of ships. Long ago they developed boat- and ship-building to a point far in advance of the other peoples of the Orient, but, until they came into commercial contact with the Occident, they built no ships comparable with those that have been developed by Europeans and Americans

See "Afloat on Many Waters" Page 353

JULY-AUGUST, 1929



TIGER HUNTING IN NEPAL

How, on the Grass-covered Plains at the Foot of the Himalaya, Tigers Are
Captured by Surrounding them with Numerous Hunters and
Beaters on Elephants. A First-hand Account of a Hunt

By WILLIAM J. MORDEN

Field Associate, Mammal Department, American Museum

All tigers, wherever they may range, belong to the same family, though they are subject to considerable variation in size, coloring, and pelage. Those of the Amur River district, to which Mr. Morden is shortly to lead an expedition to collect these animals, are generally conceded to be the largest of the family—huge, long-haired beasts with a noticeable amount of white on underbodies, sides, and faces. They are considerably larger than the southern Asiatic tiger of today, and closely allied with them are the tigers of the Manchurian forests, while the Korean variety, also long-haired, is somewhat smaller. In southern Asia, due to the warm climate, the tiger is a short-haired animal, and in addition differs somewhat from his northern relatives in size and coloration. It is of these tigers that Mr. Morden speaks in the following article. There are, of course, no tigers to be found in Africa.—THE EDITORS.

TIGERS are usually associated with India, although as a matter of fact they are quite widely distributed throughout Asia. They are found in the Caucasus, northern Persia, portions of central Asia, China, Manchuria, Mongolia, southeastern Siberia, Korea, and the islands of Java and Sumatra, though in some of these localities they are not numerous. They are hunted also in Indo-China, in Siam, and in the Malay States, although not to the extent that they are in India. It is only with the Indian tiger, however, that this article will deal, for it is south of the Himalaya that I have hunted them.

They are, of course, large and powerful beasts, and there have been many records of Indian tigers measuring more than ten feet in length, but it seems probable that these measurements were taken along the curve of the back, rather than in a straight line from nose to tip of tail. It is now pretty generally accepted that a ten-foot Indian tiger, measured in a straight line from tip to tip, is a large specimen. Tigresses are somewhat smaller; a tigress of nine feet is unusual. The average weights of tigers and tigresses are about four hundred pounds and three hundred pounds, respectively, though tigers weighing more than five hundred



THE CAMP OF LT. COL. SIR FREDERICK O'CONNOR, BRITISH ENVOY TO NEPAL
Mr. and Mrs. Morden were the Envoy's guests for a week at this camp while the "tiger
shoot" described in the accompanying article took place

pounds have been known. A full-grown tiger will stand about forty inches at the shoulder.

Aside from sources of food supply, the necessary requirements of the tiger in hot countries are a sufficiency of water and protection from the sun, and these requisites are found fairly generally throughout India, except in the deserts of the Northwest Frontier, the Sind, and parts of Rajputana and the Punjab. Although they have been killed off in some districts, tigers, generally speaking, are found all over the Indian Peninsula and even into the foothills of the Himalaya. Dense forests, bush and scrub growth, and areas of high grass form the favorite haunts of the tiger; he is almost never found in open country or far from good cover.

A tiger's senses of hearing and sight are both wonderfully acute, though it is on his ears that he mainly relies for detecting

the presence of game. His sense of smell, on the other hand, is much less sharp, and in questing after game he does not scent along the trail as do members of the dog family, but locates his quarry almost entirely by hearing.

In Mr. A. A. Dunbar Brander's excellent book entitled *Wild Animals in Central India*, the author tells of experiments with a tame tiger which he kept for some time. When this animal's food was taken away from him and dragged through the grass, he never attempted to follow up the trail by scent, but hunted around in circles until he came upon it. As Mr. Dunbar Brander very aptly puts it, "Animals develop this sense (i.e., smell) either to hunt game, get their food, or for self protection. None of these causations apply to the tiger. They find their game by their ears and eyes, and having stalked it, they rush upon it. . . . They have been 'top dog' in the country they inhabit for

so long, their strength and ferocity have been all the protection they required."

Aside from the occasional man-eaters, which are usually old animals or ones that have been partly crippled by wounds or disease, the tiger varies his food according to the district in which he lives. Where game is plentiful, as it is in much of Central India, he preys on denizens of the forest such as the sambar, chital, nilgai, and pig. When game is scarce, however, tigers often take to killing cattle, and then they become great nuisances. A full-grown tiger will average about a hundred kills a year, so it may easily be seen that, in districts where tigers are numerous and are inclined to prey upon herds of domestic cattle and buffaloes, they prove a source of heavy loss to the inhabitants.

Such is the situation in parts of the Terai, the flat area of forests and high

grass that extends along the southern foot of the Himalaya in Nepal and Bengal. It was there that I was so fortunate as to be a guest at a tiger-shoot given by the British Envoy to Nepal. This independent state, which lies between India and Thibet, is closed territory to foreigners, and very few have been able to shoot there. I believe, furthermore, that the method of tiger-shooting in Nepal is peculiar to that country. Briefly, it consists of surrounding the tiger with a ring of elephants, some of which carry the shooters in houdahs on their backs. The procedure is as follows:

Word comes that a tiger has made a kill, sometimes but a short distance away, but more often several miles from camp. Mounted on fast riding elephants, the camp's native shikaris, or hunters, ride out to inspect the kill, and if it seems probable that the tiger is not far away, word is



TEA AFTER THE DAY'S SHOOTING

The party included the Envoy and his aide, the Legation surgeon and his wife, Mr. and Mrs. Morden, and a photographer. During the hunt about six hundred natives and more than fifty elephants were employed



THE WORKING ELEPHANTS LEAVING CAMP

When the shikaris learn of a kill by a tiger, the working elephants are sent out to form the ring around the kill

sent back to camp. Then the so-called working elephants go out, each in charge of his mahout, or driver, with usually another man sitting on the pad, or matress, tied over his back. With the working elephants go also the houdah, or shooting, elephants, which carry the box-like houdahs on their backs. These are the mounts of the shooting party, and they are always huge, steady, well-trained fellows, from the top of which one can get a good view over the tall grass or through the thick undergrowth. Altogether, about fifty or sixty elephants go out in the working party, and they make a striking picture as they file away from camp and trail off into the forest.

The members of the shooting party allow the others a head start, depending on the distance from camp that the kill has been reported, and then follow on "pad" elephants, which are smaller, faster, and more easy riding than the big

houdah carriers. Usually, the ring has been partly formed when the second party overtakes the first, and then a transfer is made to the houdahs. If there is a great difference in size between one's two elephants, the mahout of the larger makes him kneel, so that one may simply step from the back of the pad elephant into the houdah. After the transfer, all the elephants take their places in the ring, with the houdah-carriers located at advantageous points. The size of the ring depends upon the terrain; in the flat areas of high grass where our tigers were found, the ring was usually about three hundred yards in diameter at first. This distance is gradually reduced as the work of dislodging the tiger progresses. Somewhere inside the ring lies the kill and, one hopes, the tiger.

The reason why a kill may be surrounded with the reasonable certainty that the tiger is not far away, is the beast's habit of gorging, then drinking and sleep-



A WORKING ELEPHANT

This photograph was taken in the dense grass of the Nepal terai. It is such cover as this that would make it impossible to locate a tiger if the hunter were on foot



MRS. MORDEN ON HER RIDING ELEPHANT

When the working elephants go out, the houdah elephants, which are slow and hard riding, go with them. The party follows on smaller, faster elephants



THE PARTY GOING OUT

An hour's start has been given to the working and houdah elephants. When the party catches up, a transfer will be made to the houdahs

ing. Where kills are found far from water, there is little likelihood that the tiger will be lying-up near by, for after his drink he will seldom move far before sleeping. So expert do the native shikaris become in judging the chances of there being a tiger near the kill, that in a total of nine rings formed during our week in Nepal, tigers were found in the seven of them—and on two occasions there were three in the ring at once.

After the circle of elephants is completed, two or three near each houdah carrier are brought forward and worked back and forth in front of the line, to trample down the high grass so that it may be possible to see the tiger, should one come that way. I had never realized how impossible it would be to find a tiger on foot in such country, until I viewed those great stretches of grass from the vantage of a houdah. From the ground I could see only two or three feet in any

direction; even when I was mounted on my elephant's back, the grass-tops, in many places, rose above my head.

The trampling out of a "field of fire" is the last operation in the forming of the ring. Shouts from all sides announce that all is in readiness, and a general tenseness becomes noticeable among the mahouts. The shooters take their weapons—usually double-barreled shotguns loaded with ball, to lessen the possibility of dangerous ricochets in case of misses—and stand to. Orderlies in the rear compartments of the houdahs hold the second guns in readiness, in case the tiger comes close and more than two shots are needed. Then, into the high grass in the center of the ring go two or three elephants, guided by their mahouts. These animals are always old timers, ones who know tigers and are not to be bluffed by them. Ordinarily, a tiger will not attack an elephant, though when hard pressed or

wounded he may spring at one. The elephants seem to enjoy the fun of rounding-up tigers, and although they often show excitement when the tiger comes close, I have never seen one exhibit fear. Once, however, a hare broke through the line and the elephants on both sides nearly stampeded.

The elephants moving about inside the ring go "whooshing" here and there, tearing up great trunkfuls of grass and generally making as much noise as possible. The mahouts know that the densest cover will most likely hold the tiger, and they guide their mounts toward the thickest places. The tension around the ring becomes greater, and all ears are strained for the first sound which may indicate the quarry's location and his probable line of retreat. Sometimes the tiger is dislodged almost at once; more often it seems that every foot has been covered and that nothing larger than a mouse can have escaped being trampled.

Suddenly, from behind one's back comes the excited voice of the orderly, "Bagh hai, sahib, bagh hai." ("Tiger, sir, tiger!") The man's trained eye has caught a movement in the grass, to which he points with trembling finger. A moment only, then a snarling roar and a movement of the grass as the tiger, aroused from sleep and thoroughly angry, dashes for a place of greater concealment. You follow his movements by the line of moving grass-tops and

stand ready, leaning over the front of the houdah in case he breaks cover near by. If he does come your way, a snap-shot from the swaying houdah at a plunging yellow streak in the grass far below is all that you will get, unless, as sometimes happens, the first shot turns him and he dashes along the trampled area inside the ring.

Should he strike the ring at a point where there are no guns, the elephants, trumpeting and squealing, let him pass between them. After he has passed, the mahouts on each side of the break turn their steeds and parallel his line of retreat, keeping track of his movements by the telltale shaking of the grass-tops.



TWO OF THE PARTY IN A HOUDAH

A mahout, astride the neck of his elephant, and an orderly in the rear compartment of the houdah make up the elephant "crew"



RINGING THE TIGER

As many as forty or fifty elephants may start out in two groups, one walking to the left, the other to the right until the two leaders meet, thus completing the ring



A BENGAL TIGER IN CAPTIVITY

Tigers in the wild state are likely to be stronger and heavier than specimens to be seen in zoos, due to their more active lives



THE DEFENSE GUARD

In case the tiger breaks through the ring, his line of retreat is paralleled by the elephants on each side of the break, and when he stops, another ring is formed



MR. MORDEN IN HIS HOUDAH

In this photograph the mahout is hidden by the houdah. Sometimes, as in this case, an extra man rides behind the houdah to speed the elephants if he lags



THE RING CLOSES IN

After a tiger is shot, the ring closes in. A wounded tiger sometimes takes cover in particularly heavy growth, and then it may become dangerous to the elephants and difficult to dislodge



A SHOT AT SHORT RANGE

A wounded tiger has broken cover and Mrs. Morden in the foreground has just fired at him. Mr. Morden is taking aim



TRYING TO DISLodge A TIGER

It is typical of tigers to take cover rather than to run any great distance. Thus the method of ringing them is usually successful

When he stops, which he does at the densest bit of growth, they surround the place and a new ring is formed. Were the tiger to keep going, he would probably get away, but his instinct for concealment is his undoing.

Sometimes, as happened to our party on two successive days, more than one tiger may be found in the ring. Then ensue a few seconds of the greatest excitement, for they almost always break in different directions. Guns pop, elephants squeal, and mahouts shout on all sides, two or three tigers dash through the ring and are followed by lines of racing elephants. It is an experience never to be forgotten.

When a tiger is killed, the ring is gradually closed in until it is but a few yards in diameter. Then, after making sure that the animal is dead, the mounts of the shikaris and those of the sahibs are made to kneel, and the prize is examined.

Before the beast is moved, however, the head shikari makes puja—literally, “worship”—a ceremony which is performed after each kill. The shikari takes five blades of grass, dips them in the tiger’s blood, and casts one to each point of the compass; the fifth he buries in the ground, all the while uttering a sort of incantation. Thus the gods of the jungle are appeased and good hunting is assured for the future.

One of the most interesting features of the Nepal tiger shoot on which I went was the elephants, which were loaned by the Maharajah of Nepal and the rajahs of neighboring states. To say that one becomes fond of one’s hathi, is to put it mildly. They are such amazing brutes, clumsy in appearance, and yet remarkably quick and intelligent. In moving along a forest trail, a low-hanging branch or creeper may look as though it would brush the mahout and his passenger off the elephant’s back. You prepare to



BEGINNING OF MAKING *PUJA*

A ceremony of propitiation is performed by the shikaris after a tiger is killed. Five blades of grass are dipped in the tiger's blood, one is thrown to each of the points of the compass, the fifth is buried in the ground.



THE RETURN OF THE SHOOTING PARTY

For return to camp a transfer is made from the houdah elephants to the riding elephants on which long distances may be covered without discomfort as their motion is easy on the rider. Their average traveling gait is about five miles an hour.

bend as low as possible, but just before reaching the obstruction, the elephant stops, and you see his trunk reach up, curl around the limb, tear it down and throw it aside. Again, a tree of considerable size may bar your path. Your mount just leans his head against it, his trunk curled; an easy push and over goes the tree.

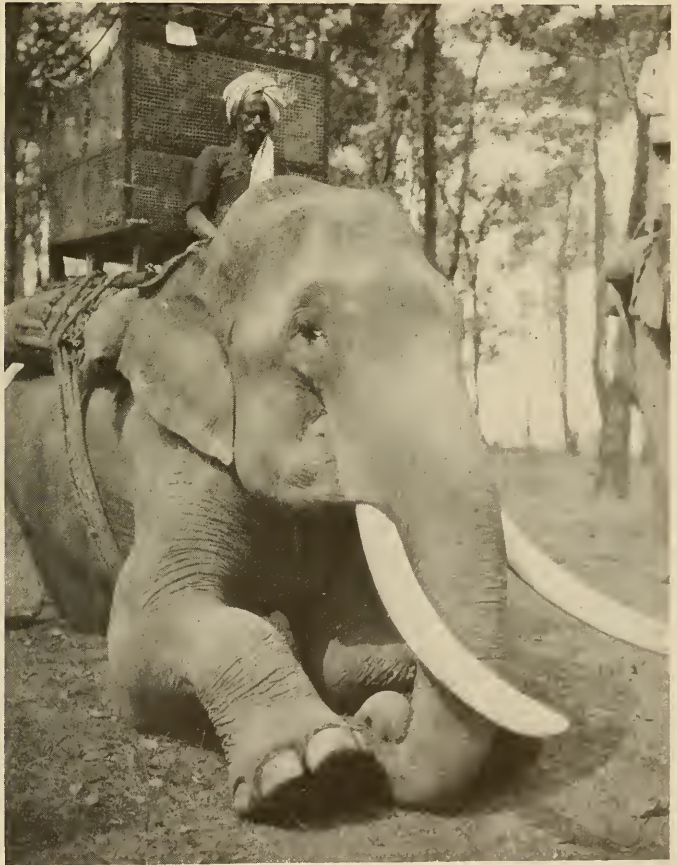
On arrival at camp after the day's work, it is customary for the rider to give his mount a piece of sugar cane, and one of the camp attendants is always on hand with a bundle of short lengths for the purpose. Hathi knows about how long it should take you to dismount and get his present, and he waits quietly until he thinks the time is up. Then he becomes impatient and "whooshes" about with his trunk until the titbit is forthcoming.

Each elephant has its own personal servants, four of them. The mahout, who rides on his neck and guides him by prodding him with bare feet behind his ears, is usually a man who has grown up in the elephant service and thoroughly knows his mount. Mahouts seldom speak loudly to their charges, but seem to do most of their guiding by low-voiced orders and by their toes. Now and then a mahout will bring the blunt edge of his kukhri (the curved Gurkha knife which they all carry) down on an elephant's head with a crack that one would think would fell the animal.

The blow does not seem to hurt the elephant, however, who just shakes his head a bit—and usually does what is required of him without further ado.

One of the three other men assigned to each elephant might be termed his groom, for this man sees that his animal is properly bedded down at night—they are always kept chained in camp—that he is watered, fed, and generally looked after. The other two men cut grass during the day and pile it up in bundles, which are brought to camp by the elephants themselves when they return from their day's work.

Although in some districts, where game is plentiful, tigers serve to maintain a



A TYPICAL TUSKER

The houdah elephants are large and specially trained for their work. Due to this training they are not likely to become excited at critical moments

balance of nature and prevent undue multiplication, in others they are malicious marauders. In the Nepal Terai, natives came to us and begged us to hunt near their villages, where, they said, tigers killed enough of their herds to cause real hardship. Nor are these natives usually able to protect themselves.

Tigers undoubtedly play an important part in the economic life of India, for they

serve to keep down the numbers of other animals that tend to destroy the native crops. It is not likely, therefore, that the government will permit them to be exterminated. Where, however, they prey too extensively on domestic herds, it is highly desirable that their numbers be reduced, for thus, and thus only, can the proper balance between wild life and agriculture be maintained.



BRINGING IN A SUPPLY OF FODDER

Each elephant daily consumes several hundred pounds of leaves and smaller branches. This fodder is cut by two of the four men assigned to each mount and is collected and brought to camp by the animals after the day's work is over



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AFLOAT ON MANY WATERS

A Photographic Series Showing the Steps by Which the Primitive Boats of Widely Differing Peoples Have Been Developed from Floating Logs to Built-up Boats, the Forerunners of the Ships that Ultimately Aided the White Man in His Domination of the Habitable Earth—Some of the Many Types that Are in Use Today as They Have Been Since Before the Dawn of Written History

LONG before the dawn of history lived the first sailor. Who he was we do not know. Where he lived we cannot even guess. Probably in a thousand different places at a thousand different times a thousand different ape-men found that by sitting astride floating logs they could ride upon the surface of the water. Such, undoubtedly, was the beginning of seamanship, and yet that first step could hardly have been a conscious one. It is not likely that it was a clearly recognized discovery. It seems more probable that it was merely an accepted fact even with the earliest of mankind.

Finally, however, this bit of information was improved upon, for some long-for-

gotten genius ultimately learned that by using a stick he could propel his log in the direction he wished it to go, so long as he could reach the bottom of the shallow waters upon which he was willing to risk his naked body. Later, probably, this inventor's descendants learned that by lashing lighter logs together they could be made into craft more easy to propel—more comfortable—more fitted to carry these early sailors and their meager belongings.

These steps, of course, simple though they were, were long in coming. Even today there are primitive folk to be found in the world who do not construct boats—whose wanderings on the water are limited



Wide World Photographs

**ONE OF THE MOST
PRIMITIVE CRAFT
IN USE TODAY**

Built of a few slender saplings lashed together, this South American raft forces the navigator to sit in the water. Naturally with such equipment, the natives spend little time on the water, and therefore have not developed into sailors



**A PERUVIAN
"BALSA"**

This boat-shaped affair is actually merely a raft, although it has been developed far beyond the stage of the other raft shown above. The craft is built of several cigar-shaped bundles of reeds lashed together

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INFLATED SKINS USED AS BOATS

Even today these ingenious floats are still in use on some Asiatic rivers, just as they have been for thousands of years. When Alexander the Great entered Asia, his soldiers sometimes used such floats in crossing the rivers



FORMOSAN RAFTS

These bamboo rafts are highly developed and thoroughly practical craft. In Formosa, where this picture was taken, many oyster fishers prefer them to small boats

*By Burton Holmes
From Ewing Galloway*





Photograph by Carl E. Akeley

A PRIMITIVE AFRICAN DUGOUT

These natives have hollowed out the log but have not otherwise changed it. It is a present-day counterpart of boats known and used in prehistoric times

by the simple rafts that they still use. In South America, for instance, a tribe called the Cuiapo Pihibi navigate the streams that flow into the upper Orinoco on rafts so small that the navigators sometimes sit immersed in water to their waists. Naturally, with such equipment, they spend little time on the water and have never become adept sailors.

Ultimately, in many parts of the earth, the size of such rafts was increased until they were capable of bearing greater weights and more men. The water, however, still tended to wash across the logs, and consequently low platforms were built upon which the navigators could ride, keeping themselves and their belongings above the wash of the waves. Even so advanced a people as the early Greeks used "boats" such as these at the time Homer wandered blindly up and down their land.

Still other peoples even learned to hollow out the larger logs—with fire, perhaps, and crude stone tools—and thus they constructed dugouts—the first real boats. They learned, too, to make and use paddles, and were thus no longer limited to the shallow waters where they could pole their crude and awkward vessels.

Dugout canoes have many advantages over rafts, and almost wherever trees of sufficient size were to be found, dugouts at some time or another have been built. Even today the dugout is one of the commonest of boat forms and can be found in use in hundreds of widely separated districts of the world.

It may be, too, that the hollowed log finally suggested the use of the curved bark of the tree as a boat, and in South America today one may occasionally find a form of bark canoe that, undoubtedly, is the simplest of all such craft. The

MORO BOYS IN TINY DUGOUTS

In many parts of the world dugouts are in every-day use. Moro boys are familiar with the water almost from the time they can walk, and have their own boats in which they play about the villages that are built on piles in shallow water



BUILDING A SEA- GOING DUGOUT

The Javanese, as well as other peoples of the South Seas, are adept at constructing large seaworthy dugouts, in which they sometimes make long voyages across the open sea

Brown Brothers





Ewing Galloway

SOLOMON ISLAND WAR CANOES

The designs and decorations of the vessels of many primitive people are striking and unique. Each of these war canoes is large enough to hold as many as sixty men



A BRITISH COLUMBIA WAR CANOE

The Indians of the British Columbia and Alaskan coasts are adept workers in wood, and their dugout canoes are beautiful examples of their art. So seaworthy are these boats, that, a number of years ago, Captain Voss, a Canadian, sailed a forty-foot canoe of this type 40,000 miles from British Columbia through the South Seas, around the Cape of Good Hope and north in the Atlantic to England

Publishers Photo Service

A TAHITIAN OUT- RIGGER CANOE

Many natives of the Pacific Islands build dugout canoes that they fearlessly use in rough water. In order to give the canoes more stability an "outrigger" is attached



PORT MORESBY, NEW GUINEA, OUTRIGGER CANOE

This photograph shows clearly how an outrigger operates. The boat is so narrow that platforms are built out on each side, and the balance of the whole is kept by the outrigger that floats far out at one side

Ewing Galloway



*American Museum Photograph*

AN OLD SAMOAN STATE CANOE

Chiefs of native Pacific tribes often possess very large and highly ornate canoes. This Samoan craft is an outrigger canoe built especially for use on important occasions. Often outrigger canoes have outriggers on each side. This is particularly true when they are intended to carry sail

Carapuna Indians of the Amazon Valley sometimes cut the bark from a tree—a section eighteen or twenty feet long—and this bark, naturally, tends to remain curled up as a scroll is curled. With a few sticks they spread it halfway between its ends, and thus create the very simplest of bark canoes, for the ends tend to remain rolled up, and with the weight of the passengers amidships, the ends tend also to rise above the water level.

Such a canoe, of course, cannot be strong, and the next step in its development is a frame to stiffen the pliable bark. Such a frame naturally is subject to considerable refinement, so, eventually, these crude bark canoes were brought almost to perfection in the birch bark canoes used so widely by the Indians of North America. Here a frame supports the weight of passengers and freight, while a covering of bark keeps out the water. With this

development, mankind had made a tremendous step toward the ultimate construction of ships.

In many portions of the world, however, trees and bark are scarce, and other methods were developed. Basket-like “boats” were woven, and in order to make them float, they were daubed with pitch. Such boats—still merely overgrown baskets, oval or circular in shape—are used to this day on the Tigris and Euphrates rivers and elsewhere. The Mandan, Sioux and other Indians, who formerly lived in South Dakota, also made circular boats, quite similar in shape to those of Mesopotamia, but they were circular frames covered with hides, instead of baskets daubed with pitch. The Eskimos, more dependent upon the water than the Mandans, learned to construct more refined skin-covered boats, and even today the kayak and the umiak are in

BIRCH BARK CANOES

No more nearly perfect light boat has ever been developed by primitive people. These canoes, built of birch bark over a light but sturdy frame, were formerly widely used by many American Indians. So thoroughly practical was their design, that the white man duplicates them in wood and canvas, and uses them in large numbers

THE CRUDEST TYPE OF BARK CANOE

The crudest of bark canoes is shown beside a white man's canoe that has been built of wood and canvas in imitation of the North American Indian's birch bark canoe



Brown Brothers



A CIRCULAR BOAT ON THE EUPHRATES

These strange craft are merely large circular baskets. In order to keep the water out, the basket work is daubed with pitch or any other material that will serve. They are much used in Mesopotamia



THE ESKIMO KAYAK

Where bark is scarce, natives have developed boats covered with other materials. The Eskimos commonly use skins stretched over frames of wood or bone. A "kayak" takes the form of the one shown here; a larger, open boat, they call an "umiak"

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Ewing Galloway

A NILE RIVER "DHOW"

Though sails were in use before the dawn of history, apparently these graceful "lateen" sails were not used until about the time the followers of Mohammed conquered Egypt

AN OUTRIGGER CANOE UNDER SAIL

This Philippine "prau" requires two outriggers in order to offset the pull of the sail

*American Museum
Photograph*



*Brown Brothers*

A PRIMITIVE BUILT-UP BOAT

For thousands of years built-up boats have been lashed together as is this boat from the Bay of Bengal. The lashings are often made inside, but boats of this type either have no frames at all, or have simple frames placed inside as strengtheners after the planks have been lashed together. Not until this type of construction was developed, were boats of considerable size possible

common use. Elsewhere in the world, too, boats of similar construction have been used, but such construction does not permit of much increase in size, with the result that larger craft could not be built until wooden planks and finally steel plates came to take the place of skins and bark.

It was the desire for larger boats—for mankind early turned to trade and needed means of water transport—that taught someone, somewhere, to increase the seaworthiness of his dugout canoe by the addition of boards along the sides. Thus he could carry heavier loads without lowering his canoe so deep in the water as to risk the loss of cargo and life. Such boats, too, were ultimately perfected, until the original dugout became merely the keel, while the planks that had originally served only as additional "freeboard" served now as integral parts of the hull. Such construction made boats of considerable

size possible, even though the planks were tied together at first with thongs.

These thong-tied boats then gave way, in large part, to boats fastened together with pegs made of wood, which were in common use on the Nile two and even three thousand years before the dawn of the Christian Era. This method is still widely used, and "treenails" are to be found in many wooden boats, and even in wooden ships of considerable size.

During all this tremendously long period of development, the propulsion of boats had been making progress just as hull construction had been. Poles were succeeded by paddles, and paddles by oars which, having appeared, were the most important means of propulsion for thousands of years. Today, of course, we think of paddles and oars as the means of propulsion only for small boats. In ancient and medieval times, however,

**A NILE RIVER
BOAT AT PHILÆ**

The earliest known historical records of boats are those found on the ruins of Egyptian temples, though boats were well developed at that time, as is witnessed by the fact that together with some of the very earliest records of boats are accounts of naval victories over invaders who, even then, had endeavored to raid the Egyptian coast



**A NATIVE BOAT,
CALCUTTA**

The resemblance between the hull of this Hoaghy River boat and the hulls of those in use on the Nile three thousand or more years ago is startling

© by Underwood and
Underwood



**A SAILBOAT OF
LOWER BURMA**

The divided mast of this boat is very similar to the masts often used by the early Egyptians. The sail on this boat could not, by any chance, serve to propel the boat "into" the wind



**ON THE PEARL
RIVER, CHINA**

For thousands of years Chinese junks and sampans have been used in much the same form in which they are found today. Awkward though most of the vessels seem, many of them are remarkably seaworthy. On more than one occasion Chinese junks have crossed the Pacific Ocean

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*Underwood and
Underwood*

A CHINESE JUNK UNDER SAIL

A favorite and very disconcerting habit of Chinese seamen is to sail their awkward boats across the bows of steamships, steering as close as possible, in order that the steamer may cut off the devils which apparently are forever pursuing these far-eastern vessels

SMALL BOATS OF ASIA MINOR

When the Crusaders brought their north European ships out to Constantinople, to Asia Minor, and Palestine, they found that the peoples of these lands had many nautical improvements to offer. As a result the ships of England, France, and the Low Countries were greatly improved



Brown Brothers

seagoing ships—some of considerable size—were propelled by oars, many ships being rowed by hundreds of slaves chained inhumanly to the crowded rowing benches.

Long before the earliest history, sails were widely used, although, strangely enough, among the peoples of North and South America they were almost entirely unknown at the time of Columbus. In two or three widely scattered and very limited districts American Indians did use the sail, but very little. Even the Aztecs, highly civilized though they were, had no understanding of the sails that propelled the ships used by the Spaniards.

In European and Asiatic waters, on the other hand, sails had been in use for thousands of years, though, until the introduction of the compass, few voyages were made far out of sight of land. The Vikings, of course, crossed the Atlantic, partly under sail and partly by using oars.

But few sailors were so daring as the Vikings, and so far as those of the Mediterranean were concerned, their voyages were almost wholly close along the shores of their own landlocked sea. Still, the commerce of the Mediterranean

was great, and many were the ships that were built upon her shores. Thus, in the thousands of years of civilization that preceded the days of Prince Henry the Navigator and Columbus, on the very waters that washed the shores of the lands where these two men were born, the craft were developed that ultimately made possible the Era of Discovery that preceded and resulted in the era of European expansion and the development of the modern world.

Today we sail the Seven Seas on ships so amazing as to surpass the wildest dreams of the old navigators, yet here and there about the world are to be found counterparts of the very boats upon which the early development of mankind so largely rested. Rafts, dugouts,

and bark canoes marked some of man's very earliest steps toward civilization and the mastery of the world, yet we have them with us still. The gap between the dugout of the savage and the palatial liner of the North Atlantic seems almost immeasurably vast, yet the one is but the outgrowth of the other. From one the other has evolved through the medium of the restless, never satisfied, and clever mind of man.



Underwood and Underwood
A present-day replica of a Viking ship.—In a vessel of this type Leif Ericsson voyaged to America. Probably the sail was introduced to the Norsemen by the Roman conquerors of Britain



Claudia often rested by straddling a horizontal limb

THE CONQUEST OF CLAUDIA

How One of the Notoriously Untamable Howling Monkeys, Caught
in Its Infancy on Barro Colorado Island, Responded
to the Friendliness of Its Captors

By FRANK M. CHAPMAN

Curator-in-Chief, Division of Zoology and Zoogeography, American Museum

ONE need not be a professed mammalogist to yield to the singular fascination exerted by a band of monkeys in its native haunts. When, therefore, these indigenes appear near the laboratory on Barro Colorado the botanist deserts his plants, the entomologist his insects, the ornithologist his birds, all impelled by a community of interest that expresses the validity of a zoölogical classification founded on real affinities and, in a measure, at least, demonstrates the truth of the dictum that the proper study of mankind is man.

The monkeys return the compliment. Quite obviously we arouse in them an intense curiosity. Whether this is because we are new and unusual, or whether,

in spite of our bipedal, terrestrial habits, they are impressed by a relationship all too evident to us, who can say? But there is something in the howler's steady, intent, prolonged stare, in the efforts of the capuchin to obtain a nearer and a better view, in the night monkey's keen peering, and the marmoset's awareness, that warrants the belief that we are something more to them than merely large, strange creatures.

Of these four species the black howling monkey (*Alouatta palliata inconsonans*) is the most conspicuous in the forest of Barro Colorado in the Canal Zone. Indeed, a howling monkey in the tree-tops defying by voice and gesture a passing airplane, would make a fitting emblem for



GATUN LAKE AND THE CANAL FROM THE FOREST

This is the point of view from which the American Museum's habitat group of Barro Colorado was made. Here Claudia was found

the island and, at the same time, symbolize the inevitable domination of man.

I estimate that during the winter of 1928-29 about eight clans of howling monkeys inhabited Barro Colorado. They frequented only first growth or mature forest, and were, therefore, confined to an area of approximately 2000 acres. The average range of each clan is thus about 250 acres. To this territory they are apparently more or less closely restricted, for in my four winters on the island I have never known the clans to associate.

Allowing nine or ten individuals to the clan and, on the basis of the estimate here given, our present howler population is between seventy and eighty individuals. These clans, or bands, are usually composed of two adult males, and a young male or two, while the remainder are females of whom one or two may have young in arms. It is the brief history of

one of these baby howlers in captivity, that I wish here to relate.

The habits of our pets, like the doings of our children, are very apt to arouse in us an enthusiastic approbation not always shared by others. But it is universally admitted that Claudia, as she was called, was possessed of a fascinating personality. If it is difficult to analyze the bases of personality in man how can one hope to do so in a baby monkey! I can only say that Claudia had large, luminous, intelligent, in fact human black eyes, and that their distance apart gave breadth if not height to her forehead. From them she regarded you with a spirit of calm, discriminating independence which was the essence of her nature and perhaps the foundation of its charm. Claudia, might with reservations be your friend, but she certainly was no one's pet. She permitted no petting and she betrayed no affection; and still I always had a feeling that Claudia had

potential affections and I knew that it was well worth an effort to win them.

It was in October, 1927, that Claudia literally fell into our hands. At this time she was probably about two months old. She was a member of the laboratory clan of howlers and, doubtless by some mishap, was left alone in a tree near my house whence she was taken by Donato. It was the 23d of the following December when first I met Claudia, and two pages of my journal of the 24th are devoted to her. From it I quote:

The baby howler is captivating. No hand-organ monkey this, but a wild, forest creature who after two months' captivity, out of the not more than four of her life, is still unapproachable. She resented the slightest touch and turned on me fiercely. For a moment I thought that she actually would attack but she vented her feelings by howling loudly. When I came from the forest at midday she was lying on her back, arms

outspread, in the bottom of her cage, to all appearances dead. But she slowly opened her eyes, looked at me dully and, with apparent effort, raised one arm. I was quite sure that she was dying, and went to my house for a poncho to protect her from the burning sun. When I returned she was up, grunted a little and soon began eating. Evidently I had aroused her from a nap.

In the afternoon we removed her from the cage, which she had shared with two simpering marmosets (to whom she paid not the slightest attention), and placed her in one of her own where she would have the seclusion her reserve demanded. It is a large cage nine feet square and seven high, and in its center we set a small, well-branched tree with the leaves still attached. It was fifteen minutes before she ventured into this new field. Meanwhile, she sat on a box similar to one in her former quarters. The moment she entered the tree she began to eat its leaves, pulling them in toward her as the adults do. This important food had been omitted from her diet of bananas, rice, papaya, bread and meat. Of the latter she seemed very fond and at one o'clock today was



A BABY HOWLER

Whenever disturbed, Claudia gave vent to her feelings by howling loudly. Even after she had become thoroughly familiar with her surroundings, the sight or sound of some of her own kind caused an outcry



A SPINY CEDAR ON THE ALLISON ARMOUR TRAIL

The face of the buttressed trunk of this cedar (*Bombacopsis fendleri*) measures 31 feet, and its greatest circumference is 90 feet. The tree is about 150 feet in height

tugging at a piece held in her left hand. Changed to the right hand there was an evident lack of coördination. Mouth and meat did not connect until the left hand came to the rescue and guided the right toward the expectant point. Apparently she is left-handed. After a survey of her surroundings she made a journey of exploration of her new home, climbing from limb to limb, moving easily and freely, making some missteps but saving herself from falling by the use of her tail; an automatic mainstay. She howled loudly and repeatedly at an airplane the approach of which attracted her attention before it was visible—a valiant little baby, born old.

Claudia's actions on being placed in new surroundings proved to be wholly characteristic. She was always intensely curious, but it was curiosity controlled by caution. Nothing was too insignificant to arouse her interest and warrant investigation. Even a small stone that chanced to be dropped on the dirt floor of her cage was approached by degrees and from all sides and was eventually tested with her teeth.

She would try any food once but promptly dropped what did not appeal to her. Raisins she would always take. The seeds cracked sharply as she munched them. The skins were thrown away. If the raisin fell before she had extracted its contents, she looked down from the limb on which she was sitting until she saw it on the dirt floor, then went down and retrieved it, a perfectly coördinated bit of action.

A vessel large enough to bathe in which was placed in her cage was finally tested, like the stone, with her teeth. She made no attempt to enter it and evidently considered water as designed only to drink. In that way she used it freely but an attempt to give her a shower brought such pitiful protests that we at once desisted. Howlers evidently do not bathe. A rope, hung from the roof to the floor of her cage about two feet from the tree, met with immediate approval. Here was something

in the nature of a vine to which she needed no introduction. Her first motion was to reach for it and pull it in hand over hand as deftly as a sailor. Then she sprang for it, or, at times, went to ground, took the loose end in her hand and, walking erect, carried it to the base of the tree which she ascended taking the rope with her. Thence she swung to a perch placed on the opposite side of her cage. It was some days before she ventured to swing free to and fro on the rope.

When in her tree, whether in motion or at rest, the tip of her tail was almost invariably wrapped about some convenient branch. It functioned as automatically as her feet. When she leaped for the rope, she did not abandon her tail-hold until the rope was grasped. To test the effectiveness of this safety device, I pulled the rope aside just as she sprang for it, but in spite of the fact that to her weight was added the momentum of her

spring, the tail always held. She stopped, it is true, with a jar; but she stopped.

The great event in Claudia's life during the three months I knew her was the placing in her cage of a fresh tree. To her it was a new world. Like everything else new, she viewed it with suspicion and approached it by degrees, making tentative advances from the ground and from her rope, both familiar territory. Gradually she increased her grasp on the ends of the new limbs, testing them with her teeth, and after about ten minutes she severed all caudal connection with the world behind and entered the tree. Suddenly, panic-stricken by the strangeness of her surroundings, she made a rush for safety on the sides of her cage. This was repeated time after time, minute inspection accompanying each visit until she had thoroughly explored her new kingdom and began to feel at home in it.

If Claudia seemed over cautious it



AN APPRECIATED TITBIT

When placed in a new cage which contained a well branched tree, Claudia eagerly began eating the leaves. These had not formerly been included in her diet



A MIDDAY SIESTA

To all appearances Claudia was either dead or dying when taking a nap. At noontime she often chose some spot fully exposed to the sun in which to sleep

must be remembered that she was almost wholly without experience and had no one to instruct her. In her clan she would still have been in her mother's arms and never called upon to take the initiative or reach a decision unaided. Alone she had nothing to guide her but her own good sense, courage, and instinctive prompting to be cautious, and the manner in which she accepted the numerous changes, small and great, in her new environment is a tribute to her adaptability. Unfortunately, there was no one at the laboratory during this period prepared to make a proper study of Claudia's mentality and development. To me she was only a very appealing, winning little person with whom it was always a pleasure to spend a minute or two of the time left from other occupations.

One day I placed a parrot (*Broto-geris*) in her cage. She looked it over carefully, as she did everything, but it did

not seem to impress her. Nor was she especially concerned with a coati that sniffed around the outer base of her cage. But a live, native mouse (*Oryzomys*) at once claimed her entire and eager attention. From a branch of her tree she followed its every movement as it ran quickly from side to side trying to find an exit from the floor of her cage. Frequently she uttered a sound like the gritting of teeth and to it added a high, excited squeak. It did not seem possible that so arboreal a creature as Claudia could have an inherent interest in an animal so terrestrial as a mouse. Nevertheless, it unquestionably fascinated her. So great, indeed, was her desire for a closer view of this strange, active little object, that it prompted her to descend to the ground. Barely had she reached it, when the mouse chanced to run at her and, with a convulsive leap, she sprang upon a nearby block of wood, back arched, tail tightly

curled, jaws set, eyes intent with a look which seemed to express fear, surprise, and indignation. It required only a little imagination to believe that we had here a primitive exhibition of a response which is commonly thought to be instinctive in Claudia's remote relatives of the same sex! The little excited squeaking aroused by the presence of the mouse was also always uttered by Claudia when I shook the gunny-sack which was her bed, as an invitation to play. At such times she jumped toward the sack to grasp it with teeth and hands. Possibly the mouse aroused a similar desire.

The grating sound indicated contemplation. It was sometimes continued for more than a minute. While eating, she often uttered a low, contented chuckling, and her only other conversational note was a slight grunt at times leading up to a roar. Doubtless Claudia was just as well

pleased to be left largely to her own devices. When not distracted by the presence in the near-by forest of her own kin, she never seemed to lack for occupation. Her tree and swinging rope made a playground where for hours at a time she entertained herself, performing rare acrobatic feats. When tired, she often rested by straddling a horizontal limb, lying on her belly with her hind legs dangling and her chin leaning on her folded arms. From this evidently comfortable position she surveyed the world composedly and with what seemed to be a slightly amused expression.

When taking her midday siesta she sought a place, either on a box or the bottom of her cage, fully exposed to the sun, lay flat on her back and stretched her arms and legs out to the limit of their reach. I have never seen any other quadruped, and but rarely a biped, assume so



CLAUDIA SEES A MOUSE

Her first glimpse of a mouse aroused Claudia's attention to such an extent that she descended to the ground for closer observation, but when the mouse suddenly ran toward her, she sprang upon a near-by block, back arched, tail tightly curled, and jaws set



INVESTIGATION

Claudia was of a cautious nature and always carefully investigated any piece of food before taking it into her mouth. Almost invariably the tip of her tail was wrapped around some convenient branch

relaxed a pose. At night she slept in a box, with a piece of gunny-sack for a bed, usually lying on her side.

Aside from Claudia's attractive personality, I think that it was largely her evident disregard of me that led to a determination to win her friendship. Also I was influenced by the fact that howling monkeys are notoriously untamable.

I deliberately devoted myself, therefore, to the conquest of Claudia. It was slow work. She had no more time for me than I had for her. It was doubtless just as well, therefore, that I could make only brief and casual visits when I chanced to pass her home. My campaign was planned on Claudia's love of food and play, two traits on which we might meet with some hope of understanding each other. The story of how I gradually gained her confidence may best be told by extracts from my journal. It will be

remembered that I first met Claudia on December 24.

DECEMBER 25. Photographed Claudia this morning. She wanted to sleep and resented being disturbed. She did not howl at me as she did yesterday, but beyond this is no more friendly. She refused to take food from my hand but picked it up from the box where I placed it. She appears to be definitely left-handed.

DECEMBER 26. Claudia took food from my hand and even ate while I held it. We are getting on. A piece of banana, a Brazil nut, a cabbage leaf, and a bit of cooked meat were all accepted, although the nut and cabbage were certainly new to her. Both the latter were soon dropped, but the meat she clung to with her left hand, eating eagerly and chewing thoroughly before swallowing. She has not yet cut all her teeth and none seems fully grown.

During the following month I made some progress with Claudia but without gaining her confidence in my good will. She soon came to recognize me as a source of unusual and palatable food, but I

myself was altogether too remarkable an object to be accepted without reservations.

Often as I entered her cage she jumped toward me from her tree to the rope and held out her hand (usually the left) for the expected gift. I tried to induce her to eat her food while I held it as a means of creating closer relations, and she frequently did so, sometimes very gently, tentatively testing my fingers; but her teeth, if small, were sharp, and I did not encourage experiments in this direction.

As a playmate I got nearer to her. Her love of play seemed quite as strong as her desire to eat. When, about half an hour before sunrise, she awoke, she went direct from her box to her swinging ropes. A second rope had been placed in her cage and she seemed never to tire of devising new methods of using them. It was with a rope, therefore, that I made my advances, and she quickly offered to bite one end while I pulled at the other. A puppy

acts in much the same way. Now and again she seemed to realize that she was becoming too intimate and retreated, but each time the lure of the wagging rope won her to a new test of strength; and for a baby she was amazingly strong! Eventually she entered into this game with so much zest that even when her only hold on the tree was with the tip of her tail, shake and swing as I would, she did not relax her grip. Her tail, indeed, seemed to be quite as firmly attached to the tree as to her body. But in spite of these associations she would not permit me to touch her.

An incident that occurred on February 7 did much to advance our relations. Attracted to her cage by unusual calls, we found her so entangled in her ropes that she was completely helpless. She was terrified, and as we cut her bands she screamed like a child. When freed, she was a very much subdued monkey and



CLAUDIA EATS A RAISIN

Raisins were always acceptable to Claudia and eaten with apparent enjoyment. The skins she discarded but not until every bit of their contents had been extracted

either for this reason, or because she recognized in me a rescuer, was very gentle, eating from my hand and almost permitting me to touch her.

Five days later, or after a siege of just fifty days, Claudia capitulated. My credentials, however, were still supported by an appeal to her palate, and it was while she was eating a raisin that I was granted the heretofore unthinkable familiarity of stroking her head. The act, indeed, seemed to give her some pleasure and it had all the elements of a personal victory for me. Finally she stretched out on her gunny-sack bed, put her head on one side, closed her eyes and, with every appearance of contentment, confidence,

and relaxation, went to sleep under my continued ministrations. I rejoiced in the conquest of Claudia.

After this epochal event our friendship developed rapidly, but on Claudia's lines; and Claudia's lines were play, more play, and harder play. She would desert her food at any time when I entered her cage and spring toward me. Indeed, Claudia now became the aggressor. I was, in effect, another rope and to be used as such. Meanwhile Claudia's teeth had become formidable. She never attempted to bite, but her methods of play called for their more vigorous use than my skin was prepared to withstand. I had, therefore, to cover one hand with a woolen sock,

leaving much toe for chewing purposes. This seemed to please her and it protected me, while with the other hand I could maul her freely.

Was Claudia now tamed? Not for a moment. I was simply one of the many strange things which she had encountered in her new environment, learned to accept and make the best of. Fundamentally she was as wild as the day of her capture. It needed only the sight or sound of her own kind to change her from an apparently happy little creature playing with her ropes, to a wild animal dashing about her cage or clinging to the wires nearest the forest and howling pitifully.

Her powers of hearing and seeing were remarkable. Often her calls first told us that howlers were



THE FOREST ON BARRO COLORADO

It is estimated that during the winter of 1928-29 about eight clans of howling monkeys inhabited these forests

roaring in the distance or passing through the trees bordering our clearing. As time passed and she became more accustomed to confinement and familiar with us, we assumed that she would cease to respond to the 'call of the wild,' but there appeared to be no decrease in the force of her reaction to the voice or presence of other howlers.

My record for December 24 reads:

This afternoon Claudia howled continuously for at least half-an-hour. Evidently she was startled by hearing some of her kind, but they were so far away that one had to listen intently to hear them. She jumped from limb to limb of her tree angrily shaking its branches with her hands and even biting them.

Under date of January 21 I quote:

Claudia is wild and restless. She calls almost constantly and rushes about her cage floor, always on the forest side, as though looking for a way out. . . . She was not still for thirty consecutive seconds during the day.

As before, this activity was caused by hearing howlers call. Then would follow a period when there were no other howlers in our vicinity and Claudia seemed wholly reconciled to cage life. But with the

return of the cause she would have another violent, uncontrollable attack. One could not imagine cries more expressive of hopeless despair; or a more pathetic figure than this baby monkey looking from her cage to her relatives in the tree-tops and moaning wistfully.

At this time we should have yielded to Claudia's plea and restored her to her clan. Perhaps they might have refused to accept her. But even if forced to live alone, she would have had the freedom of the forest and one must believe eventually have found a mate.

At any rate she could have suffered no worse fate than that which befell her in our care. Gradually her health failed until she could barely drag herself into the tree through which she had leaped and swung so agilely; and in October, a year from the date of her capture, she died. Her body is in a jar of alcohol in the laboratory awaiting dissection to determine the cause of her death. I have never had the courage to examine it, but whatever the autopsy may show, I believe that Claudia died of a broken heart.



A NIGHT WITH AN AFRICAN HERDER

How an Artist, Lost from the American Museum Exploring Party to Which He Belonged, Found His Way to a Native Hut not Far from the Shores of Lake Hanington, Where He Spent a Night in the Company of a Herder and His Family

BY W. R. LEIGH

THE sound of two distant rifle shots reached me. I promptly answered the signal with two shots and waited; there were no replies.

The sounds had seemingly come from a point a couple of miles back and I decided that the rest of the party were following, and that I might as well sit down and wait for them.

Since seven o'clock that morning I had been traveling along the shores of that strangest of all Africa's bodies of water—Lake Hanington—and was tired. It was four-thirty, and having had no food since breakfast, I was not averse to sitting still.

Lake Hanington is a wild, inhospitable, place, rarely visited by white men. It is brackish at its southern end and briny at the north. It contains, in addition to salt, what I judged to be alkali, soda and perhaps other minerals. The surface of the water is covered with a green scum of floating algæ, and the turbid water beneath this scum exhales an effluvium that is not pleasant.

At from fifty to a hundred yards from the present shore line—out in the water—there stand many stark and lifeless trees, bleached like skeletons, that mark what looks like a former shore line. The impression was forced upon me that I was treading the margin of a basin which had been seismically lowered suddenly, for the large size of the trees indicated that a century at least of quiescence must have preceded, to permit of their development; while the bald and treeless coast of today

and the entire absence of trees between it and the snags argued rapidity of action. No such trees as these exist now anywhere in the vicinity.

Beyond the blighted trees pink flamingoes formed, in places, compact armies comprising millions of individuals; their formation doubtless was due to the lake floor upon which they stood, the straight military lines indicating the depth-limit at which the birds could feed on the bottom. Novel beyond words was the spectacle of these creatures, up to their thighs in green water, and with heads submerged, casting conch-shell reflections across the shimmering surface, while those lifting their heads for air, kept up a continuous hum of conversation.

There was something weird and fantastic about this noisesome lake, set like turquoise in coral amid its red ridges—a gem of unique beauty—a poisonous talisman.

Our party had all started out together in the morning, to explore these shores of Lake Hanington, but, being impatient when the thrill of discovery lured, I had hastened ahead to see what was around the next bend, beyond the next hill—and I walk rapidly.

My gun-bearer with my canteen had lagged behind as usual—and waiting for the oaf was tedious. Besides, there was something exhilarating in being alone.

The party was a mile behind me, when I last sighted them about ten o'clock. I had paused beside a monster boiling spring to take snapshots and saw the

men coming around a bend of the shore.

I had continued along the water's edge, supposing my companions would do likewise, though the traveling became increasingly rough. There was very little soil on the red rock ridges and every form of vegetation was armed with vicious thorns, which I found impossible always to escape.

As a consequence I soon resembled a half-picked chicken. My helmet and shirt had become scarified and full of holes, while numerous scratches on my arms and one on the face were eloquent of bad going.

The sun was furnace-like, and my can-teen was a regretful memory. I had expected to find drinkable water, as on the preceding day, but no such luck was in store. What looked like good water rested in rock-pockets from showers

during the past night, but it proved to be a vivid imitation of lye, alkali and Epsom salts combined.

I had found numerous pools at the points where dry water courses entered the lake; the beating of waves had built up dams of sand across each trough, and behind these dams were stagnant ponds, some green, some yellow, and others blood-red—all swarming with wrigglers, skimmers, and flies; they were fetid and forbidding places.

At about two o'clock I had stretched myself in the shade of a large tree in the bottom of a deep and narrow canyon and rested for an hour.

A crow discovered me and spread the report that there was something very strange to be seen; other crows assembled, and the growing excitement attracted other kinds of birds, until there was a



A PANORAM OF SUPERLATIVE BEAUTY

"All about, in a scintillating blaze, the old-rose glory flooded. Below, it played with the lake; opalescent, quivering, and shimmering with kaleidoscopic reflections"

garrulous mob around me of a great variety of shapes, sizes, and colors; some of the smaller ones exhibited surprising inquisitiveness, coming almost within reach of my hand.

Even the lizards gathered to inspect me, and several hyrax—those curious little creatures, no bigger than a cat, whose nearest relative is the hippopotamus, sat on rock ledges and scolded mercilessly.

Up the gorge that wound crookedly, thick jungle and vine-matted gloom was noisy with the squawks of hornbills and monkeys. I debated whether it would be worth while to look for water there, but decided it would not.

Down the ravine toward the lake, the cliffs grew less precipitous and high and the walls separated more widely. Here, I decided, lay my best chance of quenching that thirst which was becoming a serious problem, and sure enough, there was a pool in the midst of a deep, sandy depression, at the foot of a dry waterfall. Half the water had evaporated out of it and a band of green scum a foot wide all around it was strewn with dead bugs; a defunct mouse floated in the middle of it. I didn't drink.

Making my way up out of the canyon I had pushed forward. A huge wart hog sprang up just ahead of me and glared, blinking little red eyes. With his tremendous tusks, hideous gargoyle-like head and scrawny mane, he presented a grotesque and revolting spectacle. Along the barrel of the rifle I watched quietly. He wheeled, tail rigidly erect—his danger signal—and bolted with thorn-defying recklessness.

Klipspringers and dik-dik darted out of my path and a fox glided away.

Near the southern end of Lake Hanington a peninsula extends at right angles to the shore, more than halfway across. As I approached the isthmus of this land body, I observed a herd of goats drinking

from pools in hippopotamus tracks in a stretch of marsh. I was nearing the stage where I would be ready to tackle anything wet, so I approached the stately black tender of the herds.

"Jambo!" (Good day!) said I. I doubted whether he spoke any Swahili, and was delighted when he replied, "Jambo, Bwana" (Good day, sir).

"Maji hii mzuri?" (Is this good water?) I demanded.

"Hapana Bwana, mbaya sana!" (No, sir, it is very bad!)

He conducted me across the isthmus to an expanse of denuded red soil deeply furrowed by dry streams, which, where it merged into the water, became a reed-grown marsh teeming with ibis and herons; beyond this stretch, a second flock of goats was drinking.

"Maji mzuri," said my herder, pointing across with an arm heavy with brass-wire bracelets.

I put a shilling into his hand and hastened on.

Among a great number of seep-springs I found one issuing from beneath a large rock which was comparatively free from salt, alkali, and soda, and sufficiently cool to be drinkable. All the water entering the lake, I afterward learned, is hot or tepid.

The herds of goats came to dispute my water rights. They knew good water from bad as well as I did—and I had to sit on the rock and fend them off with my feet. The animals showed a thirst-born disregard for me and strove to muzzle my feet to one side. There was plenty of water, but mine was the best. I sat amid a sea of goats, while scantily clad aborigines looked on, and grinned.

A quantity of bees refused doggedly to be driven away, so they and I patched up a gentleman's agreement. Also, a rowdy rout of baboons came down from among the rocks. They, too, were water

experts—and said most uncomplimentary things to and about me.

But I was adamant. I was sublimely egotistical—a glutton—deserving all their strictures, and not ashamed. I sat on my rock waiting—waiting.

Why didn't the rest of the party catch up?

The declining sun cast orange shafts that splintered and cascaded over the clump of trees behind me and sifted through chinks and crannies, seeking with gold-dust fingers to clutch me, but I escaped. I had born their malice all day; had paid the price; and now the trees were bearing the brunt of their fury. All about in a scintillating blaze the old-rose glory flooded; it rioted and romped; it steeped the escarpment

across the lake in a magical glow of inimitable color—gray-green and pale amber, cerulean, chocolate and ochre cliffs, ragged, broken and crumbling. It painted salmon-pink, vermilion, and peach-blow white the eroded soil that swept down in lordly lines to the very water's edge. It splashed robin's-egg blue, lilac, mauve, gamboge, and russet patterns of dead and dying vegetation; it daubed in red-purple lava flows, startling green swipes in clefts and gashes where water occurred; black scars where grass-fires had raged; incredible royal-purple velvet shadows in canyons; and it walloped in above the tremendous supernal, ultramarine dome.

Below, it played with the lake; opalescent, quivering, and shimmering



"A HUGE WART HOG SPRANG UP"

"With his tremendous tusks, hideous gargoyle-like head and scrawny mane, he presented a grotesque and revolting spectacle"

"A ROWDY ROUT OF
BABOONS CAME
DOWN FROM AMONG
THE ROCKS"



with kaleidoscopic reflections—a bewildering turmoil—a chaos of witching tints. It was a canvas upon which the wizard lavished and squandered enchantment.

Flapping horizontally, great white pelicans skimmed above their reflections, or joined them in a rainbow splash. With snowy bodies and black heads and wings, flocks of ibis rose, and simultaneously their images fell like showers of guava blossoms; wild geese sailed majestically like questing galleons of old, their forms silhouetted against the gleaming ivory band of alkali deposit that followed the water's edge along rock-bound shores. Bowing and tilting, each to the other, as if in playful mimicry, wading birds of divers kinds fished in the shallows above inverted counterparts, and dragon flies flashed hither and thither chasing each other and dancing and sporting, like splatterings from the wizard's careless brush. It was a panorama of inimitable and superlative beauty.

Absorbed in contemplation of the picture before me, I sat, essaying excursions into the beckoning canyons and masses of jungle in imagination, that weary limbs shuddered at the thought of attempting—dreaming of explorations in this fairyland—fancying flights in a flying machine to those rugged summits—those far blue peaks beyond—when crash!—two reverberating boom from a distant gun recalled me to the present!

Something may have gone wrong with my companions; perhaps exhaustion had intervened—perhaps someone had gotten hurt!

I recrossed the isthmus—a long line of shore became visible. To obtain a better view of it I walked across the marshy space to the water's edge, where a fringe of reeds grew. I hoped to see the winding "safari" of porters coming along the ridge, or the slender column of blue smoke and twinkle

of a camp fire, but nothing of the sort appeared; only far away, a wisp of steam from a boiling spring, and the bark of a lone jackal.

Suddenly there was a loud splash! Startled, I wheeled.

An immense bull hippopotamus stood within thirty feet of me. He had been sleeping in the shallows among the reeds.

Automatically the rifle flew into position; then with the realization that the beast was as much startled as I was, down came the gun and up went the kodak—but, alas!—all the films were used up.

The bull, after a careful survey, decided I was a dubious and unneighborly interloper, and with snorts of suspicion and disgust, moved out into deep water.

I continued my retreat; impalla scurried up the hill—a hyena skulked off with ungainly motions and mean and treacherous backward scowl. In a dusty place I came upon the tracks of a leopard.

The sun, a blood-red hub amid far-flung spokes of molten gold, sprinkled ruby-dust athwart the purple ridges as it sank. It was as glorious as a sunset could be—as only African sunsets can be—an orgy of barbaric crimson—a drunken spree of red.

I reached the brink of the deep canyon where I had rested; the light was fading fast; below me a tangle of jungle obscured the rocky floor of the gorge—obscured the chaos of tumbled rocks, and—what

else? As if in answer to the thought came the raucous expostulations of startled baboons; an old male leaped from a crag to the top of a tall tree, where he sat, cursing me vehemently. He started an owl out of the tree, and some roosting birds chattered and scattered from a vine-draped mass near by. There might be a variety of marauders lurking in that obscurity, and this was the prowling hour—the time and place peculiarly appropriate as foreground to the picture, with that ocean of blood in the west.

The thought of spending the night on this savage hilltop with hyenas and leopards abroad was not appealing; to attempt crossing the canyon in darkness was not inviting either. I went through all my pockets—not a single match. Most of us have been brought up on the idea that fire frightens wild animals. I

have heard it disputed by very experienced hunters, but in any case a fire is cheerful and gives warmth.

One never realizes in daylight how utterly the human is dependent on his sense of sight, but at night the truth is driven home. As the moonless night closed in, I found myself sensitive to every whisper of sound—the faint snort of a hippopotamus down in the lake, the chirping of insects, the stirring of the wind amid the trees—and I became conscious of the inadequacy of the ear for protection under such circumstances.

As I stood on the brink of the abyss, with the wind growing chilly, I heard the long weird wail of a hyena from not far distant. What was I going to do?

Seeking an answer to this question, I chanced to glance along the edge of the



“THE HERDS OF GOATS CAME TO DISPUTE MY WATER RIGHTS”

The animals showed a thirst-born disregard for me, and strove to muzzle my feet to one side

cliff, and lo—there stood an object—a—yes, a goat!

What was a lone goat doing here? Lost, evidently. I glanced about inquiringly, and discovered a man—a tall, black man—on the opposite side of the ravine, moving away. Surely, there was some connection between the man and the goat. I shouted. The man turned and started back. I told myself, as he descended into the depths, that this naked savage was going to be my host for one night.

As he climbed up the wall on my side, I saw that he was a slender man of a deep coffee color; his costume consisted of a loin-cloth, and a piece of figured calico—very dirty—over one shoulder, and depending on one side to the middle of his thighs; as adornments he wore a cord of sinew with a few shells around his neck, a bit of ostrich feather in his wool, and several brass-wire bracelets on arms and ankles. He also wore sandals.

I waited and said, "Jambo?"

He answered "Jambo!" with a different intonation. (Well, thank you!)

It was up to me to marshal all the Swahili at my command.

"Wapi nyumba ninyi?" I asked. (Where is your house?)

He repeated the word "nyumba"; evidently he did not know as much Swahili as I did. I changed my question.

"Wapi boma ninyi?" (Where is your hut?)

"Boma—boma?" he puzzled.

"Wapi shamba ako?" (Where is your patch?)

He looked at me blankly, as well he might, since gardens were unknown here.

I was becoming desperate.

"Wapi lala wewe?" I ventured. (Where do you sleep?)

Ah!—his face brightened—he understood. He pointed across the gorge toward the top of the ridge.

Encouraged by this success I propounded another pertinent question:

"Sikia bunduki wewe leo?" (Have you heard a gun-shot today?)

Again he was mystified.

"Hii bunduki!" I said, shaking the gun under his eyes.

"Vema!" (Yes!)

He pointed across the gulch once more; this time toward the lake shore.

So I was right. The party could not be very far away—camped down on the lake somewhere, probably.

Now I had an urgent question to ask.

"Wapi maji mezuri?" (Where is good water?)

He pointed down into the black depths.

But now he, too, had a question to ask.

"Tazama mbuzi moja wewe?" (Have you seen a goat?)

I led him to the spot where I had seen the goat, and lo! the beast had vanished.

"Chakula kwa fisi!" (Food for the hyenas!) remarked my friend, as he glanced about him in the thorn thicket and fast-growing darkness.

As the case of the goat was evidently hopeless, I renewed my suggestion that we proceed to where the water was; he led the way to the top of the hill. The ground rose steeply to the highest part of the ridge through which the water had carved the trough, and where the pit was deepest. I looked down into blackness where tree-snags and rock-splinters were sticking up, and bats flying about. Something that sounded like a frog sent up a wavering squawk from the inky obscurity and the old baboon uttered imprecations again—it seemed like looking into hell and disturbing the fiends!

The trail down which that aborigine took me was both engrossing and hair-raising. He was very careful to draw attention to shaky stones, and deep drops, and somehow we reached the bottom alive and even unhurt. It was a wonderful spot. I wish I could have seen it by daylight—with huge trees, great boulders, and a fine pool amid rocks and

roots. I went for that maji mezuri—it was cool and pure—a priceless treasure in this land of heat and bad water. Eerie and creepy was the gloom, and mysterious the amorphous forms that shut us in. A pendent creeper brushed my ear—a frog dived into the water with a startling splash—the drops of water struck my arm.

How helpless we would have been against the leap of a leopard—and what more likely place to encounter one?

The ascent out of the canyon was more gradual. On the level oncemore, my guide led with swinging strides for a mile and a half.

I kept a sharp lookout for the camp fire I expected to see, down toward the lake, but none appeared.

We reached a goat corral where two little boys awaited their father. Some conversation, of which I understand not a syllable, ensued. It evidently concerned the camp I was looking for, and I divined it was adverse to my hopes.

I asked the older of the boys in Swahili the same question concerning the gun-shot and he replied affirmatively, but waved his hand in the opposite direction. I wondered whether he had understood me correctly.

"Wapi usiku lala wewe?" (Where will you sleep tonight?) asked the man, turning to me.

"Mimi lala hapa," (I will sleep here.) I answered.

He led the way up the ridge to a second corral, beside which stood a lone tree. It was high above the lake on the crest of the ridge—a bleak and barren spot, all rock and scattered lava-stones, with a sparse and miserable sprinkling of stunted thorn bushes.

A hut occupied the center of the circular corral. It was so placed that when the buck goats got to fighting, the vanquished ones would have something to run around and escape being killed. This was no idle precaution.

The wife came out with a baby in her arms, followed by a mongrel dog. My hostess was solicitous—I was a stranger in distress—she must be kind, look after my needs. She was a gentle and motherly soul, with a soft and melodious voice.

"Mwanamke," said I. "Sikia bunduki lwo hivi wewe?" (Madam, have you heard a gun today?)

"Ndio!" (Yes!) She spoke more Swahili than her lord. She

waved in the same direction as the boy had previously.

'Zamani sana—bili—mbali sana!' (Long ago—two—very far!)

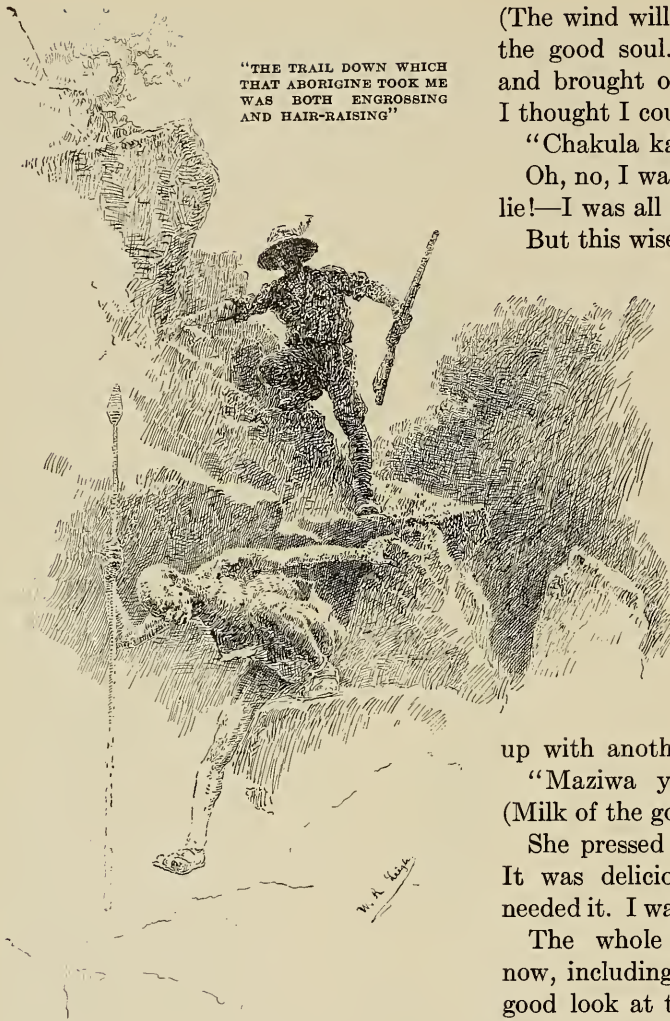
I was amazed. Evidently I had been deceived by the conformation of the hills and had come five miles back in the wrong direction.

Madam's costume consisted of a sort of skirt of leather from the waist to the



THE HERDER

"I told myself that this naked savage was going to be my host for one night"



(The wind will be cold tonight!) objected the good soul. She went into the hut and brought out two hairless goatskins. I thought I could risk these.

"Chakula kadogo?" (A little food?)

Oh, no, I was not hungry—a thumping lie!—I was all right.

But this wise woman knew it was a lie.

She brought from the shamba a gourd full of sour milk.

"Maziwa ya ngombe—mezuri sana!" (Milk of the cow—very good!)

More visions, this time of typhoid, but—it was up to me to drink some of that milk. It wouldn't do to offend my kind hostess. I drank. Typhoid or no typhoid, it was good.

Then the boys came up with another gourd.

"Maziwa ya mbuzi—mezuri sana!" (Milk of the goat—delicious!)

She pressed the gourd into my hands. It was delicious as she said. Also, I needed it. I was rather weak from hunger.

The whole family gathered around now, including the dog, to have a really good look at the strange new being who had come among them. I was a nine day's wonder—a small circus.

The lustrous full moon rose over the escarpment, across the lake, its reflection sparkling and shimmering athwart the water, while flying flamingoes sped across the golden path like wraiths, and the head of a swimming hippopotamus—a black moving dot, leaving ripples behind—cut obliquely toward the shore.

The first object of absorbing interest was my gun. I showed them how it worked. They took it in their hands, and I directed them how to place it against the shoulder and sight along the barrel.

knees, some brass rings around the ankles, a few wire bracelets, and wooden disk-plugs in her ears. The children were quite naked.

"Lala naani kibanaa wewe?" (Will you sleep in the hut?) asked my hostess, politely.

No, I would sleep under the tree.

Would I have a blanket?

I thanked her kindly—no, I would not trouble her.

Visions of vermin loomed large—and in this country devoid of adequate disinfectants—ye gods!

"Opepo myngi biridi sana Usiki!"

But I was careful to keep the safety device locked.

Next my eyeglasses had to be inspected and tried on by each in turn. They evidently thought it would give them magical powers of sight.

My fountain pen was a wonder, and when I got out a notebook and drew animals on a leaf, they clustered about closely to watch the miracle. The moonlight enabled me to see what I was doing.

But my watch was the most absorbing marvel of the evening. It was mysterious and charming beyond words. Everybody had to listen to it tick, and when I tried to explain what its use was, I got all balled up in my Swahili, and what weird notions they imbibed heaven knows.

The buttons on my clothes were fascinating objects, also the buckle on my belt, and the stuff of which my clothes were made. My helmet had to be tried on by every one except the baby and the dog.

My kodak was so awe-inspiring that no one would touch it—luckily—and my shoes with the hobnails in the soles were bewitching.

The freckles on my arms and neck were infinitely interesting to the boys, and the baby wanted to take hold of my moustache; even the dog found me most interesting to smell. I was on the verge of becoming con-
ceited.

Small animals very much resembling Arizona skunks came searching in every crack and crevice—evidently for beetles—and absolutely disregarding our presence, foraged be-

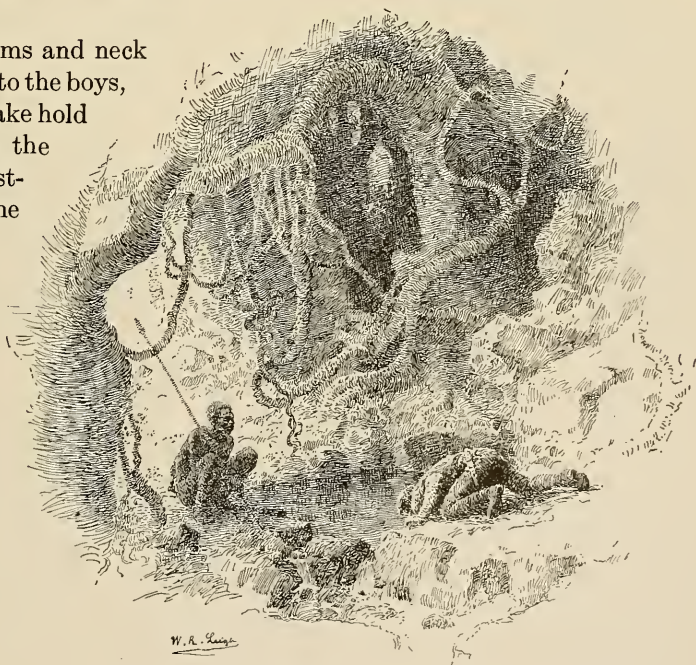
tween our very feet. No attention was paid to them. Even the dog ignored their presence with odd indifference.

I began to grow weary and adjusting the goatskins as best I could to protect me against the sharp wind, which by this time was blowing, I made myself as comfortable as possible amid the stones; the family retired to the hut, but the man brought his blanket out and slept under the tree to keep me company.

I was not conscious of sleeping any that night; the stones were the trickiest and most malicious I ever encountered. No matter how I shifted and squirmed, they got me. They were really diabolical.

Somehow—I never have figured out just how—the moon got from one side of the sky over to the other side. I know, because I had to keep my back to it to keep it from shining in my face, and there came a time when I had to turn over.

My host slept with the calm serenity of an infant—stones, moonshine, and all. Several times I raised my head and looked at him enviously. Even the goats



"HOW HELPLESS WE WOULD HAVE BEEN AGAINST THE LEAP OF A LEOPARD"

W. R. Lacey

ceased their bleating and went to sleep some time after I closed my eyes. At last everything slept but me, and the near-skunks, and a lone hyena far away.

I looked at my watch—it was four o'clock. I became shivering cold; my teeth almost chattered.

The man evidently felt it too. He got up and gathering a few sticks, lit a fire. I didn't see where he got the coals from, but they must have had a little fire back in the hut. The boys came out with him when he brought the coals, and the four

of us hugged the little blaze. Then the dog came out. He was not entirely out of his puppyhood, and wanted to play with somebody's fist or foot all the time.

The boys snuggled up to their father, and he told them little snatches of story about the stars, of which I understood nothing.

The moon had gone down in the west, and now a wan luminosity began to grow in the east. Some water bird down the lake began to call. In the east a comet went down the sky.

"MY WATCH WAS THE ABSORBING MARVEL OF THE EVENING, AND EVERYBODY HAD TO LISTEN TO IT TICK"



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"Nakuja karibu marra kwa marra chui kwa mbuzi?" (Do leopards ever come after your goats?) I asked my host.

"Pana-siku," (Sometimes,) he said. Hyenas also came, he stated, and told me things doubtless deeply interesting had I understood what he was saying.

Soon objects began to become more distinct. A ghostly wisp of mist lay along the shore of the lake. It was the steam from a boiling spring.

A little fragment of cloud directly above the sun suddenly became a gleaming dab of gold on a rose-purple background; an infinitely delicate and elusive panorama emerged gradually from the obscurity of night. The stars paled.

Below us on a dead tree a dozen vultures sat like wooden dummies; without warning one made a lunge at his neighbor, wings loosened, spread, and one bird flapped off heavily to another tree.

My hostess emerged from the hut. I said "Jambo" and put a shilling in her hand.

"Kwa heri!" (Good-bye!) I said.

We shook hands cordially.

"Kwa heri bwana!"

I picked up my gun and camera.

"Kiongozi!" (Guide me!) I said to the man.

He picked up his spear.

But I was not to get off so easily. The boys discovered my hunting knife in its lionskin sheath; they must examine so wonderful an object. They asked their father what kind of skin the sheath was

made of—he was undecided—there are no lions in that vicinity.

"Simba," (Lion) I told them.

They were enormously impressed, assuming, of course, that I had killed the lion, which I hadn't.

The baby cried, and Madam re-entered the shamba and immediately returned with the baby taking his breakfast.

I gave the boys some pennies, and the man and I "hit the trail" just as the first dazzling bit of the sun's rim climbed above the horizon.

My guide was expert at avoiding thorns. It interested me because I had not been so successful; the lack of clothing was one thing in his favor, and experience become instinct did the rest. The natives adhere fairly consistently to trails. The goats and game make a great many of these, but my trouble was that I got tired out dodging under bushes which the animals could pass under easily.

My native showed me the trail, which had branched off at the big boiling spring from the lake shore, and climbing the ridge halfway, had passed around the canyon and me; in the dust were the impressions of the automobile-tire sandals of my tent-boy, so all question was eliminated.

An hour and a half of trudging over rocks brought us in sight of a small river entering the lake, above whose strip of forest rose the welcome blue smoke of the cook's camp fire.





*From a painting by
Louis Agassiz Puertes*

FALCONING

By GEORGE G. GOODWIN

Assistant Curator, Mammals of the World,
American Museum

How Hawks Are Trained for One of the Oldest Sports. Tercels and Eyesses,
Haggard and Passage Falcons, Branchers and Others

HAWKING is one of the pastimes of olden days that everywhere has retreated before the advance of modern hunting inventions. It is not astonishing, therefore, that the average English-speaking person of today has only a vague idea of the meaning of falconry, its antiquity and medieval splendor. There are still a few followers of this sport, however, both in England and in America, and occasionally a falconer may be found with his falcons and tercelts, his lures, and his hoods.

The art of training and flying hawks as a means of securing game flourished in the age of chivalry five or six hundred years ago, when one of the distinguishing marks of a man's rank and birth was the hawk upon his wrist. It was the sport of kings when the wild boar was hunted in Eskdale, and the wolf and polecat were still to be found in the Sytchly country, and when the heron and the bittern were at home in the meadows and marshes around castle moat and abbey wall.

A picturesque language tinged with

jargon has long since become inseparably attached to falconry. The falconer has a name for every part of the trappings and gear he uses. He also has a name for each of his hawks. A glance at some of the records of old hawking clubs reveals some very striking and romantic names, such as "Comet," "Destiny," "Lady Jane Grey," "Empress"; for the male falcons or tercelts the names "Druid," "Butcher-boy," "Vanquisher"; Goshawks were given names such as "Gaiety Gal," "Enid," and "Shadow O' Death."

In medieval times hawks were allotted according to rank. None but kings and members of the royal family were allowed to fly gyrfalcons. The peregrine falcon was legally assigned to prince, duke, and earl; the sparrow hawk to the priest; and the holy-water clerk had to put up with the musket.

Falcons at various ages are so surprisingly different in performance and character that the falconer has a separate name for each age. A young falcon taken from the nest is an "eyess." When the

young hawk has left the nest, even though it is still in the neighborhood of its infancy, it is a "brancher." Those taken during the autumn migration are called "passage falcons," and adult wild hawks that have had two or three years of liberty are called "haggard falcons." The name "falcon" is usually applied to the female, while the smaller male is called the "tercel" or "tercel gentle."

The eyesses, or young hawks, taken from the nest, though much easier to handle and train than the haggard, lack the dash and style of the old, wild caught birds. To overcome this drawback, the falconer puts his young hawks out to hack—that is they are put in an open basket on a roof or on the stump of a large dead tree, fed with fresh meat, and left entirely alone. The wilder they get,

the better hawks they make when trained. Young hawks, if properly handled, will learn to fly and stoop in a remarkably short time, making long flights into the neighboring country, but returning at regular intervals to be fed. For three full weeks the young hawks have absolute freedom, but as soon as they begin to kill for themselves, which usually occurs during the third week in the case of the tercel, they must be taken in. The falcons, being larger birds, take longer to mature, and may be left out for a greater period of time.

The process of training has been discussed by numerous writers in many books and in many languages. The procedure varies. The Hollander catches his hawks when in passage or migration, while the Scotchman takes his from the nest.



CHARLES W. R. KNIGHT WITH HIS TRAINED GOLDEN EAGLE

The golden eagle is used mostly for game such as hares and foxes, but as it is large and clumsy and goes directly at the quarry, its flight is not so spectacular as that of the falcon. In Asia the natives still use the golden eagle for supplying their larder with game

The object, however, in either case is the same, that is to teach the hawk to be obedient.

The real training of the hawk, or manning, as it is technically termed, starts when the eyess is taken in from hack or at the time of the migrant's capture. First a soft leather hood is put over the hawk's eyes, and a pair of jesses (short strips of leather) are fastened around its legs just above the foot. The jesses are then joined together on a swivel which, in turn, is attached to a leash and tied to a block.

To keep the falconer in constant touch with his bird, a bell is fastened on each foot just above the jesses. He knows exactly what it is doing from the sound of the bells, and in the case of a lost hawk these are of infinite value. As

the hawk moves, the tinkle of a good bell can be heard distinctly for more than a quarter of a mile. The best bells are now made in India, but European bells, though of a different shape, answer the purpose very well.

The hawk, equipped with all the necessary trappings, is now ready for the delicate business of training. It is carried on a gloved hand for several hours each day, gently stroked, and spoken to. The feeding is first done through the hood; later, the hood is removed by candlelight while the hawk is feeding, and is replaced before the end of the meal. In this way the hawk does not associate the hood with the end of its meal and thus resent it. When the hawk has become used to people by artificial light, it is fed unhooded in day-



A PEREGRIN FALCON
(Passage Falcon)

This particular individual, captured by the sailors on a liner at sea, 200 miles up the coast of Nova Scotia, later came into the possession of Mr. Goodwin, who trained and used the bird during the hawking season, and then gave it back its freedom. Falcons, under normal conditions, perch on rocks, and therefore the falconer provides a rock or a wooden block for them to rest upon



EUROPEAN GOSHAWK

This powerful short-winged goshawk catches its prey in a short, quick flight. It is naturally a forest-living bird, perching on the limbs of trees, so when in training, it must be provided with a bow perch

light, but the hood is always replaced toward the end of the meal.

If it is a falcon that is being trained, the lure is next brought into use. This is the most important factor in the falconer's equipment. It consists of a padded flat weight covered with leather, with the wings of a pigeon attached to either side. It is also provided with strings for the attachment of food, and a long string by which to swing it. The weight, however, is discarded when the hawk has been trained, for by then the hawk has been taught not to follow its natural instinct to carry its victim away. The feeding is now transferred from the glove to the lure, and after a few lessons the falcon goes immediately to the lure for food. The distance it has to fly is increased day by day, first with a line attached to the jesses, then without.

When the hawk will come two hundred yards, the lure is jerked out of sight just as the hawk reaches it. If all goes well, the hawk then mounts in the air and wings round for a second attempt at the meat on the lure. This time it is rewarded. After a few repetitions of this, the hawk is kept on the wing, or "waiting," as it is called, for several minutes. This exercise is increased daily.

The hawk is now ready to be "entered." An easy bird of the particular quarry that the hawk is to pursue, is put out in a small clump of bushes in an open field and sprung when the hawk is overhead. If a crow is used, the falconer places a freshly killed pigeon under the black wing before the hawk has a chance to taste the unpalatable flesh of the crow.

The error is often made of entering the hawk to a pigeon thrown out of the hand.



AMERICAN GOSHAWK (Haggard)

Mr. George Goodwin obtained this bird from the New York State Game Farm where it had been caught in a trap. It is probably the first of its species to be trained for falconry



READY FOR A MORNING'S SPORT

Mr. Goodwin inherited his interest in falconry from his father, Mr. W. J. Goodwin, who was a devoted follower of this sport, and is here shown with his hawk and lure in the Shropshire Hills, England

An eyess hawk will faithfully follow the game that it is entered to, and there is no surer way of losing a hawk than by having it check off after some stray pigeon half a mile away. Throwing the pigeon out of the hand also gives the "show" away, and the hawk will always expect a repetition.

The manning of a haggard or "passage falcon" is in some respects similar to that of the eyess, which has been but briefly described, but it would be impossible even to begin to explain here the skill, patience, and understanding that are required by the falconer before he can redeem a wild caught falcon from a state of fierce hatred and suspicion and subdue it into com-

plete trusting submission.

There are four principal hawks used in Great Britain today. They are the long-winged hawks: the peregrine falcon, and the merlin; and the short-winged hawks: the goshawk and the sparrow hawk. The short-winged hawks are flown straight from the fist at the quarry. The flight is short, quick, and close to the ground, whereas the long-winged hawks usually kill up in the air and trust more to speed.

I have trained and flown successfully, in America, duck hawks, American goshawks, Cooper's hawks, and sharp-shinned hawks. The little pigeon hawk, an equivalent to the European merlin, would train to perfection, but so far neither old nor young has been obtainable. The American sparrow hawk is for all practical purposes

too small to be useful. It is very different from the European sparrow hawk, which is a short-winged hawk similar to a sharp-shinned hawk, but larger.

In Great Britain, hawking, like hunting and fishing, has its proper seasons. In the early spring the long-winged hawks are flown at rooks, crows, and magpies. By the twelfth of August, these same hawks are through the molt and ready for the Scotch moors, where the falconer witnesses the unforgettable sight of his hawk stooping downward from a great height at a fast-flying grouse and knocking it headlong into the heather. In September

these hawks will make equally short work of the partridge.

In the *Badmington Library*, Lascells gives the following excellent description of the famous flight of "Bois le Duc," a haggard falcon, at a rook.

We take up our position behind a stack to wait for a rook passing on his way from the rookery in the valley to the sheep-fold on the hill. Presently we see one coming, toiling slowly over the shoulder of the down.

Shall we fly one of the young falcons lately entered and coming on so well or shall it be the old heroine of a hundred flights, victress over more than double that number of rooks, that flies now her fourth season with all the vigor and dash she displayed in the blinding snowstorm and heavy gales of her first year? A hundred or two yards is far enough for a slip with a young hawk, but with a real good one a quarter of a mile is not too far, while many and many a time, if the wind be right for her the old hawk has been slipped at rooks a fair half mile away.

It looks as if this slip would be too far for a young hawk, so the handsome old falcon is taken on hand to the delight of the whole field, not one of whom, however, large as it may be, but will stay on just one half hour more when it is announced that it is the turn of old "Bois le Duc" to fly at the next chance that occurs.

All is hushed as the rook, a single bird, presumably a strong old cock, comes slowly up. He passes us and is going nicely on when something about the party awakens his suspicion and he gives a sudden swerve that in one second takes him about 150 yards off on a side wind.

We are not to be done this way, though, and in a moment the head of our party, with falcon on hand, dashes out at a brisk gallop down wind of the rook which hastens up on wind. But a hundred yards or so is no

matter to us with this hawk, and the moment we are fairly down wind of him the hawk is unhooded and flung off; and the falcon is in hot pursuit of her quarry, rising with each stroke of her powerful wings till she seems to shoot upward like an arrow from the bow.

The rook has seen her, and is making his way upward at no mean rate; but the pace of the falcon is too much for him, and ere long she is above him. Poising herself a moment, she comes with one terrible perpendicular stoop straight at him.

It would seem as though nothing could escape, but our rook is equal to the occasion, and with a clever shift he has dodged her attack by a good yard or more.

Well done, rook! but there is clearly now no safety for him in the air, for the falcon has shot up again, with the impetus of her swoop, to a height scarcely inferior to that from which she



AMERICAN PEREGRIN FALCON
(Eyess)

Hooded and waiting to step on to the falconer's hand



PEREGRIN FALCON
(Tercel)

Hooding the falcon requires great skill and gentleness to avoid alarming the bird and making it hood shy. Mr. W. J. Goodwin has just removed the hood from his favorite tercel, before releasing the bird

descended; so turning his tail to the wind, he makes all possible haste to a small patch of thorns that promises a temporary shelter, having, however, on the way to evade two similar stoops from the hawk, almost as fine as the first.

Alas for friend rook! On reaching the covert he finds it already occupied by the enemy, in the shape of the excited field who soon drive him with halloo and crack of whip from his shelter, and compel him again to seek the open. The falcon has, however, strayed a little away; so he starts with might and main to ring, in spiral curves, into the very clouds.

After him starts the hawk, but soon finds that a really good rook, such as this one is, can mount nearly as fast as she can.

Up, up they go, gradually becoming smaller

and smaller. Ring above ring does the falcon make, yet without getting above him, till, apparently determined to gain victory, she starts off into the wind to make one tremendous circle that shall attain her object.

Steadily into the wind she goes, the rook striving to follow her example, and appearing from below to be flying after the hawk. At length, as she almost completes the outer circumference of her circle, the rook perhaps feeling his powers exhausted, turns down wind, and, at a great height makes off as fast as he can go.

Surely the flight is over, for the falcon is still working away, head to the wind, as hard as she can—in fact, the two birds are flying in opposite directions, half a mile apart. "Not a bit of it," say the initiated, who are off down wind as fast as they can ride.

In another moment you see the falcon come round, and though at such a height she looks no bigger than a swallow, you can see that she is far above the rook, while her pace, slightly descending as she is, is almost that of a bullet. So thinks her quarry, apparently; for shutting his

wings, he tries to drop like a stone into a clump of trees now nearly beneath him.

Swiftly as he drops, there is a swifter behind him, and down from that terrific height comes the falcon like a thunderbolt. Lord, what a stoop!

By the powers she has missed! and surely he must escape.

But no, shooting upward like a rocket, the old falcon put in one more straight, swift stoop, and the rook is taken just as he enters the sanctuary which he has had his eyes on from the first. Whoo—who-op! A grand ring! A magnificent stoop! A splendid flight! Bravo! 'Bois le Duc'."

It is only in modern times that the crafty rook has been pressed into the list of available quarry. Both rooks and

crows, though common, are possessed of considerable powers of flight in time of need, and can shift from the stoops of some of the fastest hawks with considerable ease.

During recent times the writer has noticed a marked interest shown in falconry by American sportsmen. Through the invitation of Mr. E. T. Tefft, falcons and goshawks were imported from England and flown during the springer spaniel field trails at Brewster, New York, in 1926. These same hawks were again

flown at Fisher's Island the same year, and I also flew American falcons at this meet. In 1927, Mr Tefft had four or five duck hawks and Cooper's hawks trained at Brewster.

Falconry is a noble, picturesque pastime in itself, and has many attributes that make it an interesting and pleasure-giving sport. Its possibilities are unbounded here in America, where hawks can easily be procured, and where the ample, open spaces of the plains afford an excellent opportunity to carry on the sport.



NEST AND YOUNG OF THE RED-SHOULDER HAWK

A peculiar habit practiced by many hawks is the decorating of the nest with evergreen branches. The significance of this habit has never been determined so far as Mr. Goodwin knows. Near the egg may be seen the body of a Brewer's mole

THE BLACK ART

An ancient and elaborate fiction which man has invented to
give himself a sense of power of circumstances

By MARGERY L. LOEB

Department of Anthropology, American Museum

A FEW years ago an alert social worker in Little Italy found to her amazement that the tenements of Mulberry Street housed numerous sorceresses who carried on a prosperous business in charms and incantations, and that in hall bedrooms people were piercing effigies with darning needles and scorching them over the gas flame, to destroy their rivals in love or other persons against whom they bore a grudge.

More recently a farmer of York, Pennsylvania, was killed by two boys whose crops and cattle had been blighted and whose families had sickened. It was claimed that the victim was a witch doctor, or "hexer" as the Pennsylvania Dutch dialect has it, and that he had been bringing misfortune on the whole neighborhood by his sorcery. The trial revealed that an elaborate traffic in witchcraft was firmly established in the midst of what is in many ways one of the most progressive farm communities of the country, among people who tune their radios to station WJZ or WEAf, New York.

Such incidents seem fantastic anachronisms, and yet we find the vestiges of magical practices persisting even in the commercial centers of our big cities. When hard-headed business men in the silk industry feel that they must discard a textile design based on peacock feathers because of the superstitions associated with this bird, and when skyscrapers, the symbol par excellence of the Twentieth Century, commonly omit the number thirteen from their floors and rooms, it seems evident that even in this rational

and materialistic day and age the deep-rooted belief in the potency of certain talismen to divert the forces of destiny still has a foothold.

The belief in magic is probably as ancient and as widespread as is the concept of a supra-mundane force or forces which control the fortunes of human beings and the every-day occurrences of the earth and account for the unreliable vicissitudes of luck and all the inexplicable experiences which must have puzzled man from the beginning. In the face of his utter helplessness at the hands of these whimsical and indomitable powers, man, in order to keep up his courage, has always had to imagine that there were means by which he could exert some influence over them. At times he has chosen to sway them by the same methods he has successfully used in influencing his fellows—by cajolery, flattery, bribery, or supplication. On the other hand, he has also believed that he could under some circumstances actually exert compulsion over destiny. To this end he has invented the technique of magic, by which he has conceived that the "powers that be" could be compelled to bring about his desired ends, whether of revenge, love, fertility, or health.

Man has imagined that, often guarded by an intricate and delicately set approach of rituals and incantations, there must be triggers, so to speak, which, when once touched off—whether willfully or by accident—would automatically divert the forces of destiny into particular channels. A given result would follow from the release of a specific trigger in a sequence

of cause and effect, as an electric bulb will glow if the button by which it is controlled is pressed.

The magnetic force which man believed could so effectively divert the supra-mundane powers, operated by virtue of a sympathy—a magnetic circuit as it were—which existed between events, and certain actions, objects, sounds, or words, which bore one of two relationships to each other. The first of the relationships was that of similarity. There was a potential force—a charged channel, through which, when opened, the powers of destiny would be drawn—between things which looked or sounded or felt alike. Thus, when the image of a person was mutilated under the particular circumstances which released the trigger and rendered the channel active, events would inevitably so shape themselves that the person himself would receive a similar mutilation.

The second relationship was that of contiguity. There was the same kind of a bond between things that had once been associated with each other. Thus, since the number thirteen had once been associated with the catastrophe of the Last Supper, anything to which it was subsequently applied would also attract to itself a doom of misfortune. Often the origins of charms and incantations are obscure or lost. Probably always the reasoning behind the procedure is as unconscious as are the rules of grammar to a person speaking a language. But when objectively viewed, the same principles are found at the core of magical practices the world over.

He who has knowledge of how to arrive at and set off the triggers—who knows the formulæ of incantations and rituals—is master of the power latent in the elaborate switchboard. Sometimes the means of energizing the channel are



Courtesy of the Museum of the American Indian

A MEDICINE LODGE CEREMONY

A witch doctor of the Black Coyote tribe performing a mystic rite for the benefit of his companions in Southern Cheyenne, Oklahoma



From "The Arunta," by Spencer-Gillan

Courtesy of Macmillan

AUSTRALIAN ARUNTA PREPARING FOR THE WITCHETTY GRUB CEREMONY

The members of the clan are decorated to imitate the appearance of the grub. The participants sit in a long narrow structure which represents the chrysalis, and sing about the grub in its various stages of development. Then they shuffle out, squatting on their haunches, and sing of the insect emerging from the chrysalis. The natives believe that this performance will multiply the actual number of grubs

simple and direct, such as the mere application of the number thirteen to an object. At other times, although more complex, they are at least common knowledge. The mass of magical lore which most commonly finds its way into literature is that which is generally known to the people at large in any given community. But often, and particularly when matters of importance are at stake, the procedure is intricate. The triggers are deep-hidden in the folds of esoteric lore and only the professional sorcerers—the witch doctors, medicine men, shamans, or whatever they may variously be called in various places, know how to reach them. As a result, especially among certain primitive people to whom the belief in witchcraft is a dominating factor of life, the professional sorcerer is probably the most important and powerful person in

the community, as well as the most highly respected authority on all matters.

There is probably no people among whom some phase of the magical complex may not be found, yet the forms which it takes differ widely in different places. It is often associated with the most matter-of-fact economic pursuits, so that however skillful a hunter or builder may be, his main concern, among many peoples, is with the magic he employs to bring about his results, and he attributes his success rather to his knowledge of charms than to his skill in hunting or building. Again it may relate to the most esoteric religious practices, as among the Todas of Ceylon, whose religion is centered on the tending of the sacred cow herds, and whose priests are constantly busied with the magical means of caring for the dairy temples. It is often involved with related

complexes, as for instance in Africa where divination and trial by ordeal are important functions of the witch-doctors. Its techniques vary from the hysterical states in which alone the Eskimo and Siberian shamans can make themselves effective, to the simple and direct charms for curing specific ills, which are passed over the garden fence in country villages.

And yet in spite of these multitudinous variations, the minute similarity in the details of magical practices in widely separated parts of the world is striking. A particularly good illustration lies in certain formulæ used to insure the growth of strong second teeth after the first teeth have fallen out. Thus, among the German peasants, a child will throw a cast tooth into a mouse's hole, saying at the same time "Mouse, mouse, give me your iron tooth; I will give you my bone one." Similar formulæ are followed for the Jewish children in Southern Russia, the children at Raratonga in the Pacific, on the Kei Islands southwest of New Guinea, and in Mexico. Among the Singhalese, it is to the squirrel that the tooth must go. The Cherokee Indian child addresses the beaver, and the Macedonian child throws his tooth on the roof for the crow.

Perhaps the most commonly known and the most widespread magical practice is that of working the desired end on an image or effigy, in order to bring about a similar result on the person him-

self. This is the clearest illustration of the principle of similarity or imitation—that between like and like there is a potential power. No catalog of the places in which it is found could come near being complete. It was known in ancient Egypt, Babylon, India, Greece, and Rome, and is practiced today in the Italian community in New York, among the Pennsylvania Dutch, among many European peasants, and by primitive peoples from sea to sea. It frequently explains the difficulty explorers have in photographing natives, for many savages feel that with so exact an image in his possession, the



From "The Arunta," by Spencer-Gillan

Courtesy of Macmillan

DRESSED FOR THE CEREMONY

This Australian Arunta, decorated with down and paint, is ready to take part in one of the imitative ceremonies for increasing the food supply

*American Museum photograph*

A PUEBLO DANCE TO BRING RAIN

The kachina dances of the arid Southwest are almost all directed toward the bringing of the rain so necessary for the corn crop. A feature of some of the dances is to throw sacred corn meal into the air, letting it scatter and drop in imitation of the rain

white man's power over their persons would be unlimited.

The Peruvian Indians, to kill an enemy, moulded an image of fat mixed with grain, and then burned the effigy on the road where the victim was to pass. They drew a fine distinction between the puppets made to kill a white man and those made to kill an Indian. For an Indian they used maize and the fat of a llama, but for Spaniards, who did not eat llamas and who disliked maize, the image was made of wheat and the fat of a pig. The aborigines of Victoria, Australia, drew on the ground rude likenesses of their enemies, and condemned them to destruction with cabalistic ceremonies. This incantation was so dreaded that persons who learned that it had been directed against them were often known to die of fright. A Malay desiring revenge repaired to a medicine man, who made an

image of his client's victim, and, muttering a spell, fastened it to a tree by driving a sharp point through the navel until the sap of the tree ran through the hole. The oozing sap was believed to be the life-spirit of the victim, who, it was supposed, directly began to suffer from a deadly ulcer which could only be cured if a friend secured a piece of wood from the tree to which the image was attached. When so extreme a revenge is not desired, many formulæ prescribe that the eye of the image may be pierced to render the victim blind, that the stomach may be pierced to make him ill, or the head to give him a headache.

Sometimes the effective similarity is between two actions. This is often true of many war dances, performed before going to battle. The Iroquois Indians pick out a rotten log to represent the enemy they are about to attack. This

they put in a hole in the ground, and, dancing about it and jeering, they hurl their lances into it, crying "Where is your power now? My lance is in you to the hilt." Their actions and their jeers insure a similar victory over the real enemy.

But imitative magic is not always employed for such cruel and gruesome ends. It is equally popular as an agent for realizing happier and more gracious desires.

The ancient Hindoos made use of the waxen image to obtain favors of love. With a bow of black ala wood strung with hemp and an arrow barbed with a thorn, the heart of the effigy was thorned, while incantations were recited.

Young Ojibway men and women carried about with them little images of the person whose love they wished to win. These were regularly pierced through the heart and magical powders were rubbed into the hole. A common practice of ancient witches was to melt a heart of wax in order that the heart of the loved one might also melt.

Ceremonies clearly based on the principle of imitative magic are often also resorted to, to increase the supply of food. Thus, among the Arunta of Central Australia, one of the clans is charged with the propagation of the witchetty-grub, an important food staple. This is accomplished by elaborate ceremonies in which such propagation is enacted in pantomime by members of the clan decorated in imitation of the appearance of the insect, in the belief that the number of grubs are thus multiplied and a plentiful harvest is assured.

Almost halfway around the world on the coast of British Columbia where the people are largely dependent on salmon for food, small fish forms are whittled out of wood in order that the salmon may propagate.

Numberless are the imitative devices

to secure success in hunting. The unsuccessful Cambodian hunter, in order to change his luck, strolls in the direction of his nets and, pretending that he does not see them, lets himself fall in, saying, "Hello, what's this? I'm afraid I'm caught."

A Malay, watching crocodile traps, must gulp down the first three mouthfuls of his curry, just as he desires the crocodile to swallow the bait. Accordingly, a friend must take out all the bones, lest the hunter find himself in the position of having to choose between swallowing a bone and losing a crocodile.

The imitative potency of a charm may lie in the meaning of the words. Thus a Malay hunter may use the following incantation to create in himself the power to face the dreaded tiger, and to strike fear into the heart of the beast:

"Oh Earth-Shaker, rumble and quake!

Let iron needles be my body-hairs,

Let copper needles be my body-hairs!

Let poisonous snakes be my beard,

A crocodile my tongue,

And a roaring tiger in the dimple of my chin.

Be my voice the trumpet of an elephant,

Yea, like unto the roar of the thunderbolt."

Sometimes magical lore prescribes certain precautions to avoid the inadvertent touching off of triggers which might bring about misfortune. Thus, in Siam, where the resinous gum exuded by certain insects is used for food, all workers must refrain from washing themselves or combing their hair during the harvest, for the gum-producing insects might become detached from the branches just as the parasites are removed from their bodies.

Even the actions of persons far away from the scene may by some fortuitous similarity influence the success of an exploit. While the Eskimo crews are at sea hunting whales or walrus, no work which necessitates pounding or hewing or any general commotion must be undertaken at home, because the game might be frightened away. Nor must the



Photographed by Morton Kahn

A PHANTOM BARRIER AT THE ENTRANCE TO A BUSH NEGRO VILLAGE

As the palm fronds brush the backs of the visitors, any evil motives they may have are wiped off. The approaches to all the Bush Negro villages of Dutch Guiana are protected in this manner

bedding be raised and shaken, for if it were, the ice would crack and drift off under the hunters' feet. The wife of an elephant hunter in Laos must not cut her hair nor oil her body while her husband is on the chase. Cutting her hair would cause the elephant to break his bonds, and oiling her body would render her husband "butter fingered," and the game would slip through his hands. The Gilyak of Siberia believe that if the children make drawings while the father is away from home, the paths of the forest will become as perplexed as the lines of the drawings, and he will most certainly be lost. When writing was introduced, the people were aghast at the thought of the dangers to which so complicated a form of drawing would expose the hunters in the woods.

The medicine man makes use of imitative magic as a cure for many ills. The following illustration from the Dyak of

Borneo could be duplicated from many parts of the world. The medicine man called in to a case of serious illness will pretend himself to be dead. He will be treated exactly like a corpse, wrapped in a shroud and laid outside on the ground. After about an hour, other medicine men will undo his bonds and bring him back to life. As he revives, the patient is supposed to recover too. A somewhat different application of the imitative principle is evident in the prescription of Marcellus of Bordeaux, court physician to Theodosius the First. In order to cure a tumor, take a root of vervain, cut it across, and fasten one end of it around the patient's neck, letting the other end hang in the smoke of a fire. As the root dries up in the smoke, so will the tumor also dry up and disappear. However, if the patient should afterward prove ungrateful to the physician and not pay the

required fees, it is only necessary to drop the root into water, and as it absorbs moisture and swells, so will the tumor return.

The second principle of magic, that of contiguity—that between things which have once been associated with each other there is a bond of potential power—is equally widespread and is often found combined with the principle of imitation. Thus nail parings, pieces of hair, drops of sweat, shreds of clothing, or remains of food belonging to the persons toward whom a spell is directed, are often important ingredients in the formula. It has been remarked by travelers that this belief is an effective agent for cleanliness, since people, fearing that an enemy may gain possession of something which has once been in contact with their persons, take scrupulous care to dispose of any offal which might open an opportunity to do them harm.

The details of the York murder reveal this principle behind the magical practices of the Pennsylvania Dutch. The defendants claimed that they had consulted another witch doctor as to how to rid the vicinity of the malignant sorcerer who had been bringing misfortune on his neighbors. The witch doctor had instructed them to obtain a lock of the man's hair so that a spell might be directed against him. When the defendants attempted to take

the lock, the "hexer" resisted, and it was in the ensuing struggle that he was killed.

Often it is not necessary that the object through which a charm may be made effective has so close a personal contact with the individual it is to effect. Implements once used by the victim may serve as well, or any object which he has touched. Footprints or impressions of his body on the ground may also be used. Even the length of the footprint is a factor in one Malay recipe.

An Ainu woman will attempt to get rid of her husband by wrapping up his



Photograph by Herbert Lang

AN AZANDI WITCH DOCTOR DIVINING WITH AN EGG

A common method of divination in the Congo is to press an egg between the knees. Whether or not the egg remains whole, is the point on which the outcome of the event in question is foretold. If an egg is held squarely from end to end, it is very difficult to break it

headdress in the shape of a corpse and burying it in the ground up-side-down, while she breathes a prayer that he may rot and die with the headdress. On the other hand, in the interests of domestic harmony, the natives of New Caledonia tie firmly together two spindle-shaped bundles made up of specified ingredients including threads from the woman's girdle and from the man's apron. The talisman is said to render the union of the spouses indissoluble. If, nevertheless, a domestic jar should occur, the husband fumigates the bundle, and sprinkles it with water from a prescribed source. He then performs certain rites and stirs the needle in the bundle, saying "I change the heart of this woman that she may love me." If this treatment is ineffective, he ties a sugar cane to the bundle and sends it to his wife through a third party. If she tastes of the sugar cane, she will feel her love for her husband revive.

The widespread notion that the treatment of a weapon affects the wound it has inflicted, is another expression of contiguous magic. In Melanesia, when a man has been wounded, his friends make every attempt to secure the arrow with which the injury was done. If they succeed, they wrap the weapon in damp leaves and deposit it in a cool place, that the wounded man may not become feverish. Meanwhile the enemies will be chewing irritating leaves or drinking hot and burning juices in order to inflame the wound. Or, if the enemies retain possession of the arrow, it is thrown in the fire so that the wound may burn as well. And occasionally they amuse themselves by twanging the bow-string in order to give the injured man a similar twinge of pain. This idea is not limited to primitive people, but is firmly believed in rural communities in parts of England. A conscientious groom will carefully grease each day the nail which has penetrated one of his horse's feet, in order that the

cut may heal quickly. A Suffolk farmer who had scratched himself with a thorn, on being told by the doctor that his hand was infected, exclaimed "That didn't ought to for I greased the bush well arter I pulled it out."

The question perpetually arises "Why do people continue to believe in the efficacy of these practices which must time and again and over countless ages have proved themselves utterly futile?"

There are in the first place several simple alibis which may account for the failure of a charm and keep faith in it alive. Perhaps some unfortunate slip was made in carrying out the ritual. Something may have been touched with the right hand instead of the left, a word in the incantation may have been mispronounced, or the steps of the procedure may have been taken in the wrong order. Often specific antidotes for charms are known, such as that of obtaining the wood of the tree to which the effigy is attached, in one of the Malay charms described; and the possibility that someone has pronounced an even more potent spell to counteract the first, is an ever appropriate alibi.

Moreover, there are the convincing cases when the end to which the magic is directed is in one way or another actually attained. Sometimes the ritual is accompanied by practical means of bringing about the same result. Again there are the cases in which the power of suggestion or fear may operate, as in Australia, where people may actually die of terror when they realize that certain spells have been directed against them. And often the time in which a given charm must take effect is not set, and a coincidence may validate the efficacy of the magic. Every observer of human nature will recognize how effectively such occasional successes serve to imbed belief. A black cat may cross the path of hundreds of people without any serious consequences.

But let the black cat once cross the path of a person who is subsequently run down and injured by an automobile, and the whole neighborhood will walk miles out of its way to avoid the haunts of the innocent grimalkin.

These factors, however, only serve to bolster up the belief, and to prevent it from slipping in the face of repeated failures of the sequence. But the belief itself is established in the first place because it is part and parcel of the education which is handed on from generation to generation. And this education recognizes as the highest authorities in the community the sorcerers, whose prestige in turn depends on their sanction of the fundamentals of magic.

The dependence on the best authorities at one's command is no special characteristic of a primitive or ignorant mind, for it would obviously be impossible for each man to test out for himself each fact which he is willing to accept. We all firmly believe that the stars are universes an incredible distance away. We believe it because the authorities on the subject, the astronomers, tell us so—or more likely because someone has told us that the astronomers say so. How many of us are familiar with the telescopic ap-

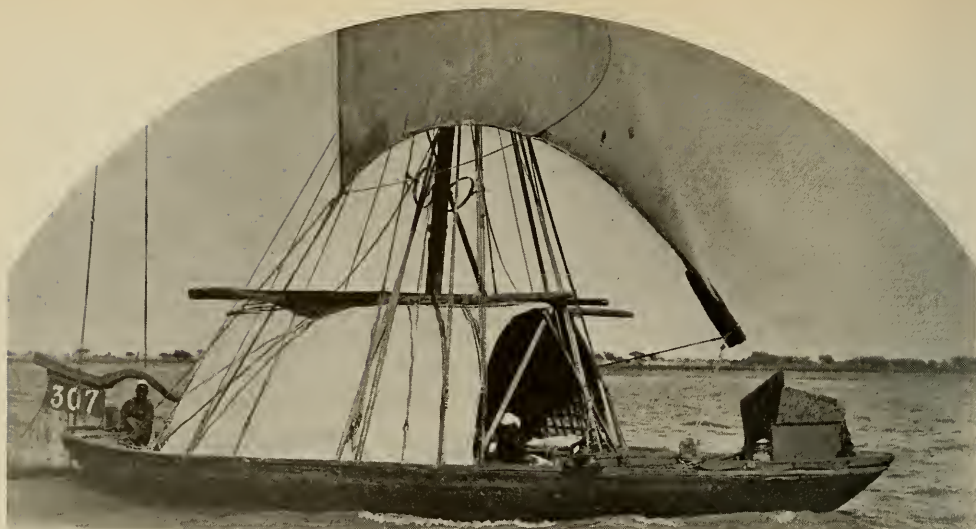
paratus and the mathematical calculations which are the only means of ascertaining that the stars are anything but needle-pricks of light in a dusky dome? Every careful and intelligent housewife is scrupulous about the use of disinfectants in her home, but has one in ten thousand of them ever observed at first hand the effect of such preparations on living bacteria, or even the effect of malignant bacteria on the human organism? They continue to act, as indeed they must, on the basis of what is sanctioned by the highest authority each one recognizes, whether that be a street-car advertisement or a publication of the Department of Agriculture.

So countless people from sea to sea, who have not followed the modern Twentieth Century mode of shifting their authority from the folk knowledge of the past and the medicine man, to fourth or fifth-hand reports on the controlled observations of science, still act on the belief that a mysterious and compelling power is latent in the bond between like things, or things which have once been in contact with each other, and that this force can be manipulated at will if one is possessed of the formula by means of which it is rendered active.



Courtesy of the Museum of the American Indian

In South America, where the perils of the teeming jungle are ever present, the resources of the witch doctor are in constant demand. Even sceptical white visitors have reported that these crafty and able practitioners can in some inexplicable manner accomplish what seem to be impossible things



One of the expedition "nuggers," a common type of Nile sailing craft

GLIMPSES ALONG THE WHITE NILE

An Account of One Phase of the Taylor-Sudan Expedition—Natives, Animals, Fish, and Birds South of Khartoum

By H. E. ANTHONY

Curator, Mammals of the World, American Museum

PHOTOGRAPHS BY IRVING K. TAYLOR AND H. E. ANTHONY

THE Taylor-Sudan Expedition of 1927 spent the months of January, February, and March, in collecting museum material along the White Nile and its tributaries from Khartoum south almost to the border of Uganda. During this time many species of mammals, birds, and fishes were taken, and the material and studies for two groups, white-eared kob and Nile lechwe, were secured. The resulting travel afforded a fairly representative cross section of the White Nile region and brought the expedition into contact with many interesting animals and primitive natives.¹

Mr. Irving K. Taylor, the sponsor of the expedition, held a charter for one of the Nile shooting steamers, to take effect about the middle of February, and we had arrived in Khartoum early in January. While waiting for the steamer, two

native sailing boats, known as "nuggers," were fitted out to serve as floating collecting stations, and we set out to work along the White Nile from the immediate vicinage of Khartoum southward as far as our time and slow-sailing schedule permitted. By thus working the stretches of river near Khartoum we could pass them without any stops, once we had taken over the shooting steamer.

Fortunately for the Nile sailing craft, the prevailing wind during a large part of the year is from the north. This wind will sail boats south against the descending waters of the Nile, and when one wants to turn about and come north, the sailing boat can either drift down with the current or wait for a tow from the post-boat or other passing steamboat. The nugger cannot sail into the wind or even approximately into that quarter. Where the Nile makes a bend and the wind ceases to come from astern, the

¹See "With the 'Fuzzies' after Ibex," *NATURAL HISTORY*, Vol. 27, pp. 601-614.

nugger proceeds at a snail's pace and all hands take to poling, the Arabs keeping up the continuous chant which seems to be necessary to all Arabic labor.

We tied up along either bank of the Nile, according to the collecting conditions, and spent most of our time at this stage of the expedition building up a representative series of bird skins. Small mammals were trapped wherever it was possible to set out a line of traps, but continuous shifting of position interfered with this phase of activity.

The sand-bars and banks (wherever they were open and not covered with dense stands of rushes and grass) teemed with water fowl. Great flocks of cranes were almost constantly in sight, either looming up above the mud flats like detachments of infantry or strung out across the sky in long flying columns, with trumpets sounding to keep the order and marshal laggards into line. The clarion

call of the crane carries for miles, and a flock might be heard while yet so distant as to be all but invisible. Many varieties of ducks were encountered, some of them species that are resident and nest along the Nile, others that are migrants from Europe and Asia and merely spend the winter in the Sudan. One of the commonest of the ducks is the whistling teal, a small duck with an even smaller whistle, a weak "little-bird" sound that floats down from a passing flock as one of the most characteristic bird sounds of the White Nile. Geese of several species, storks in variety, kites in abundance, and a host of other birds such as ibis, herons, terns, sandpipers, hawks, et cetera, made up an assemblage that was always a numerous and, at times, a vast congregation of feathered life. Back from the river bank, in the areas of sparse, thorny scrub, or in the occasional regions of low forest, the land birds



A GALA OCCASION

A newly appointed governor was expected to make his first call at Jebelein and the natives of the region had gathered to welcome him. An abundance of red and white bunting draped tall poles and the booth that commanded the landing from the steamer



MOHAMMED SULEIMAN, MR. ANTHONY'S
SHIKARI

In the Sudan the shikaris are registered by the British officials, and at the conclusion of the trip must secure a satisfactory recommendation from each party they guide

always presented interesting features. Guinea fowl flew up with terrific clamorous din when the hunter walked into a flock; long-tailed, glossy starlings shone in the bright sunlight with a metallic luster; and the bright-colored bee-eaters gleamed against the blue sky as spots of green or rosy red. From the trees along the river, or over the numerous khors or backwaters, we often started flocks of black ibis that announced their alarm and displeasure in raucous outbursts of what sounded like grating laughter.

While on the nuggers, we did not sail far enough to the south actually to enter the big game country, although we reached the northern limit of it. At Akona, one evening, we almost heard a lion. A distant, rumbling roar seemed to be possible of only one interpretation, and I set down in my notes of that day that I had heard my first wild lion. Mr.

Taylor was dubious but could not satisfactorily explain the noise otherwise. The next day we heard the lion again, in the forenoon, and the animal was apparently closer. Investigation disclosed that our Arab captain, or "reis," was asleep between decks and snoring. This rather weakened my confidence in the journal entry of the day before. However, we did hear bona-fide lions at that place several nights in succession, and I shall always believe that the first night we were serenaded by Leo and not by the reis smuggled off for a cat-nap under the deck.

Although we hunted for lion at this place, found fresh tracks, and lions were seen twice by natives while we were tied up to the bank of Akona, we were not fortunate enough to see one. Later, along the Bahr-el-Ghazal, at a place where we had hunted on two occasions, a



THE SHOEBILL STORK

This large bird, (*Balæniceps rex*), known also as the whale-headed stork, feeds on small fish which it catches by standing quietly in shallow water until a fish swims by



THE "BEATRICE," A SHALLOW-DRAFT RIVER STEAMER

Because of the high superstructure, these boats always have one or more barges lashed alongside, both to prevent the wind from capsizing the steamer, and to afford additional deck space for the wood which is used for fuel

few days prior to the incident, and again but two or three days afterward, the unfortunate Count Hunyadi encountered a lion and was fatally mauled. He wounded the lion, followed it into the tall grass, evidently in the belief that the animal was helpless, and unexpectedly walked on to it. The lion was upon him before he could shoot, and bit both the Count and his shikari severely. The native recovered but the Count died of blood poisoning before the steamer could reach Khar-toum on its hurried return.

At Akonā we had our first glimpses of Shilluks, a tribe of tall negroes who live along the Nile and hunt and fish for a living. The Shilluks are fine physical specimens, many of them well over six feet tall. They are frequently to be seen spearing fish from canoes or rafts of ambash, a very light, porous wood. The water of the White Nile is so loaded with sediment that one can seldom see fish in it. It is possible to see the swirl made by the fish, but not the outline of the fish

itself. The Shilluk drives his spear at random into the water, patiently throwing again and again and apparently not discouraged by the many times that his spear strikes nothing. By fishing along the edges of the reeds and in the likely places, the natives secure many fish, however, by this haphazard method.

Throughout most of the river system fish abound. We were collecting specimens for the American Museum and detailed a native to cast a net at each place we tied up. Another native set out hand lines, and between these two methods we had the pick of hundreds of fish. Some of the Nile fish are remarkable for their size or structure. The Nile perch attains a weight of more than two hundred pounds and is much sought for by fishermen. A species of catfish is equipped to deliver a severe electrical shock to any animal that grasps it, and one caught on a line provided us with a unique sensation when we tried to lift it out of the pail. If grasped so that the fingers touched the

fish on the right and left sides simultaneously, the shock was quite enough to make one drop the catfish immediately. A lung-fish, found in the backwaters from the Nile, buries itself in the mud when the sloughs dry up, and, by means of functional lungs, is able to live out of water for weeks at a stretch.

Most of the terrain along the Nile is monotonously flat, but at long intervals there are detached rocky hills or "jebels." We spent several days at one such rocky outcrop located at Jebelein. Here we found animal life different from that we had been seeing on the plains. The rocks are the home of the rock hyraxes or conies, thickset, tailless animals with bodies about as large as a plump house cat. The hyrax belongs to an order by himself, not very closely related to the other orders of living mammals, and related in some characters to the proboscideans. This animal is mentioned several times in the Bible, and one passage, Proverbs 30:26,

states that "the conies are but a feeble folk, yet make they their houses in the rocks." There were leopards about the rocks, but we had no success in our search for them. The only leopard bagged by the expedition was one shot on the train at Atbara when it broke loose from a shipment of live animals being sent out to the United States from the Zoo at Khartoum. While the situation contained great possibilities in the way of excitement—there were many people about and this leopard was noted for a bad disposition—the animal was killed before it had any chance to make trouble.

At Jebelein, and later at Mongalla, I tried hunting at night with a headlight. The light "shines" the eyes of mammals and the method is remarkably successful as a means of securing museum specimens. In the United States it is known as "jack-lighting" and is forbidden by law, not only because it is dangerous to hunt this way about dwellings and where there



THE TOMB OF MAHDI

This shrine, second only to Mecca for the faithful Mohammedan, was built by the Khalifa Abdullahi upon the death of the Mahdi or "Deliverer." It was almost demolished by the artillery of Kitchener's forces when they took Khartoum in 1898 and overthrew the Dervish empire



THE HOME OF CONEYS, GENETS, AND LEOPARDS

Because the prevailing topography is flat, the hills at Jebelein are landmarks for a considerable distance, and loom up out of all proportion to their meager elevation

is domestic stock, but because it is a deadly method when employed against deer. By means of the light, a museum collector can often secure specimens which he would not otherwise obtain, and in remote regions there is no risk involved except to the hunter himself, as for example, should he encounter a lion or a leopard. "Jacking" occasioned no little amusement to my native assistants and gun-bearers. Unable to see anything at a distance themselves because the light reflected by the animal's eye is visible only in the direct line of the light, they could not understand how I was able to fire apparently at random and bag a hare, a nightjar, or a genet, when all to them was utter darkness. Such a performance seemed so uncanny that it gave the natives great confidence in what the white man could do. This confidence was rather rudely shattered, in the case of Ali, the bird-skinner, one night at Jebelein, when I wounded a genet in the rocks

and he rushed in to retrieve the fierce little carnivore. In the excitement of the moment he seized the genet with his bare hand about one-thousandth of a second before the genet seized him and began going over his hand to find a spot that really suited. We got the specimen.

On the seventeenth of February we took over the "Beatrice," the shooting steamer, and made as direct a run as possible for the big game fields, stopping only to take on firewood and to pick up our shikaris and gun-bearers en route. After entering Lake No, we began to devote most of our time to the larger mammals, the bird work being incidental. Along the Bahr-el-Ghazal we encountered large bands of white-eared kob and numerous waterbuck. Our program was to steam up the narrow river, with several of our keen-eyed natives on top of the engine house on the lookout for game. We watched also, except when at meals, but throughout the daylight hours one



DWELLERS ON THE WHITE NILE

Shilluks, one of the most picturesque of the Nilotic tribes, are tall negroes who lead a care-free existence hunting and fishing

or more of our six shikaris and gun-bearers were always looking out over the plains. Whenever something desirable was sighted, the "Beatrice" was pulled over to the bank, and a hunting party went ashore. At certain localities known to be good hunting ground, the steamer was laid up for several days at a stretch.

We passed almost a constant procession of animal life. In the river itself we saw hippopotami daily; often, for long stretches, we would not be out of sight of one or more of these huge "river-horses." Crocodiles are plentiful in the Nile, but we saw comparatively few, because the river was high and there were not many sand-bars or bare banks on to which they could pull out. Back from either bank of the river the game herds varied from bands of elephants, giraffes, buffaloes, or antelopes, down to solitary gazelles or reedbucks. One assemblage of giraffes was scattered along the north bank of the

Bahr-el-Ghazal for at least three miles, a great herd that dominated the landscape because the necks of the animals were taller than the scrub forest and their heads came up above the tree tops. The giraffe is an animated observation tower and it is well-nigh impossible to stalk one, under ordinary circumstances, because of the commanding position its eyes have above everything about it. As well try to hide from a bird!

When the steamer was tied up to the bank, care had to be taken that no gang planks made contact with the shore overnight. On the one occasion when a plank thus spanned the water from the deck to the earth, myriads of fierce ants swarmed aboard. We had six donkeys stabled on the barge that was lashed alongside the "Beatrice," and the barge had an iron deck. Toward morning we heard a constant stamping from the donkey quarters and wondered if the



A NUER WARRIOR

The Nuers are war-like people, and in times not so far distant raided their neighbors, the Shilluks and Dinkas, for slaves

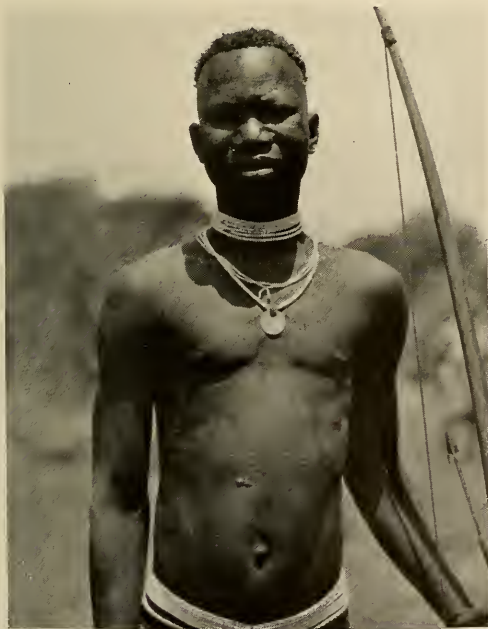
mosquitoes were disturbing them. With daylight we found the barge acrawl with ants which were concentrated in force about the carcass of an antelope that had come aboard too late to be skinned the day before. Along one side of the antelope most of the hair had been cut off as with a razor. As the ants had increased in number, scouting columns left the antelope in the center of the barge and explored for other plunder, attacking the donkeys and routing out the natives sleeping on the barge deck. For some time the crew was busy sweeping ants off into the river and driving the raiders out of the corners with hot water.

In most years the waters of the Nile recede with the passage of the rainy season, and as the dry season advances, the falling rivers drain off all of the bayous and back-waters. The grass along the river banks and for great distances inland becomes dry and yellow.



ACTORS IN A MIMIC LION HUNT

At Wad Akona a small band of Shilluks staged a mimic lion hunt. The negroes acted out this dance with intense enthusiasm



A DINKA HUNTER

The Dinkas scarify themselves on the head and body with conspicuous welts arranged in patterns which undoubtedly have tribal significance

The natives set fire to the dead grass in order to clear the ground for the new grass. After the grass has been fired, the plains are so devoid of cover, in many regions, that it is possible to see game for great distances. During the early part of 1927, the Nile failed to recede as usual. The height of the river remained almost at the level of the rainy season and the papyrus and grass stayed green, too damp to be burned off. The burned-over areas were small and scattered, and game might be very abundant and yet be hidden in the rank growth of grass and rushes. The Sudd was scarcely touched by fire, and here the papyrus grew to a height of ten or twelve feet, or even more in some places. Bands of elephants were completely concealed by these giant rushes and we were made aware of their presence only by the movements of the white cow-herons that continually fly up about herds of elephants, and by an occa-



A FIRE IN THE SUDD

Although the situation seems fraught with great possibilities for destruction, apparently all the papyrus of a given area does not dry at the same time, and the fires burn themselves out without doing any great damage. The herds of game move ahead of the blaze and are seldom trapped by fire

sional trunk that writhed up out of the green ocean, like a great snake rearing its head. On rare occasions we saw elephants in more open localities and had good opportunities to observe them. One such herd contained from fifty to seventy-five individuals.

Just south of Mongalla, near the Lado, we made our southernmost stop, and after some interesting experiences at this place, Khor Suleiman, the "Beatrice" was headed north for the return to Khar-toum. At Khor Suleiman and at Sim

Sima, a short distance down the river, we had our most exciting moments of the expedition, with buffalo. The African buffalo is an uncertain beast and although he never is wantonly aggressive, when man has crowded him too far, he is ready and eager to make trouble.

At Sim Sima Mr. Taylor and I had stalked a small band of seven or eight buffalo. We were in close and each shot at an animal. One buffalo fell after running but a short distance, the other left the spot with the herd. Mr. Taylor

A NUER VILLAGE DWELLING

The Nuers are rather more warlike than the Dinkas and Shilluks and frequently make trouble for the British who organize punitive expeditions to chastise the particular group of natives that cause the trouble. The expedition visited a Nuer village at the mouth of the Bahr-el-Arab



SEEN FROM THE
DECK OF THE
"BEATRICE"

Occasionally it was possible to secure photographs of elephants seen in the more open spots in the Sudd. It would have been useless to attempt photographs of them from the ground since they had but to take a few steps to be lost in the green ocean of papyrus



started to follow the wounded animal, while I, with my shikari and gun-bearers, turned aside to see what had happened to my buffalo, off to the left in brush and high grass. I glanced back at the other party once more, before giving my complete attention to my own errand, and was appalled to see one of Taylor's shikaris running for his life just ahead of a charging buffalo, and bringing the animal right back through Taylor's party. I could not shoot at that moment for the men were scattering like a covey of quail

between me and the charge, and I was as likely to hit one of them as the buffalo. Taylor's gun was with his gun-bearer and it was every man for himself. The native and the buffalo disappeared beyond a screen of thorn and scrub and I waited for them to emerge. I never saw that buffalo again.

The buffalo had caught the native, but missed the man with its horns and merely pitched him head foremost into the bushes. Apparently satisfied with this, the animal swerved aside into near-by cover and



HUTS OF THE
DINKAS

These huts are crude structures made of poles and thatched with long grass. Dinka villages are scattered along the Nile, but none encountered by the expedition were very large. The Dinkas own large herds of cattle, and during the day the men of the village are out attending them



A NILE PERCH

This 45-pound Nile perch (*Lates niloticus*), taken on a rod and line at Lake No, was but a small individual compared with full grown ones which sometimes reach a weight of 200 pounds

went off to seek seclusion. The shikari, aside from a great bruise where he was struck and sundry cuts and scratches where he landed, was not seriously injured. He was singularly fortunate, for the odds were greatly against his coming out of the episode alive. He told us, afterward, that the buffalo was standing back of a bush waiting for the hunter to follow the track in and had taken this early opportunity to retaliate.

By the time we returned to Khartoum, March thirtieth, we had enriched the Museum collections by a series of practically all of the big game of the White Nile region. We had seen no lions or leopards, and had made no attempt to

take specimens of the elephant, giraffe, and hippopotamus, but with these exceptions the Museum had secured, thanks to the generosity of Mr. Taylor, a very good representation of the Sudan mammals as well as the birds and fishes of the White Nile. Two groups, the white-eared kob and the Nile lechwe, are now being mounted at the Museum

from the material secured on this trip. The study specimens will be preserved in the various departments as permanent records of the Sudan fauna, and will afford invaluable data on the many problems of geographic distribution, specific and individual variation, and the various biological aspects which deal with the interesting life of Africa.



ISA, MR. TAYLOR'S SHIKARI, IS A TALL ARAB OF FINE PRESENCE



Photographed by F. E. Lutz

In the Brownsville region of Texas, the great western desert meets the moisture-laden winds of the Gulf

HONEY WASPS

The "Mexican Bees," Which Enter the United States at Brownville, Texas, Are not Bees at all, Although They Have a Bee-like Ability to Gather and Store Honey

By HERBERT F. SCHWARZ

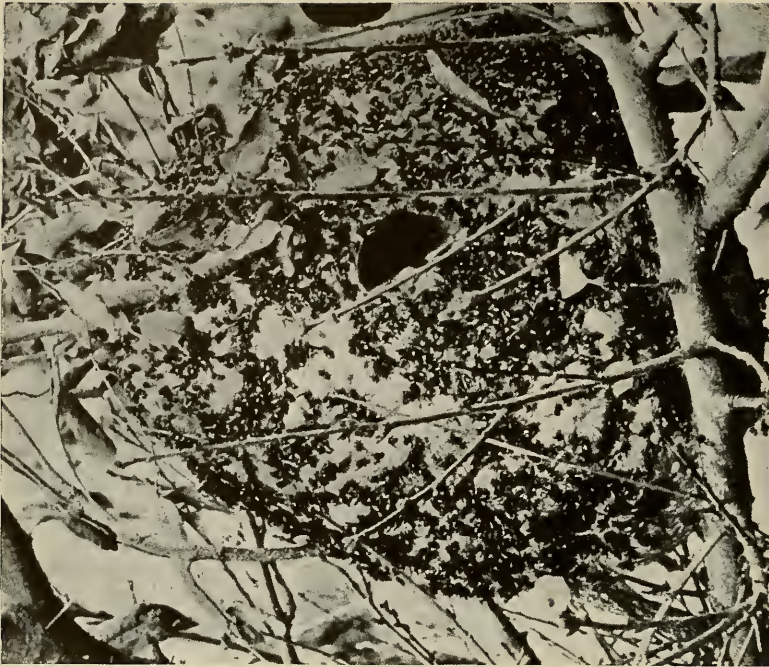
Research Associate in Hymenoptera, American Museum

WHY not make a field trip to Brownsville, Texas, this winter?" The prospect of entering the land of sunshine where December seems May was altogether too alluring to resist. Accordingly I set out from New York on a rather unseasonably mild afternoon shortly after Christmas to join Dr. Frank E. Lutz, who had suggested the trip, in New Orleans and to proceed with him thence to our destination on the Rio Grande. I had been assured at the Pennsylvania Station that the train I was boarding was headed south but, as the day went by, I had difficulty convincing myself that I was not making for the boreal regions. Each hour it became colder and colder. The "sunny" South was wrapped in clouds and the farther south the train sped, the less promising conditions seemed to be. By the time I reached New Orleans my teeth were chattering. Some twenty hours later Doctor Lutz and I rode into Brownsville on the crest of a "norther."

We had chosen to come to the region at

one of those rare periods when the local thermometer was near its low limit. But the warm hospitality of those at Brownsville did much to take the chill off the unusual weather. (At Brownsville, natives tell you, there are only two kinds of weather; fine weather and *unusual* weather.) With especial gratitude we remember the government taxonomist, Mr. Foster H. Benjamin, who placed his time at our disposal, taking us in his automobile to localities we could not otherwise readily have reached and with Mrs. Benjamin entertaining us in their home.

At first collecting was rather thin. Wind and cold and clouds kept the insects from emerging. We hunted about in thickets adjoining the old Mexican *resacas*, breaking up decayed logs to uncover possible denizens, examining leaves and bark and crevices for insects that might have taken refuge there. For several days low temperatures and sullen skies prevailed, but in the end we almost blessed the persistence of the cold, for



Photographed by L. Diquet

WASPS ON THE
ROOF OF THEIR
DWELLING

Viewed from the outside, the paper nest of the honey-makers looks somewhat like that of one of our northern yellow jackets. Within, the architecture is very different. Instead of a series of horizontal combs that hang chandelier-like one below the other with pillar-like supports between, the nest of *Nectarina* consists of more or less spherical combs that are attached directly or indirectly to the envelope.

when the thermometer finally did rise and the sky cleared, it was as though the old fairy tale of the Sleeping Beauty had come true, with such abundant virility did dormant nature awaken after being under the spell of the cold.

The first feeble rays that struggled through the clouds had scarcely attracted our attention before the venturesome advance guard of the flower-visitors made its appearance. The flowers were so few that rather than risk breaking them by swinging the net and so destroy the lure, it seemed advisable to pick off the insects one by one with the narrow-throated killing bottle.

In succeeding days numerous flowers began to bloom, and the only limit then to the catch of bees and other flower-frequenting insects was our diffidence to take beyond a reasonable number the duplicate specimens that offered themselves. Unusually abundant were females of *Augochlora azteca*, an Halictid bee originally described from Mexico. With their metallic green thorax appearing like

a knightly cuirass, and the shimmering segments of their brassy abdomen resembling jointed armor, they suggested Amazons of the insect world engaged in a foray on the floral granaries.

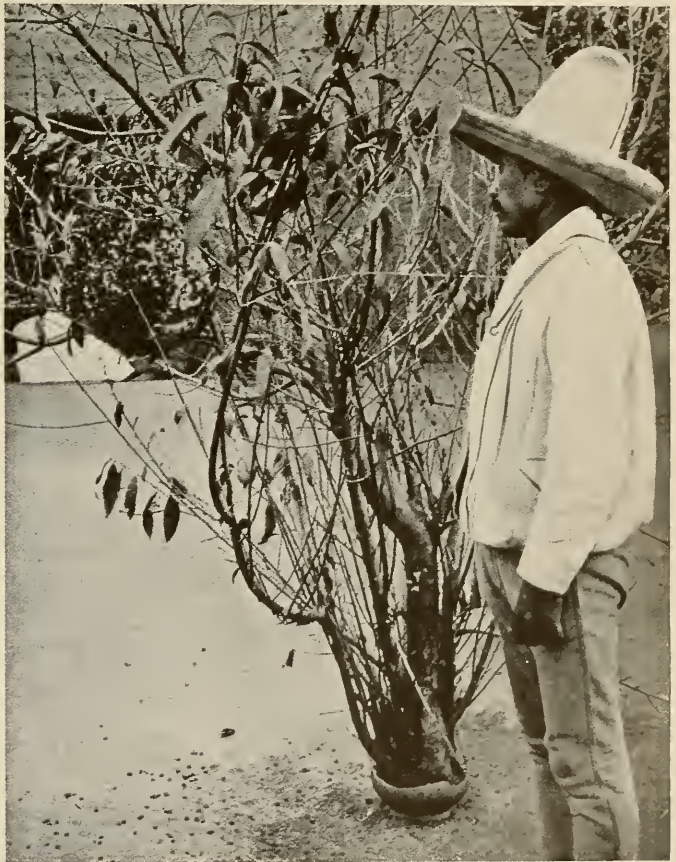
An interesting circumstance connected with the catch of bees was the disproportion in the number of individuals collected. Thus out of a total of 370 specimens all but 13 were members of one family, the Halictidæ. Halictid bees share with bumble bees the distinction of being among the earliest fliers in the spring, and one is tempted to conclude that their large representation in the January fauna of Brownsville indicates that January in that region corresponds to say early May of the latitude of New York.

In the course of our sojourn we had heard frequent mention made of an insect that lives in colonies and produces honey. It was generally referred to by our informers as the "Mexican bee" because of the partiality of the Mexicans for the honey it produces. Some people told us that the insect did not sting, and this

aroused our curiosity more than ever. We asked ourselves: could it be that on American soil and in a region that is generally classed as desert, there flourished colonies of the stingless honey bees of the tropics, the *Meliponidæ*, generally associated with the hot moist regions? The words bee, honey, stingless, taken in association, all seemed to point to such a possibility. On the other hand, there were elements of doubt. Most people implied that the nests were of paper and this suggested the work of wasps rather than of bees. Also there were those who maintained that the insects were mild in their behavior rather than stingless, and that now and then at rare intervals individuals had been stung. These reports, so contradictory, needed verification, and so, when we were told that a nest of this type was located on a not distant plantation and that we might have it for the gathering, we gladly availed ourselves of the offer.

After an hour or two of travel by motor we reached our destination. There were four in our party, but there were many more people awaiting us in the home of the planter. I suspect he had "tipped off" his neighbors that there were some "fool fellows" from New York who had come to give them an afternoon's entertainment free of charge. At any rate, everyone came along with great alacrity to see the

show. Even the dogs insisted on joining the party. And so we set off as though to tree a racoon instead of to gather a hornets' nest, for a hornets' nest that object in a low ebony tree surely seemed to be. It was well surrounded by branches and foliage that had to be cut away, but even these did not conceal the nest, and a black mantle of wasps was plainly visible over one entire side of it. Every time a branch was snipped with the shears and the nest thus shaken lightly, an angry hum arose from these congregated hosts. It sounded very menacing, but instead of turning upon the intruders,



Photographed by L. Diquet

A MEXICAN AND HIS HONEY SUPPLY

The honey bee is a denizen of the Old World and was unknown in the Americas until the European colonists introduced it. On the other hand, honey of the wasp *Nectarina* was probably relished by the pre-Columbian Indians as it is by the Mexicans of today

those of the wasps—for wasps they were—that roused themselves to flight, mostly flew away from rather than toward us. They well justified their reputation for unaggressiveness, and some of us even began to think that perhaps they were really stingless.

Doctor Lutz—conscientious scientist that he is—refused to have this point remain in doubt and to silence local sceptics forever after, he seized two of them—I mean the wasps, not the sceptics—and started to anger them. Hardly had he given them a rude jolt with his thumb when they retaliated with a rapier thrust that was thoroughly convincing—to Doctor Lutz at least. His audience did not feel the pain and so withheld judgment. At any rate, he seemed to think it necessary, in order to produce conviction, to extend his hand among the group of spectators and to tilt it so that every eye could see where the wasps had imbedded their sting. Then, feeling that he had made his point clear enough to win over the most confirmed doubter, he flicked the insects off and away they flew. But not all that there was of them took wing. The stings, like discharged weapons, were left on the field of battle. This is of rather curious interest, for it recalls the similar phenomenon in the case of our honey bee, which likewise loses its sting and, it is said, its life, in sheathing its weapon in its victim. The after-effects of the sting in Doctor Lutz's case were rather severe. Although he was stung in the hand, the pain extended up the entire length of his arm and was, in fact, most severe in his arm-pit.

After the nest was completely severed from the tree, it was dropped into a large sack, and over this sack was fitted another from above so that the imprisoned wasps could not make their escape. Then a suitable box was secured and the nest was expedited to the American Museum labeled "Handle with care!" You may

be picturing to yourself the consternation of those at the receiving end as, in ignorance of the contents of the box, they started boldly to pry it open and heard the angry hum within, making them pause to hold a council of war before proceeding with their storming operations. But your mental picture has no basis in fact, for the instructions *handle with care*, like all similar notices, were given for the protection of the cargo, not to safeguard the recipients. They had already been safeguarded—if safeguard was needed—by a message sent in advance of the shipmen; and on reaching the Museum the sack was exposed to the deadly cyanide before the nest was withdrawn.

A few days after taking the first nest we learned that there was yet another nest to be had for the gathering and, as we wished to have an opportunity to study the contents and structure, this nest proved a welcome supplement to the one taken for exhibition purposes. It was obtained without adventure—that is, no one was stung—and after the wasps inhabiting it had been killed, it was opened up for study. It is of some interest to note that neither larvæ nor honey were found, yet there was a strong smell of honey in the nest and chemical analysis of the empty cells would undoubtedly have revealed traces of it. We came to the conclusion that possibly this nest represented the winter stage of the colony just before the resumption of spring activities, and that as a result the cupboard was bare. Some days later I caught other wasps of this species visiting flowers, and it is likely that these were engaged in provisioning their nest. The number of insects in the nest we examined reached, by count, the impressive total of 15,000, and in this figure could not, of course, be included the insects that made their escape before the nest was detached from the tree. In this large total there was no insect structurally differentiated as a

queen, for the very good reason that these wasps, in distinction to certain other social Hymenoptera, have the egg-laying functions of the colony distributed among many individuals that are not distinct from the workers in external structure although of slightly greater size and more telescoped abdomen.

Males were present, possibly in the proportion of 1 to 15 of the population. It has been stated that "males always make their appearance in the second half of the more propitious season, that is to say at a time when flowers are most abundant and the

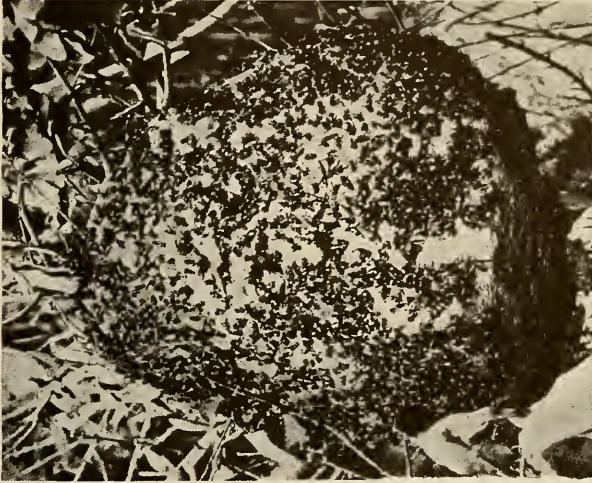
population is very numerous." Certainly there were no evidences of race suicide in the nest of which we took a census, but recent memories of the inclement weather and the scant flora made the second half of the quoted passage seem inapplicable.

These wasps bear the rather savory generic name *Nectarina*. The name of the species, *lecheguana*, has a less pleasing cadence, but it is significant of the wide range of this insect, being the name given it by the Indians of Brazil. In Mexico, where *Nectarina lecheguana* is well represented, the honey, according to du Buysson, is sold in the markets. It is sometimes poisonous, depending on the plants from which it is gathered—a statement which holds true also in the case of the honey of some of the Meliponid bees of the tropics. Especially is this true in

times of drought when *Daturas* are the only plants that furnish alimentation to the visiting wasps. The honey is gathered usually in December. If the base of the nest is left on the branch to which it is attached, it is said the wasps will begin their construction on the same spot and

that, as the population of the hive is large, reconstruction is rapid. Nests are of variable size, ranging from 18 by 20 centimeters to 41 by 52 centimeters.

Nectarina lecheguana, it is stated, withstands in Mexico frosts of severity, and certainly the Brownsville representa-



Photographed by L. Digue

A THRIVING COLONY

Unlike the colonies of our yellow jackets, which dissolve with the approach of cold weather, colonies of these honey wasps occupy their nests perennially

tatives of the species survived in impressive numbers the icy weather that was a test of their powers of resistance. Nevertheless, prolonged cold would probably be fatal. It is rather significant that the northern limit of these wasps seems to be the Brownsville region. A colony transplanted to Hamilton, Illinois, was unable to survive the winter. In northern Argentina, when frosts occur during the cold months of June and July, the *Nectarina* wasps, according to E.-R. Wagner, secrete themselves head foremost in the cells with only the tip of the abdomen projecting.

Although the insect was well known in the Brownsville region, it is of interest that its presence there was reported in scientific literature only as recently as 1922. This may serve to indicate how

many chapters still remain to be written before a well-rounded picture of our American wasps and bees can be obtained. Of other Hymenoptera that we took in the region, two at least—*Augochlora nigrocyanea* and *Colletes punctipennis*—had hitherto been known, so far as I have been able to ascertain, only from south of the Rio Grande. The specific name of the latter indicates a condition of the wing exceedingly rare among bees. Most of these insects have wings that are more or less uniformly clear or dusky, but in *punctipennis* the wing has a distinct pattern due to distributed spots of deeper color.

Our week to ten days at Brownsville came all too swiftly to a close and again we were compelled to turn northward. We were glad to have visited the region when we did. In the first place, it gave us the chance to witness the swift recuperation of nature after an unusual spell of cold, and in the second place we felt that, with the rapid settlement of the region,

even a matter of months might witness transformations not much less marked than those which are eternally going on in our own city of unrest. Instead of a quiet little desert town, such as I had pictured to myself, we found Brownsville a thriving community, with every modern convenience, streets abustle with passing automobiles, electric bells regulating the counter movements of traffic, and real estate signs along the faultlessly paved automobile roads offering this unredeemed field and that for cultivation. It is not hard to visualize what is bound to happen under such circumstances.

The region will still continue verdant and attractive, but it will be with the blossom of citrus growth and of other market products, and less and less with the wild bloom of the cactus, the huisache, and the Mexican mahogany. Let us hope that amid all the changes *Nectarina* and other representative groups of wild life may succeed in surviving, even if in diminished numbers!



Photographed by F. E. Lutz

A PALM GROVE NEAR BROWNSVILLE

The Rio Grande, muddy as the "tawny Tiber" itself, once bore the name of Rio de las Palmas thanks to the presence of these trees as it approaches the Gulf



Photograph by Huberti, Rio de Janeiro

A view from the summit of Itatiaya

ITATIAYA BRAZIL'S MOST FAMOUS MOUNTAIN

A Landmark of Southeastern Brazil Which Was One of the First Notable Peaks in that Country to Attract the Attention of Geographers. A Spot That Has Long Been Recognized as an Ideal Locality for Research in Geology, Botany, and Zoölogy

By ERNEST G. HOLT

Carnegie Museum, Pittsburgh

ILLUSTRATED WITH PHOTOGRAPHS BY THE AUTHOR

AWAY back, in time so remote that geologists are loath to venture its calculation—æons before the birth of the Andes—there emerged from the waters of the South Atlantic a mighty chain of mountains.

Age succeeded age, and torrential rains, sweeping back to the ocean vast quantities of material from the precipitous slopes, left stark and naked great masses of ancient rocks.

Then another cataclysm shook the land. Right through the middle of the range a fiery finger of rock thrust itself upward until it towered well above the very highest of the old peaks.

This new peak, born of fire, then cooled

and splintered. Relentless rains through other ages cut deep flutings into its sides, and trickled into every crevice. Recurrent seasons brought alternate heat and cold. And after the passing of still more ages, men—brown men—appeared, and, gazing in awe upon the majestic, shattered crags, called them in poetic fancy, Itatiaya—which means in their Tupi tongue, Multiplying Rock.

Time, moving more swiftly now, brought white men to this peaceful land, and they, after the manner of white men, were searching for gold. But Itatiaya held none and they passed it by. Hence, because it had no riches to offer, Itatiaya remained in obscurity until 1856. Today,



THE "HIGHEST HOUSE" IN BRAZIL

The government meteorological observer lives here the year around, high on the side of Itatiaya. The name of the mountain, translated from the Tupi Indian language, means "Multiplying Rock"

though France boast of Mont Blanc, the United States point complacently to Mount McKinley, or Argentina wax self-conscious over Aconcagua, for the true sons of Brazil the first mountain in all the world is their own Itatiaya.

The mountain rises at about $22^{\circ} 24' S.$, $44^{\circ} 50' W.$, in southeastern Brazil near the point where the states of Minas Geraes, Rio de Janeiro, and São Paulo meet, and is the principal peak of the Serra da Mantiqueira. Because of its situation midway between the two largest cities of the country, it was one of the first notable mountains of Brazil to attract the attention of the geographer, and for many years its altitude has been the subject of speculation. In the reign of the benevolent Dom Pedro II, a railway was constructed to link the capital with São Paulo, Brazil's second city, and this line, skirting the foot of Itatiaya and rendering the mountain really accessible, naturally lent impetus to this speculation. Pages upon pages were printed, giving various estimates and calculations of its height, but until 1911

no one had ever succeeded in scaling the last towering crags. And notwithstanding that the railway at its foot offered a base line of known elevation, it was not until 1922, ten years after Itatiaya's supremacy had been challenged by the Pico da Bandeira, of the Serra do Caparaó—and much newsprint had been expended in a bitter controversy—that any real effort was made toward a scientifically exact measurement of the height of the mountain. In that year, Dr. Adolpho Odebrecht, a government engineer, ran lines of levels up the two rival peaks and definitely relegated Itatiaya, with its 2790 meters of altitude, to second place by more than 200 feet. Nevertheless, Itatiaya remains supreme in the hearts of the people—a position to which it is justly entitled by reason of its superior grandeur and scenic beauty.

Such a mountain, rising well above all of its fellows at a point where the three greatest orographic systems of eastern South America—the Serras do Mar, da Mantiqueira, and do Espinhaço—closely

approach one another, has long been recognized by scientists as an ideal *locus* for research, and the region has been visited by many illustrious workers in geology, botany, and zoölogy. In these investigations the avifauna was not altogether neglected, yet so meager was the knowledge of the bird-life, and so great its potentialities, that the American Museum charged me in 1921 with an ornithological survey of the mountain.¹

It was early on a December morning of that year that I found myself a passenger on the Estrada de Ferro Central do Brazil, slowly rolling out of the Rio de Janeiro station. My destination was a small town, shown on the maps as Campo Bello, about halfway up the line to São Paulo.

At noon I descended from the train at Barão Homem de Mello (the railway name of Campo Bello), fortunate in the posses-

sion of a letter of introduction to a local ranchman. He had been apprised of my coming, and no sooner had my feet touched the concrete than I was greeted by a gentleman in khaki who smiled a welcome through a rich coat of tan. A servant took charge of my bed-roll, and my host led the way to his home, almost lost amid a profusion of roses and vines and palms, behind a stately row of eucalyptus.

The garden, delightfully unkempt, was a riot of flowers and birds! The perfume of countless roses dominated all other odors; numerous mango, orange, and other fruit trees struggled under burdens of color—the most wonderful orchids I had ever seen; finches, ovenbirds, tanagers, and wrens sang everywhere and without pause. The whole world seemed flooded with sunshine and, although the elevation was but little more than 1300 feet, the air had a tang about it that was



PRATELEIRAS

One of the lesser peaks of Itatiaya, as seen from a spot near the weather station

¹The scientific results of this survey were published in the *Bulletin of the American Museum of Natural History*, Vol. LVII, Article V, 1928.



A TEMPERATE ZONE BEAUTY

The striking plant (*Pæpalanthus polyanthus*) flourishes on the upper slopes of Itatiaya where the elevation creates a "temperate zone"

positively tonic. Even the mantle of clouds that had enveloped the summit of Itatiaya lifted to expose the final broken crags, naked except for a thin veil of mist swirling high above the last outposts of forest.

A number of years ago the federal government purchased the Serra do Itatiaya and attempted to establish on it a colony of immigrants. Upon the failure of the scheme, the mountain was turned over to the Botanical Garden of Rio de Janeiro and became the Reserva Florestal do Itatiaya. The headquarters of the Reserva, a group of buildings perched upon a deforested shoulder at about 2700 feet altitude, is designated as Monte

Serrat. Here, as a guest of the government, I made my base.

Monte Serrat is nine kilometers from Campo Bello, and nearly 1400 feet above it, and is reached from the valley town by a cart road that leads northward into the mountains by way of the wide cañon of the Rio Campo Bello. Leaving the whitewashed houses on the banks of the Parahyba, this cart road first crosses an open expanse of pasture land and then passes through a narrow gap in the denuded foothills into a sort of basin where well-to-do men from the cities of São Paulo and Rio de Janeiro have purchased the abandoned colonists' lots and erected on them summer cottages. Here the Rio Campo Bello is called the Bemfica. (This remarkable stream

changes its name as often as it shifts its course!) From this basin the road climbs laboriously over a forested shoulder into another larger basin, and comes to an end at the reserve buildings.

In former times the large *fazenda* of the Visconde de Mauá, which encompassed the whole mountain, made its headquarters at Monte Serrat, and much of the surrounding forest was cut over for timber, but later a still greater amount of clearing was done by the government in its ill-advised colonization scheme. This deforestation has allowed the tropical zone to advance above its normal limit of about 2000 feet altitude and form a pocket well within the subtropical zone.

Large tracts of the formerly forested area are now covered with a well-nigh impenetrable growth of giant bracken, beautiful to look upon, but a heart-breaking collecting ground. A little wren-like spine-tail (*Synallaxis spixi*) was very abundant in these fern tangles.

Monte Serrat proved to be the most luxurious field station that I ever occupied. I was assigned an end room in a long, one-story structure, and had ventilation through four windows and two doors. Besides, the room was furnished with a good iron bed, and was supplied with running water from a spring farther up the slope. The building even boasted a shower bath; and there were no mosquitoes! Certainly I had come to a summer resort to collect birds!

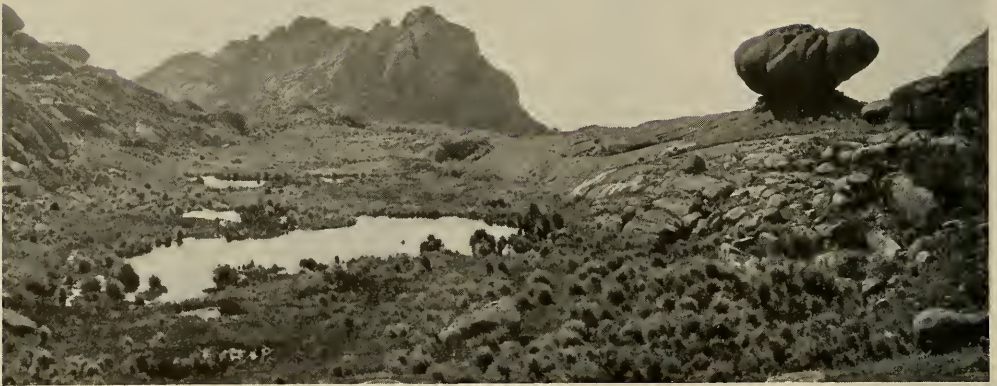
But I was soon to discover the fly in the ointment. There was another house opposite, and out of it each morning came a nondescript cur that rolled in the

dirt and howled as if its heart would break. Naturally I inquired why the pup should be so disconsolate. "*Bernes*," was the laconic answer. Well, *bernes* meant nothing to me—then. A few days later I became aware of an irritating spot on my side, like the beginning of a small boil, but I thought it merely a "chigger," or harvest mite, applied the iodine, and tried to forget it. But it wouldn't be forgot. Then I realized with horror that I had a *berne* all my very own. When finally I got it out I found that it had burrowed in nearly a half-inch deep! Immediately a sense of fellowship with the cur across the way possessed me, and with a helper and a can of ether I went to his rescue. We took seven huge larvæ from his back, but had to leave as many more because the forceps would not grip them. They were hideous, repulsive things, as large as the distal third of one's little finger, and belted about with rings of retrorse spines.



A MOUNTAIN DAISY FIELD

Wild flowers were abundant, and the trail up Itatiaya passed through a meadow at 7500 feet altitude which was carpeted with daisies (*Eupatorium* and *Erigeron*)



THIS IS NOT A GLACIAL POND

Although this miniature lake has every earmark of having been created by glacial action, no glacier ever scoured the slopes of Itatiaya

The *berne* is the larva of a green fly (*Dermatobia hominis*) which exhibits to a remarkable degree that something we call "instinct" whenever we find ourselves unable to explain a psychological phenomenon in any other way. The animals which for generations have served as unwilling hosts to this parasite have learned to recognize the adult insect and will not permit it to come near them. But does the little fly in its modest coat of green suffer its kind to perish from the earth in consequence? Not at all. Lacking strength, it resorts to strategy, and seizing upon house flies, mosquitoes, and other flies smaller than itself, it fastens its eggs upon their bodies. These carriers, not being *verboten*, then visit some warm-blooded animal, the eggs hatch, the larvæ attach themselves to the new host, and the vicious circle remains unbroken.

Shortly after my arrival at Monte Serrat a day was set for a reconnaissance to the summit. My *camarada*, Miranda,

was impressed with the importance of an early start, coffee was ordered for six o'clock, and all put in readiness for a quick get-away. About nine on the appointed morning Miranda appeared, but merely to inform me that the mules, "ungrateful beasts without shame," had wandered during the night and therefore we could not start until the morrow! Swearing is utterly futile in such cases. The experienced traveler bows to the inevitable, expresses the hope that the mules will become conscience-stricken and return through the same gate so thoughtfully left open, and busies himself with tasks especially planned for the occasion.

At seven-thirty the next morning we actually started. As our mules swung out on the trail, a flock of parrakeets, startled at their breakfast in the flat tops of the Paraná pines, flew screeching away to the forest, which already rang with the howls of monkeys. Immediately we had passed beyond the deforested slopes, the trail

began to wind in and out of side ravines resplendent in a wealth of edible palms, tree ferns, orchids, and bromeliads, and luxuriantly draped with vines and creepers in wildest abandon. All thought of the mire underfoot or the hardness of my mount was forgotten. I even forgot that I wanted to wring Miranda's neck, and gave myself over completely to enjoyment.

With many a meander, but ever upward, climbed the trail. At 3600 feet it crossed the roaring Campo Bello (here called Rio Maromba) on a rickety old wooden bridge that sooner or later will hurl someone to certain destruction on the rocks below. Bending sharply back upon itself, the trail surmounted, by several switchbacks, another bracken slope, marking the site of an old burn, and then, at

about 5000 feet, plunged us into the clouds. We continued through a ghost world of dimly outlined giant trees, hung with sinuous lianas and burdened with great rosettes of bromeliads, where every leaf was dripping. All about was only mist, underfoot only mud. As we rode along, we were swept by the long, gracefully drooping tips of a beautiful species of bamboo, and soaked to the skin.

At 6000 feet we rode into a little clearing and, to our astonishment, found ourselves in a laden apple orchard. It had been planted years ago by the old Viscount who then owned the mountain, and was still bearing nobly, though its days were numbered. The altitude was just right for the production of fine fruit, but in this land of mists the trees must surely succumb to their burdens of



Photograph by Robert Donati

THE TARTARUGA

The dwellers on the mountain call this huge rock "the turtle" because of its fancied resemblance to that reptile



Photograph by Robert Donati

A LAKELET AT 7800 FEET ELEVATION

This view is toward the south from near the base of the final peaks

moss. A mud-and-wattle cabin, erected to shelter trail workers, stood in the clearing, so we dismounted there to eat our lunch—with fresh apple-sauce for dessert!

The orchard marked the upper limit of the subtropical zone and the heavy forest which is coincident with it. Above, the trail emerged upon the open *campos* (literally, fields) of the temperate zone. Before us rolled away ridge after ridge, some blotched with dark patches of stunted forest, others covered only with grass and flowers, while, towering above them all, great broken peaks of naked rock reared skyward. To pass from the gloom of dense, dank forest into the light and freedom of these elevated flower gardens was like a sudden transition to another planet.

I rode on in a trance until, rounding the shoulder of a grassy knoll, we came face to face with the highest human habitation in Brazil. Paradoxically, it was a structure

of but a single story—the home of the government meteorological observer. The white posts, poles, and chicken coops of an orthodox weather station stood just to one side, at an elevation of about 7200 feet above the sea. Small though the house was, we were given shelter for the night, and later I lived here during the rainy weeks spent in studying the bird-life of the heights.

And rainy indeed is the climate of Alto Itatiaya, as the upper levels are called. The mean precipitation, registered by the official gauge, is more than ninety inches a year. As for temperature, Alto Itatiaya holds the record for the lowest mean, maximum, and minimum of the whole country. These are 52.7, 73.6, and 21.2 degrees Fahrenheit, respectively.

The morning following our arrival at Alto Itatiaya dawned crystal clear, and as soon as we could swallow some bread and coffee we were off afoot to scale the

peak. A league lay between the house and the base of the last crags, but we gave no thought to distance as we swung across a wide grassy slope toward the valley of the upper Rio Campo Bello.

Upon the threshold we stopped, appalled, for we seemed about to enter a region whence all life had fled. Mountain valleys above timber line were not strange to me, but never before had I looked upon such a scene of absolute desolation. On every hand only barren rock greeted the eye, and the naked bowlders strewn in chaotic piles and ridges everywhere over the broken surface of the basin suggested the ruins of a vast amphitheater whose stone columns and benches had been shattered by some cataclysmic force. Forest there was not, unless one would consider the wretched little dwarf trees struggling upward along the stream.

At length, when we had eyes for less

majestic things near at hand, the oppressing sense of desolation vanished. For there, among those same forbidding stones, flourished countless flowers of every hue. A red *Amaryllis* stood up bravely between the bowlders, in striking contrast to a rich purple *Utricularia* that hid among the tall grasses; an *Alophia* of palest blue preferred the wetter spots; scarlet and yellow "toucan's beak" (*Syphocampylos*) thrived in stony soil beside the trail; and at a lower level behind us one entire slope was ablaze with the purple blossoms of a low shrubby *Chætostoma*. But most striking of all were the compound umbels of a peculiar white-flowered plant, the *Pæpalanthus polyanthus*. There were whole fields of it. A little farther along, a mass of the largest begonias I had ever seen grew in a cranny in the rock itself. Then the trail passed through a meadow that was a single mass of daisies. And I have heard it said that Brazil has no wild flow-



ON THE CLIMB TO THE SUMMIT

The plants growing in the crevices of this slope are *Chusquea*, a species of bamboo dwarfed to a height of about 18 inches

ers! Even the high mountain meadows of California could scarce rival these rocky *campos* in the splendor of their efflorescence.

And there were animate flowers too. The sweet liquid notes of the white-capped tanager floated out from a stunted copse with a clearness that was startling. Even the humming-birds were trying to sing, and in the stillness of the heights the volume of noise produced by a tiny plover-crest was out of all proportion to the diminutive bird. And here had wandered the common dooryard sparrow, the *tico-tico* so dear to the hearts of Brazilians. But in such a setting its cherry song seemed strangely out of place.

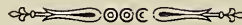
From the Vargem das Flores the trail crossed the "Little River of the Flowers" (the translated name for the highest reach of the Rio Campo Bello), climbed over a boulder-strewn slope where hopped thousands of tiny toads with bellies as red as the *Amaryllis* we had just passed, and lost itself in a wild jumble of talus at the western base of the culminating peak. As I stared up at the formidable wall towering 1200 feet above us, I was struck by the appropriateness of its old Tupi name, Itatiayassú (Grand Itatiaya), and by the utter misnomer of Agulhas Negras (Black Needles), applied by the Brazilians. The massif of gray nephelene-syenite is not black, nor does it bear any semblance to needles. A narrow dentate ridge, it may be likened more truly to a cutlass with its upturned edge badly nicked by the neck vertebræ of sundry pirates.

To attain the summit seemed impossible, for the last 600 feet of naked rock

were vertical. But Miranda knew the only route, and at length we scrambled up from the dusk of a deep fissure into the light at the top of the highest pinnacle. A sea of mountains rolled away in every direction, but heavy clouds prevented any view of the more distant landscape except where tiny patches of sunlight had managed to break through. The lovely spots of *campo* or forest thus exposed were sufficient guaranty that under clear skies the view is superb. This day, however, the summit was not a place to tarry. Rain drops were beginning to splash upon the rocks, and we were both cold and hungry. A humming-bird whizzing by like a bullet seemed possessed of true wisdom, and we followed it to lower levels.

A Brazilian writer has said, "In truth, shins of steel, lungs of bronze, and a heart of iron are needed to climb Itatiaya, whose ascension is agonizing, terrific, and full of the most painful difficulties." The ascent of the peak by an American botanist of seventy and his wife of sixty-five rather discounts such a statement, though the fact that no one had succeeded in reaching the highest point until September 8, 1911, suggests the old truism that it's all in knowing how. Nevertheless, the visitors' book kept by the weather observer shows that surprisingly few have climbed the peak since the way has been known.

The mountain is easily accessible from Rio de Janeiro, and the traveler who fails to include Itatiaya in his itinerary will miss a scenic wonder that ranks with the Falls of Iguassú as one of the greatest in all Brazil.



INSPIRATION

The Story Back of Lincoln Ellsworth's Polar Achievements

By HAROLD T. CLARK

Secretary, the Cleveland Museum of Natural History

On May 29, 1923, the Congress of the United States voted to award a special Gold Medal, now in the course of preparation, to Lincoln Ellsworth, a Trustee of the American Museum of Natural History, for his participation with Roald Amundsen in the airplane flight of 1925 and the flight of the dirigible "Norge" in 1926. How Mr. Ellsworth's ambition took shape and crystallized into history, to make as part of his own life experiences an attempt to solve the mysteries of the northern wastes—mysteries that had also lured Peary and Amundsen and other gallant men to pit human endurance, courage, and enthusiasm against the odds of Nature—is told but briefly in the following tribute to the man whom his country has seen fit to honor.—THE EDITORS.

HOW many of us really appreciate the tremendous changes that travel by air has wrought in Polar exploration? This question is uppermost as one watches the throngs who pause in the Polar Corridor of the American Museum of Natural History before the case containing memorabilia of the Amundsen-Ellsworth flight by airplane in 1925 and the first crossing of the Polar Sea in the dirigible "Norge" in 1926, and sees them glance hastily first at the near-by sledge which took Peary to the North Pole in 1909—the crowing achievement of twenty-eight years of endeavor—and then at the one used by Amundsen in his remarkable journey to the South Pole in 1911.

The amazing recent flights of Commander Richard E. Byrd and of Sir Hubert Wilkins in both the Arctic and Antarctic, make it easy to forget that less than five years ago such a method of exploration was regarded as foolhardy. It was the airplane flight by Amundsen and Ellsworth in 1925, when they reached a point only one hundred and twenty nautical miles distant from the North Pole, that prepared the way for later flights, and in his book *Skyward*, Commander Byrd, with characteristic generosity, has emphasized the enduring importance of the flight of the Norge, as follows:

The epochal flight of the Norge across the north polar regions did much to wipe out some of the skepticism created by disasters among dirigibles. . . . It is already apparent that the flight has had a profound and beneficial effect upon aviation in the lighter-than-air field, but when we think that plus that demonstration of the great value of aircraft, those hardy pioneers have performed a tremendous service in exploration, we must conclude that those men have accomplished one of the great feats of our age which will shine through future ages as the feats of Columbus, the Cabots, Magellan, and other great navigators of the past, shine through our age.

Fitting it is, therefore, that our Congress should recognize in a very special way the epoch-making character of the flights of 1925 and 1926.

Few there are who realize how important a part in revolutionizing the methods of Polar exploration was played by those very sledges of Peary and Amundsen on display in the American Museum. The story is worth telling both for its own sake and as an indication of how far-reaching the inspiration of a great Museum may be.

As a boy, Lincoln Ellsworth was fascinated by stories of the Arctic. Of a thoughtful nature but with an active imagination, he was thrilled by accounts of men willing to endure physical hardships that they might push further back the barriers to human knowledge. Although Ellsworth was a rather frail child, the desire to achieve physically became the ruling ambition of his life, so much so, that it amounted almost to an obsession. There fell into his hands a copy of Theodore Roosevelt's *Ranch Life and the Hunting Trail*. This account of outdoor life made a great appeal, and when he learned that Roosevelt had been able to fashion a body naturally weak into a fit instrument "to seek, to strive and not to yield," he determined to do the same.

By the time he reached school and college he had made good progress along this line and had become a long-distance runner and oarsman of recognized ability. While a student at the Columbia School of Mines, Ellsworth haunted the American Museum, studying the exhibits relating to the Arctic.

"I feel quite certain," said Ellsworth in an address before the Museum in 1927, "that the American Museum is unaware of just how deeply I feel its debtor, for here, in this very Museum, came my first urge to want to go into the Arctic. The vividly colored allegorical paintings in the

Museum halls—scenes from the far-away shores of the Polar Sea—stirred my imagination. A gaunt land. A waste of cold and storm. What was the attraction, wherein the fascination? Just why or how would be difficult to explain. While one cannot always dissect a taste or a passion, these filled me with dreams that would not let me be. There, too, were the sledges that had reached the North and South poles. How it thrilled me to trace their journeys on the relief maps on the walls above them, stage by stage until the goal was reached—a goal that had acted as the motive-force to produce some of the most wonderful journeys in the face of terrible conditions, in the history of our race."

Since, at the close of his college course in 1903, there did not appear any opportunity to go at once to his chosen field, Ellsworth decided to join as an axeman the second survey party to be sent out by the Grand Trunk Pacific, to explore a new route through Canada. During the succeeding five years he remained in the employ of this company, rising to the positions of chainman, rodman, leveler, transitman, and finally at Prince Rupert, the Pacific terminal, he held the position of resident engineer in charge of a party.

During the next four years Ellsworth alternated between working as an engineer in Pennsylvania and Alaska and exploring many out-of-the-way places. To use his own words—"Because my great-grandparents were among the first white settlers on the Western Reserve of Ohio, from them I must have inherited my love of the open frontier—the outskirts of civilization. Among the hunters, trappers, scouts, and 'two-gun men' of the early American West are to be found my boyhood heroes. They were all brave and fearless men, and as long as I live they will

ride their phantom horses across my memory. Today only a few are left. The rest have gone west—to the eternal west beyond the setting sun. I have known many of them. I have done most of the things that the boy of a generation ago

dreamed of doing; I have hunted buffalo, lived among the Indians, prospected for gold, and dragged the surveyor's chain across the unmarked western prairies—things I always wanted to do."

All this frontier training developed not only a fine physique but the ability to respond quickly to any emergency. Ellsworth's courageous act on the 1925 expedition, in saving Dietrichsen and Omdal from drowning, when, heavily laden, they broke through newly formed ice—an act which Amundsen publicly declared saved the entire expedition—was made possible only by these long years of quiet preparation.

In 1912 through the American Museum of Natural History, Ellsworth met George Borup, who with Donald B. MacMillan was planning an expedition in search of Crocker Land in the Arctic. From among a long list of applicants Ellsworth was selected by Borup as one of his companions. Borup's tragic death while trying to rescue a friend from drowning ended this project.

Determined to take up Arctic exploration as his life-work, Ellsworth went to London and there spent a winter in the study of practical astronomy and surveying at the school of the Royal Geographic Society.

Upon his return to America in 1913, seeing no immediate opportunity to go to the Arctic, he obtained a position as field assistant with the United States Biological Survey because of his love of nature and wild-life. Liking to climb mountains, he specialized in the distribution and



ROALD AMUNDSEN AND LINCOLN ELLSWORTH
Photograph taken at Nome, Alaska, May 15, 1926

habits of the wild sheep of America, tramping and hunting in the Rocky Mountains from the Gulf of California to the Yukon Boundary.

In 1917 appeared Peary's *Secrets of Polar Travel*, in which he suggested that airplanes might be used for Arctic exploration. Ellsworth immediately sought out Peary and endeavored to interest him in trying out such a plan. Peary had succeeded in his great quest for the North Pole and felt that such an attempt should be left to some one else. Ellsworth tried to interest others but without success. The attention of the world was then centered on the war in Europe and the times were unpropitious for the organization of any expedition.

Shortly thereafter and before the entrance of the United States into the World War, Ellsworth joined the Ambulance Service and sailed for France. He tried to join the Lafayette Esquadron but was declined because of being several years beyond the age limit for pilots.

While in Paris, he received an urgent letter from Dr. Henry Fairfield Osborn, who was familiar with Ellsworth's hopes, saying that he had just lunched with Amundsen and that Amundsen was going to "steal his thunder," as he was planning to fly across the Arctic. Amundsen had been working quietly upon this idea for about eight years. In *My Life as an Explorer*, pages 103 and 131, he outlines his different efforts dating as far back as 1909.

Shortly after this, Amundsen went to Paris. Ellsworth met him and asked to join the "Maud," but the personnel was already complete.

Soon thereafter the United States entered the war. Ellsworth enlisted in the Aviation Service

as an observer, and, although over the age limit, learned to pilot.

A serious attack of influenza then laid him low and virtually incapacitated him for several years after the war. During this time, however, he clung to the determination to explore the Arctic by air, following closely the unsuccessful effort by Amundsen to fly from Alaska to Spitzbergen in 1923.

Amundsen's bankruptcy, made necessary by his having been too trusting in his dealings with others, kept him busy in Norway during most of 1924. Since no opportunity to go to the Arctic appeared, Ellsworth became a co-leader with Dr. Joseph T. Singewald, Jr., of an expedition to Peru for Johns Hopkins University, to make a measured geologic cross section of the Andes. This was so successful that he planned to go again and he had even purchased his tickets, when he saw in a newspaper that Amundsen was in New York at the Waldorf-Astoria Hotel. Without the loss of a minute Ellsworth drove there.

In *My Life as an Explorer*, page 119, Amundsen has described his discouraged state of mind at this very moment. His lecture tour had proven almost a failure, and his future seemed a blank. "I was nearer to black despair than ever before in my fifty-four years of life." A ring of the telephone, a brief exchange of words, an invitation by Amundsen to Ellsworth to come to his room, and within a few minutes they had decided to join forces. That decision changed the course of all future Arctic exploration, and made possible a contribution to man's knowledge of the unknown polar seas that has proved epochal in the history of the world.



"AIR PIONEERING IN THE ARCTIC"¹

The Two Polar Flights of Amundsen and Ellsworth 1925 and 1926

MANY a drama has been played out on the Arctic ice, and many an heroic story has been written of the adventures and trials upon that frozen desert. Yet rarely has there been a more dramatic story than that of the Amundsen-Ellsworth Flight of 1925, and never has there been a more successful expedition than the epoch-making crossing of the Polar Sea in the dirigible "Norge," in 1926.

The stories of these two flights have been told in many forms. Even the most casual of newspaper readers knows the major facts, yet so extraordinary were the happenings that took place on those two expeditions that even the smallest details bear with them an interest comparable to the major facts.

Because of this, this handsome volume of the National Americana Society has a double value. To the reader interested only in the drama of these two amazing flights, the book is fascinating. To the student interested in the details of Arctic exploration by air, the volume is invaluable.

¹Published by the National Americana Society, New York, 1929.

No more gripping account of adventurous exploration was ever set down, and no record ever made of man's struggle to overcome the Arctic was ever more meticulously complete.

Divided into two major portions descriptive, firstly, of the 1925 flight, and secondly of the flight of the *Norge* the following summer, the volume is beautifully and completely illustrated with scores of remarkable photographs, with photostats and maps and reproductions of newspaper accounts. Finally, and properly, the book contains a sincere tribute to Roald Amundsen written by Lincoln Ellsworth, whose friendship and assistance made possible the final accomplishments of one of the greatest explorers who ever entered the ice-bound regions of the north.

Great were the flights of which this volume tells. Great is the record that has been made of them. No individual interested in mankind's struggle with the frozen north should fail to read this volume through. No library that desires to possess complete records of the Arctic can afford to be without this magnificent account.

CONTRIBUTORS TO THIS ISSUE

The Cover of NATURAL HISTORY

Arthur A. Jansson has depicted the critical moment of a tiger hunt in his painting "Ringing the Tiger," on the cover of this issue of NATURAL HISTORY. The tiger, surrounded by his pursuers, finds himself trapped, and is nerving himself for one last dash for liberty. The tiger is of the short-haired species found in southern Asia.

William J. Morden, author of "Tiger Hunting in Nepal" has appeared before in NATURAL HISTORY. As leader of the Morden-Clark Central Asiatic Expedition, Mr. Morden collected *Ovis poli* in the Russian Pamirs, hunted ibex in the Thian Shan, and, with Mr. James L. Clark, was captured and tortured by the Mongols in the Gobi Desert. The complete account of this extraordinary expedition appears in Mr. Morden's book, *Across Asia's Snows and Deserts*, and an account of the *Ovis poli* hunt entitled "Marco Polo's Sheep" appeared in NATURAL HISTORY for September-October, 1928. Mr. Morden has also spent much time in Africa and India. He sailed July 16 to lead the Morden-Graves North Asiatic Expedition which, among other things, hopes to collect the long-haired tiger of the Amur River Valley in Eastern Siberia.

Frank M. Chapman, curator-in-chief of the American Museum's division of zoology and zoogeography, went to Barro Colorado Island, in the Canal Zone, to make studies for the habitat group of tropical birds now on exhibition in the American Museum; but he found there such an unusual opportunity to observe both birds and mammals that he returned to the island four successive seasons. The principal results of this additional field work appears in his monograph of the *Oropendolas*, or giant orioles, published by the Museum in its *Bulletin* (Vol. LVIII, 1928, pp. 123-166). Incidentally he has gathered enough material to form a book, which will appear in the fall, on the life of the island. The "Conquest of Claudia" is from this forthcoming work.

In 1921 **Ernest G. Holt** of the Carnegie Institute was assigned by the American Museum of Natural History to make an ornithological survey of the Serra do Itatiaya, in Brazil, and it was while engaged in this undertaking that he had the opportunity to photograph and record the scenic wonders that are the subject of his article in this issue, entitled "Itatiaya, Brazil's Most Famous Mountain."

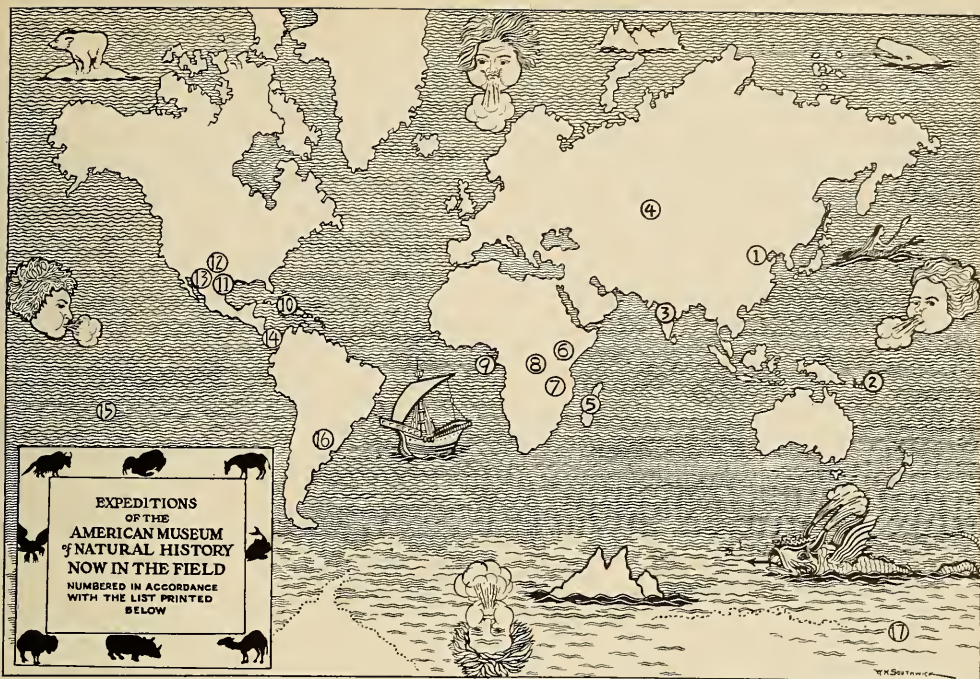
Herbert F. Schwarz, author of "Honey Wasps," has been a frequent contributor to NATURAL HISTORY on the subject of bees, to which particular division of insect life he has devoted much study. Upon Mr. Schwarz's retirement from the editorship of NATURAL HISTORY in 1925, he undertook the editorship of the publications of the New York Academy of Sciences, in addition to continuing his scientific studies as research associate in Hymenoptera at the American Museum.

Each summer, for some years past, **W. R. Leigh** has visited America's southwest to paint studies of that colorful section of the United States. This work proved excellent preparation for painting African landscapes when he was selected as one of the two artists to accompany the Eastman-Pomeroy-Akeley 1926 African Expedition—as the coloring of Africa is very similar to our southwestern country. It was while on the Eastman-Pomeroy-Akeley African Expedition that the adventure described in "A Night with an African Herder" took place.

"The Black Art," by **Mrs. Margery Loeb**, of the American Museum's department of anthropology, gives but a slight idea of the breadth and earnestness of her studies of mythology, particularly that of the North American Indian, which is to be the theme of her doctoral thesis. In her work at the American Museum she plans and assembles the educational exhibits on anthropology that are lent to schools in New York City. At the present time Mrs. Loeb is making a detailed study of artifacts found in association with the Aleutian mummies that were brought to the Museum by the Stoll-McCracken Expedition of 1928.

The author of "Falconing," **George G. Goodwin**, is primarily a mammalogist, and holds the position of assistant curator of mammals of the world, in the American Museum, but he has devoted much of his spare time to the art of falconry, both in Europe and in America. He is never so happy as when on the moors with one of his high-flying falcons wheeling three steeples high overhead.

"Falconry," says Mr. Goodwin, "is the finest and most humane sport of its kind, for it not only gives the game a sporting chance to get away from a natural enemy, but there is no such thing as a maimed bird lost and left to die. The quarry is either killed instantly or escapes unharmed."



1. Central Asiatic; 2. Whitney South Sea, Solomon Islands, for birds; 3. Vernay-Faunthorpe for Asiatic mammals; 4. Morden-Graves, Turkestan, for mammals; 5. Madagascar, for birds, mammals, and fossils; 6. Sanford-Legendre, Abyssinia, for mammals and birds; 7. Columbia University-American Museum, to Africa for anatomical study; Straus, Nyasaland for birds; 8. Tanganyika for birds and mammals; 9. Thorue-Correia, Gulf of Guinea, for birds; 10. DeSola, Cuba, for reptiles; 11. Whitney-Olson, Texas, archaeological survey; 12. Whitney-Snodgrass, Folsom, New Mexico, archaeological survey; 13. Frick-Rak, Sante Fé, for fossils; Bernheimer, Cañon del Muerto, pictograph study; Ogden mills, Cañon del Muerto, archaeological survey; 14. Benson, East Panama, for birds; Blick, Honduras, for fossils; 15. Shapiro, Polynesia physical anthropology; 16. Naumburg-Kampfer, Southeastern Brazil, for birds; 17. Byrd, Antarctic

IN THE FIELD OF NATURAL HISTORY

Expeditions — Scientific Research — Conservation
Books — Meetings of Societies

EDITED BY A. KATHERINE BERGER

EXPEDITIONS

THE Columbia University-American Museum Expedition to Africa, which is being sent from the department of anatomy of the College of Physicians and Surgeons of Columbia University and from the department of comparative anatomy of the American Museum of Natural History, will be the only expedition ever sent out for the purpose of securing entire, well preserved adult gorillas of all known varieties exclusively for anatomical study; together with similar specimens of chimpanzees and other African primates. It will also make special studies and photographs of the feet of unshod natives, unspoiled by civilized shoes. This material is desired by Dr. Dudley J. Morton of the College of Physicians and Surgeons, who has taken a prominent part in organizing the expedi-

tion and who expects to use this information in his studies on the evolution of the human foot and on its postural disorders.

The expedition plans to spend about six months in its journey across Africa from east to west. It is under the leadership of Mr. Henry C. Raven, associate curator of comparative anatomy in the American Museum of Natural History, who is well known for his previous explorations for the National and American Museums, in Borneo, Celebes, Africa, Australia, and Greenland. The other members of the expedition will be Dr. William K. Gregory, professor of vertebrate paleontology, Columbia University, and curator of the department of comparative anatomy of the American Museum of Natural History, Dr. J. H. McGregor, professor of zoology, Columbia University, and Dr. E. T. Engle,

associate professor of anatomy, College of Physicians and Surgeons, Columbia University.

The expedition expects also to visit the grave of Carl Akeley, who lies buried on the slopes of the beautiful Mt. Mikeno in the Parc National Albert, east of the Belgian Congo. Largely as a result of Akeley's efforts to secure protection for the fast-vanishing gorilla, King Albert and the Belgian Government set apart this district to be a perpetual sanctuary for wild life. The expedition hopes to be able to study and photograph the living gorillas in this sanctuary and to secure its anatomical specimens in other regions outside of the Parc. In the Gaboon region of French West Africa it will study and collect the West African gorilla made famous by Du Chaillu.

As NATURAL HISTORY goes to press, word of the expedition comes in a letter from Doctor Gregory to Professor Osborn. He says in part:

"At last we can report success in obtaining the necessary permits from the Belgian government after a period of doubt and anxiety. Baron de Cartier de Marchienne received us most kindly in London, but we found that Akeley had made him so rock-ribbed a conservationist that he was extremely loath to cede any gorillas to us, even outside the Parc National Albert. Dr. J. M. Derscheid of Brussels, however, to whom the Baron referred us, felt that in view of the importance of our plan to secure a record of the anatomy of the mountain gorilla, it would be well for the government to assist us in every way. Consequently he secured all necessary documents and permits, orders to game warden, etc., together with invaluable advice gained from his own experience in studying the gorilla on the Akeley-Derscheid expedition.

THE Morden-Graves North Asiatic Expedition is now somewhere in the Soviet territory. The personnel of the expedition comprises William J. Morden, leader, field associate in mammology on the scientific staff of the American Museum; Mr. George C. Graves, II, and Mr. George G. Goodwin, assistant curator, department of mammals, on the staff of the Museum. The expedition is being financed by Mr. Graves.

The primary objects are the collection of an exhibition group of the long-haired Siberian tiger of the Amur River region, and of the saiga antelope in Russian Central Asia. In addition to these a general collection of fauna of the regions visited will be made.

Mr. Morden and Mr. Goodwin left New York in July and will go first to Leningrad and Moscow, and from there into the district of Russian Central Asia, where the few remaining saiga

antelope are said to range. They expect to spend the months of September and October in Central Asia. After the completion of the work in that district, they will trek across to the Trans-Siberian Railroad and travel by it eastward to Vladivostok. Mr. Graves will cross the Pacific and join Mr. Morden and Mr. Goodwin in Vladivostok about the first of November, after which the three will proceed northward to Khabarovsk and endeavor to obtain the necessary specimens of the tiger in the little-known region northwest of that city.

Last fall Mr. Morden made a special trip to Moscow and Leningrad to make the very necessary contacts and obtain assurances that when he brought an expedition to Soviet territory, every facility would be accorded him. On his return he reported that he had been extremely well received and had been assured that all possible assistance would be given him. Mr. Morden was previously known to the Soviet Government, for in 1926 he was the leader of the Morden-Clark Asiatic Expedition, which made an excellent collection of *Ovis poli* in the Russian Pamirs, and ibex and roe-deer in the Thian Shan Mountains, and crossed Central Asia to the Trans-Siberian Railroad.

Owing to the fact that the tigers must be hunted in the winter time when they are in their best pelage and when there is sufficient snow to enable the hunters to track them, the expedition has been equipped for very cold weather. Much of the work will be done on snowshoes and skis, and for a considerable portion of the time the party will probably be out of touch with the outside world. The expedition expects to return in March or April of next year.

THE anthropology department will have expeditions this summer to Mexico, Santo Domingo, Arizona, the Folsom district in New Mexico, Texas, the Montezuma Creek region in Utah, the Andean region, and Polynesia.

THE return to New York of the Tyler Duida Expedition, with large collections of the fauna, flora, and rocks, from the sides and summit of Mt. Duida, coupled with the collections gathered by the Lee Garnett Day Expedition sent last year by the American Museum to Mt. Roraima, furnishes material, it is believed, sufficient for very definite conclusions to be reached concerning biological distribution in the very interesting and little explored mountainous region lying between and parallel with the courses of the Rivers Amazon and Orinoco.

The personnel of the expedition included Mr. S. F. Tyler, Jr., who is at present traveling in

search of more adventure up the River Orinoco, and through whose generosity the trip was prosecuted; Mr. G. H. H. Tate, leader; Mr. Charles B. Hitchcock; geologist and cartographer; and Mr. R. S. Deck, ornithologist.

Mt. Duida is a principal feature in a vast, isolated, and hitherto unexplored region; it is a tableland varying in elevation from 4000 to 7000 feet above sea level, with an area of about 300 square miles, and stands in the extreme south of Venezuela, a few miles from the parting of the Casiquiare Canal from the Orinoco.

Mt. Duida's existence has long been known. Humboldt, the explorer and geographer, spoke of it as "the granite group of Duida"; but it remained for Sir Robert Schomburgk to divine that its formation is sedimentary—sandstone.

The tableland is roughly foursquare, bounded not by sheer walls of rock like Mt. Roraima, but by bold, steep slopes, in part steplike, banded with narrow, horizontal stripes of precipice, and elsewhere jutting out as promontories or receding into walled-in valleys that seem most effectively to bar any ascent to the plateau.

A way was discovered, however, up the steep slopes of one of the headlands, and with the assistance of local Indians—Maquiritares—suitable trails were cut, not only for the slopes, but all over the top of the mountain. On the actual ascent more than 150 ladders of various sizes were required. These were built with saplings and lashed with "sipos" brought from the forest below. As the work of trail construction progressed, camps were formed in all places of distinctive environmental conditions, in order that, later, collections completely representative of the Duida region might be secured.

Three months were passed on the top of Duida, which was found composed of great, undulating, parallel ridges and valleys, and clothed with a covering of woods and brush so dense and matted as to be practically impenetrable except for a native armed with a macheté. Collecting was prosecuted from eight stations, efforts being made to gather exhaustive material, not only of the birds and mammals, but of all zoological and botanical groups, since it was felt that an opportunity such as this for sustained and intensive collecting in such an inaccessible region as the Mt. Duida plateau was unlikely to occur again for many years. Besides, the knowledge that a very high percentage of even the commonest plants or animals would prove to be new to science, gave an added stimulus to the collectors.

The highest station was approximately 7000 feet above sea level, and placed close to the top of the next to highest point of Mt. Duida (the highest

is only a few hundred feet higher, but a number of miles away). From this vantage point magnificent views were afforded by relatively near-by mountains to the north and northeast, and farther away to the east and south by the Parima Range, and its offshoots. Westward appears only peneplained country some 300 feet above sea level, broken by a few low, relatively unimportant hills. The bearings of all visible features were carefully taken by means of planetable and alidade with a view to subsequent revision of extant maps, and planetable maps were drawn of Mt. Duida itself and of the territory in the immediate vicinity. At the center of the plateau a change in the geology with consequent reflections in the vegetation and zoology, was remarked, the significance of which has yet to be surely determined.

The expedition left New York for Mt. Duida by way of Para last July. Regrettably, two of its members, Mr. Tyler and Mr. R. S. Deck, were forced by ill health to return home before completion of the time planned upon; nevertheless, the information and collections obtained by the remaining members and their helpers are far in excess of what they themselves had foreseen.

The dried plant collection includes about 500 species, a very large proportion of which, coming from the summit of an unexplored mountain, should prove to be undescribed.

Dr. H. A. Gleason, of the New York Botanical Gardens, who identified the plants collected by the Lee Garnett Day Expedition to Mt. Roraima (1926-7), has undertaken to work upon the material from Mount Duida.

This collection of plants, will be donated to the New York Botanical Gardens, as has been done on previous occasions; however a named second set of specimens will be kept at the American Museum for some time to come for purposes of reference.

On June 3, President Osborn on behalf of the Trustees of the American Museum gave a luncheon to the returned members of the Tyler Duida Expedition and to representatives of the Museum departments concerned with this expedition. Among the guests were Dr. Isaiah Bowman of the American Geographical Society, Mr. Lee Garnett Day, patron of the Museum's expedition to Mt. Roraima in 1928, and Mr. H. A. Gleason of the New York Botanical Gardens. The geographical, botanical, and zoological significance of the expedition was discussed by Doctor Bowman, Mr. Gleason, and Dr. Frank M. Chapman respectively. Mr. Tyler, having already returned to the Orinoco for further exploration, could not be present.

THE American Museum has just received from the Sanford-Legendre Expedition, now collecting in Abyssinia, a beautiful series of specimens of the mountain bushbuck, or nyala. The best specimens from this lot will be incorporated in a group for the Akeley Memorial Hall.

The largest head in the set has a symmetrical pair of horns measuring forty inches along the outer curve, twenty-five inches from base to tip in a straight line, and twenty inches from tip to tip. This is the fourth largest head ever recorded.

Among other specimens received in this first shipment are several klipspringers and jackals.

Word from Mr. T. D. Carter, who is a member of the expedition, states that the second shipment of specimens is already well on the way to the Museum. Mr. Carter's plan at the time of writing was to continue from Soddu to Jiren in Jemina Province, thence to Sherada in Kaffa Province, and from there home via the White Nile, arriving in New York the early part of August.

AMATEUR ASTRONOMERS ASSOCIATION

SUMMER classes in elementary and general astronomy will be held under the direction of Mr. Paul Shogren on the second and fourth Wednesdays of each month at 8:00 P.M. at the American Museum of Natural History, outdoors, when weather permits. Other classes will be resumed in the fall.

The first regular fall meeting of the Amateur Astronomers Association will be held on Wednesday evening, September 18, 1929.

GARRETT P. SERVISS

THE widely known writer and lecturer on scientific subjects, Garrett Putnam Serviss has gone, and in his passing the world has lost a great teacher who has during more than forty active years, instructed and inspired many thousands of persons. In this time he has probably done more than any one else in America to popularize the study of astronomy.

Mr. Serviss died in the Englewood Hospital on May 25, 1929. He had made his home in Tenaflly, N. J., although for a number of years he had spent the warmer part of each year in France.

Born on March 24, 1851, at Sharon Springs, New York, he was educated at Cornell University, where he was graduated with the degree of B.Sc. in 1872, and at Columbia Law School, where he received the degree of LL.B., but he never practiced law.

In 1882, he became night editor of *The New York Sun*, a position which he filled for ten years.

During this time he began writing on astronomy, which work continued until within a few weeks of his death. In fact, several of his newspaper articles are being published posthumously.

The early articles by "The Sun's Astronomer," published anonymously, attracted much attention and became a regular feature of his paper. In fact, they impressed the editor of *The Sun*, Mr. Charles A. Dana, so much that he advised Mr. Serviss to make astronomy his life work, a bit of advice which, no doubt, had great weight. At any rate, the interest in the astronomical articles grew until they were syndicated in a great series of American newspapers. By this means alone, doubtless, he reached a wider reading public than any astronomer who has ever lived.

In 1888 he published his first book on his favorite subject, entitled, *Astronomy With an Opera Glass*. This was popular from the start and is still widely used. It was followed by several others, including *Astronomy With the Naked Eye*, *Curiosities of the Sky*, *The Moon*, *Other Worlds*, and *Around the World With the Stars*. He also wrote a number of semi-scientific novels.

Mr. Serviss was the first Honorary Member of the Amateur Astronomers Association and was a frequent attendant at its meetings. On April third last, he was scheduled to give his lecture on "The Poetry of Astronomy" before this society, and there was great disappointment when, on account of illness, this lecture could not be given.

Mr. Serviss spent his life in the joyous service of turning the thoughts of his hearers and readers from the sordid and petty things of this earth to the vast, celestial universe. His passing is a great loss to millions, who looked upon him as a great friend and an inspiring teacher.—CLYDE FISHER.

EDUCATION

THE third season at the Trailside Museum at Bear Mountain is well under way. This educational project, developed and maintained by the department of public education of the American Museum, is being operated in coöperation with the commissioners of the Palisade Interstate Park. Mr. William H. Carr, naturalist in charge of the trail work, is assisted this year by Mrs. Carr, Mr. Joseph Rintelen of Cornell University, and Mr. Samuel Yeaton.

The attendance this season has shown a marked increase. More than 20,000 persons have visited the Nature Trails since the 20th of April. Many special groups from schools have come from New York City and elsewhere to study biology and general nature subjects. Several organizations have sent their leaders to study the nature trail

project. These men remain for one week and are then replaced by others who aid in the building of the trails as they learn how the work is done.

New methods of labeling out-of-door specimens have been developed. The increased number of visitors have made it necessary to construct more permanent exhibits along the trails. The trailside museum will cooperate with Miss Ruby Jolliffe this summer in teaching nature to the thousands of campers who, annually, live in the Park camps. There were more than 100,000 campers, last year, and the field for nature education is indeed a great one.

IN memory of his father, William Lyman Underwood, Mr. William J. Underwood has presented to the education department of the American Museum 1200 lantern slides made from original photographs taken by his father during the many years he was devoted to natural history. Mr. Underwood's delightful book *Wild Brother* is to form the basis of an illustrated lecture for school children, to be prepared by the education department with slides taken from pictures in the book.

CONSERVATION

THAT whales are now in danger of extinction and can only be saved by a concerted international effort for their preservation, is the opinion of Prof. H. F. Osborn, who announces the organization of the Council for the Conservation of Whales by a prominent group of scientists and conservationists.

The Council, which will work toward the preservation of the romantic industry of whaling, as well as that of the whales, numbers among its members Dr. Ray Lyman Wilbur, Secretary of Interior; Gifford Pinchot, former governor of Pennsylvania; David Starr Jordan, president emeritus of Leland Stanford Jr. University; and Prince Nagamichi Kuroda, scientist and member of the royal family of Japan.

An effort will be made to work out a program for treaties between nations and regulations by which the killing of whales may be reduced below the danger point. The movement had been organized under the auspices of the American Society of Mammalogists, of which Dr. Glover M. Allen, of the Museum of Comparative Zoology at Harvard, is president.

ACCORDING to a statement recently coming from the office of the National Association of Audubon Societies, 1974 Broadway, New York City, it generally may not be known that today there are breeding on the lower Texas coast large numbers of the rare and beautiful reddish egret.

These birds for twenty years prior to their discovery in 1918 by Dr. T. Gilbert Pearson, had been regarded as practically extinct as breeding birds within the boundaries of the United States. It was while studying bird life on the Texas coast that Doctor Pearson found several thousand reddish egrets breeding on Green Island in Laguna Madre.

This island, which lies about 35 miles north of Point Isabel, affords an ideal nesting place for these birds. It covers about 40 acres and is clothed with a dense and almost impenetrable growth of mesquite and ebony, together with a goodly sprinkling of cactus and yucca. On the tops of this dense growth the birds build their nests. Extensive shoals and mud-flats constitute ideal feeding grounds for the birds, and serve to make the island inaccessible save only to the lightest draught boats.

Shortly after Doctor Pearson's discovery of this marvelous rookery, the General Assembly of Texas, without solicitation, officially leased it to the Audubon Association for a term of 50 years to be administered by it as a bird sanctuary.

THE BASHFORD DEAN MEMORIAL EXHIBIT OF FOSSIL FISHES

THE exhibit of fossil fishes in the southeast pavilion of the fourth floor of the American Museum, a memorial to the late Bashford Dean, first curator of fishes in the American Museum, was opened on the afternoon of June 10, with President Henry Fairfield Osborn presiding. The immediate family and many personal friends of Doctor Dean were present, including a number of his colleagues from the two universities (Columbia and New York) in which he was a professor, and from the two museums, (American Museum of Natural History and Metropolitan Museum of Art) in both of which he was a curator.

President Osborn read a cablegram of greetings from Dr. W. K. Gregory, curator of fishes, who is at present on an expedition to Africa. He then paid a brief tribute to Doctor Dean as his student, colleague, and friend, and asked Miss Francesca La Monte, assistant curator, to unveil the bronze bas-relief tablet by John W. Hope, which is the gift of Doctor Dean's friends from all over the world. Mr. J. T. Nichols, curator of recent fishes, said a few words in explanation of the exhibit, and Dr. E. W. Gudger, bibliographer and associate in the department, gave a brief history of Dean's great work, the *Bibliography of Fishes*, and of its continuation, and of the plan for the publication of a memorial atlas of the valuable unpublished plates, drawn by Doctor Dean himself, portraying the outer development of certain primitive sharks.

Among the noteworthy collections represented in this exhibit are one of Devonian placoderms made by Prof. J. S. Newberry (Doctor Dean's teacher in palæichthyology), the E. D. Cope collection, and the Alfred Ely Day collection from Mt. Lebanon, Syria. These form the basis of the exhibit, which from time to time has been augmented by other specimens.]

FISHES

THE American Museum's collection of primitive fishing appliances has been increased by a gift from Gerrit P. Wilder, now in the Cook Islands in the South Pacific. Mr. Wilder not only sends a sample wooden hook but also the native names for each part and wrapping of the implement. Like all primitive workmen, the makers of fishhooks in the Cook Islands take pride in their work and follow precise patterns. This requires that names be given all the important parts and steps in the process. The native islanders fish with large wooden hooks of a special shape, for a curious large fish in the Pacific, known as the ruvettus, or more commonly as the oilfish. The lines are of coconut fiber. Ages ago primitive man found that certain fishskins especially the skins of sharks, would polish wood and shell. Mr. Wilders ends an interesting contrivance used by the Cook Islanders to polish their wooden and shell fishhooks. This is a small wooden bow strung with a strip of sharkskin. By grasping the bow in the hand, the native workman can rapidly and effectively stroke the surface to be polished. This method is superior to the usual one of polishing by holding a piece of sharkskin loosely in the hand.

REPTILES AND AMPHIBIANS

THE Brooklyn Museum has deposited its reptile and amphibian study collections in the American Museum. These collections contain much local material of interest and some rare exotic species, among them a fine series of Surinam toads, the remarkable amphibians of the genus, *Pipa*. The females of this genus carry their developing eggs and tadpoles in shallow pockets in their backs. The collection also includes rare turtle skeletons new to the Museum.

In a recent number of the *Bulletin* Dr. G. K. Noble has described, some remarkable tadpoles from East Africa. They hatch from eggs laid in the hollow stems of bamboos, or between leaves of banana trees. They are devoid of both external and internal gills and hence breathe air from the time of hatching. In adaptation to their peculiar habitat, the tad-

poles develop a pair of climbing appendages out of the skin and muscles of the throat. Such temporary locomotory organs are unique among the Amphibia. It was interesting to note that in spite of the restrictions of their nursery, the tadpoles retained the distinctive characters of mouth, limbs, and spiracle found in other tadpoles of the same family, Brevicipitidæ. The study gave further support to the view that larval characters may be as important as adult characters in defining relationships.

In the same number of the *Bulletin*, Doctor Noble has described the anatomy of the suction disk on the ventral surface of various Chinese tadpoles. This permits them to cling to rocks in the swift water of mountain torrents. The mechanism was apparently evolved from an unspecialized integument and ventral musculature such as is found in our common pond polliwogs.

EXPERIMENTAL BIOLOGY

A LARGE series of eel-like amphibian *Siren* was recently brought from Florida by Mr. William G. Hassler. No less than 67 adults and 250 very young ones were brought back alive for investigating the problem of metamorphosis in this form. Incidentally, 11 large *Amphiumas*, or snakelike amphibians, and several snakes new to the collections of the American Museum were obtained, and a large series of other species. The more striking will be mounted by the new infiltration method recently perfected in the department.

MEETINGS OF SOCIETIES

THE twenty-fourth annual meeting of the American Association of Museums convened in Philadelphia, May 22-24, with headquarters at the Bellevue-Stratford. The time and place of this meeting was arranged to coincide with the twentieth annual meeting of the American Federation of Arts, so that joint sessions could be held. The American Museum was represented by Director Sherwood and members of the department of education.

SCIENCE OF MAN

UPPER Pliocene Man in East Anglia.—Through the discoveries of J. Reid Moir of Ipswich, England, and the writings of Sir Ray Lankester and Professor Osborn, the Upper Pliocene man of the Red Crag of England is now well known and well established. The Red Crag marks one of the final stages of Pliocene time in which, for the last time, appear two types of mastodonts and an early type of the elephant family known as *Archidiskodon planifrons*. Now Reid Moir comes forward with a new discovery of traces of man more ancient than those of the

Red Crag—namely, two flint implements of human manufacture, a “sling-stone” and a “flint scraper” found *below the Red Crag* near Ipswich, England. These implements, remarkable for the relative perfection with which they are fashioned, are described in the British magazine *Man*,

and has finally secured very distinctive fossil teeth associated with *Pithecanthropus* and *Eoanthropus* respectively. At the present moment they appear to give a new and very surprising interpretation of the geologic age of these specimens—namely, that *Pithecanthropus* is geo-



DOWN HOUSE, KENT, ENGLAND

Here Charles Darwin lived for forty years, and here *The Origin of Species* was written

April, 1929, pages 62 to 65. The author concludes his description as follows:

If in this I am right, then it becomes clear that the presence of this object at such an horizon, as a study of the excellence of much of the flaking on the sub-Crag flint implements had led me to believe, points to the fact that man of the Pliocene period had already progressed some distance upon the evolutionary path, as it seems impossible to imagine any ape-like creature producing artifacts such as have now been found in the detritus-bed. The discovery of this “sling-stone” is yet one more reminder that, to judge of the advancement of any prehistoric people merely by the stone implements they made, may be a risky and unsatisfactory procedure.

This appears to be indirect corroboration of Professor Osborn's prophecy that the discovery of the skeleton and brain of Pliocene man will furnish one of the greatest surprises in the whole history of anthropology. In the same connection Professor Osborn is making a very careful restudy of the remains of fossil mammals found associated in the same beds with the Trinil man of Java (*Pithecanthropus*) and the Piltdown beds of Sussex (*Eoanthropus*). If it proves possible to absolutely associate the skull fragments of *Pithecanthropus* and of *Eoanthropus* with the fossilized remains of teeth found in the same beds with them, the geologic age of these two classic forerunners of the human race may be precisely determined. For two years past Professor Osborn has been in correspondence with his colleagues and friends in the British Museum and in Berlin

logically much more recent than formerly supposed, whereas *Eoanthropus* is geologically more ancient. In a future note in *NATURAL HISTORY* Professor Osborn hopes to present these results in a more definite form.

DOWN HOUSE

ON June seventh the home in which Charles Darwin lived and worked from 1842 until his death in 1882, Down House in Kent, was formally opened to the public. For many years there has been an agitation to recover this famous house from the hands of tenants and to establish it as a permanent memorial to Darwin, freely open to visitors. In 1927 it was purchased and presented to the British Association in trust as a public memorial by Mr. G. Buckston Browne, a London surgeon, and since then leading scientists in Great Britain and this country have been diligently working to restore Down House to its original appearance during the forty years of Darwin's residence and to collect the priceless Darwiniana that has been scattered in some instances to the far corners of the earth.

The unceasing efforts of Mr. Browne and others have yielded most gratifying results. To quote from the *London Observer* of May 19:

The drawing-room has been furnished with a great deal of the original furniture which has been gathered from

various branches of the family. Of all the rooms the most important is what is known as 'the old study.' Here *The Origin of Species* was written; the chair and writing board which Darwin used are standing in the accustomed corner. . . . Here is his working table brought in great triumph from Cambridge.

Of the many unique and interesting gifts to the collection at Down, one of the most valuable is the presentation by Prof. Henry Fairfield Osborn of the entire series of letters written by Darwin to the great German naturalist, Fritz Müller. These fifty-eight letters were found in the possession of the Müller heirs in Brazil, and after several months of negotiation, Professor Osborn succeeded in purchasing them in time to cable an announcement of the gift to England for the opening.

Another extremely generous gift is the purchase of Sir Charles Hartwell's bust of Darwin for Down House by Dr. Joseph Leidy of Philadelphia. Doctor Leidy attended the opening as the official representative of the American Association for the Advancement of Science. Professor Osborn had hoped to be present also,

but at the last moment found that it was impossible to go, and Prof. Edward B. Poulton of Oxford University was chosen to represent him and the American Museum of Natural History.

NEW BOOKS

Holiday Pond. By Edith M. Patch.

IT is always a pleasure to be able to recommend a nature book to the general reader, and we thank Edith M. Patch for again giving us this pleasure by writing *Holiday Pond*, recently published by Macmillan. Doubtless the publishers—possibly even the author—intended this book primarily for children. It is admirably adapted for such readers but adults would do well to borrow it from the nursery in order that Miss Patch may tell them, too, about the interesting things that may be in the pond near their home. Best of all, one is safe in accepting her statements as facts for, unlike certain "popular" writers, she knows her subject. Our only regret is that the book is so short.—F. E. L.

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A HAITIAN RHINOCEROS IGUANA

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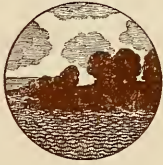
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The Journal of The American Museum of Natural History

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THE RHINOCEROS IGUANA

This largest of the West Indian lizards claws its burrows in the coral ledges on the islands off the coast of Haiti. With head encased in grotesquely weird plates, little glinting eyes, great crest of dorsal spines, and long black claws, this creature is strongly reminiscent of a dinosaur

See "Lizard Hunting in the Black Republic," Page 451

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XXIX

NATURAL HISTORY

NUMBER
FIVE

SEPTEMBER-OCTOBER, 1929



LIZARD HUNTING IN THE BLACK REPUBLIC

Making Motion Pictures of Rhinoceros Iguanas on the Island of La Petite Gonaïves
off the Coast of Haiti. Hunting Buried Lizard Eggs and Making Other
Reptile Studies

By GILBERT C. KLINGEL

WITH PHOTOGRAPHS BY THE AUTHOR

IN the American Museum of Natural History there is a habitat group of the rhinoceros iguana, a striking West Indian lizard between four and five feet in length, which has been so named because of the three spikes on its snout. I was so much impressed with the group that I decided some years ago to become better acquainted with this beast if opportunity afforded. Last winter I started to try my luck, not in Santo Domingo where the group material was collected, but in Haiti, the western end of the Island of Hispaniola.

The day of the rhinoceros iguana is almost over. On the Haitian-Dominican mainland it is rapidly becoming extinct. In the desert land of Haiti, near St. Marc and Gonaïves, it once occurred in great numbers. There today it is seen only on rare occasions. In the Dominican Republic its haunts are being converted into canefields and plantation land. True, it may still be found in goodly numbers in Haiti, especially around Anse à Pitre and

a few other localities, but its doom is inevitable. Only on small islands off the coast does it still flourish. But even here a shooting party could destroy the last remnant of these curious lizards in a few days.

I decided to investigate first La Petite Gonaïves, a small inhabited island in the blue Gulf of Gonaïves, just south of the larger island of La Gonaïves. As a result of the good services of my friend, the Collector of Customs, we engaged a native sailboat and a captain, and made preparations for a ten-day trip.

Late in the afternoon we glided into the mangrove-bordered harbor of Anse à Galets and dropped anchor. The village consisted of a few thatch huts and the Gendarmerie Headquarters. Lieutenant Wirkus, in charge of the native police, is an American marine officer, and the only permanent white resident of the place. He has under his control some hundred thousand blacks who are said to have crowned him "King" of the island. His



APPROACHING THE CAMERA BLIND

The rhinoceros iguana is primarily herbivorous, and banana peels and mangoes placed before the camera blind proved to be a great attraction to the iguanas of La Petite Gonaives

home and the Gendarmerie are the only substantial buildings on the whole island.

We passed a pleasant evening, enjoying the hospitality of Lieutenant Wirkus, and left the next morning for the little island to the south. Jagged coral heads protruded above the blue waters of the bay, and we soon found it advisable to keep a sharp watch for those just beneath the surface. Our native captain claimed, before leaving, that he was familiar with these waters, but I soon discovered that he knew neither the channel nor the way to manage his boat. As we approached the fringing reef of the island, the situation became strained and without waiting for further remarks from the captain, I took the tiller and headed for the south end of La Gonaives. Several hours later we rounded Point Fantasque, the extreme tip of the island, and there pictured in vivid greens and browns, against a background of blue sky and still bluer sea, lay the little

island of La Petite Gonaives. It is formed of coral and is so small that it could be "crossed in a hop, skip and jump" as the gendarme lieutenant had told us. However, it is far more interesting than its big brother island to the north.

Our little boat nosed its way into a diminutive harbor, frightening six sleepy pelicans which were eying us disdainfully. We ran our bow well up on a little strip of shell-strewn sand that served as the beach for the two or three native fishermen who had their huts near by. The entire village, a mere handful of ragged men, came down to see their unexpected visitors. In answer to our inquiry for "layzah," the patois name for the rhinoceros iguana, one of the fellows volunteered to guide us across the little island. A few feet from the village we came abruptly upon eight of the beasts we were seeking, which dashed away upon our approach. It was thus obvious that



SUSPICIOUS

Sometimes the great brutes would come within a few feet of the lens. One fellow sneaked around to the back of the blind and looked in

we could not obtain pictures of them without a blind. Returning to the boat, we stripped it of its sails and, when these were draped over the slabs of glaring coral, our improvised concealment looked far less conspicuous than I had imagined it would. We had brought some bananas and mangoes for bait, but after our hours of hard work in the midst of the blistering coral, the sight of this luscious fruit was too much for our powers of resistance and we decided to eat the bananas and use the peelings for bait.

Hardly had we settled ourselves within our blind before a half score of the ungainly iguanas swept down upon the banana peels. The temperature was gradually rising under the sail and soon it became stifling. The great brutes came nearer and nearer until they were within a few feet of the lens of my motion picture camera. One grotesque fellow even

walked around the blind to the opening in the rear and looked in upon us. I made a wild grab for him with my hands but he was off like a flash. The remainder of the lizard company dashed away but soon came back and eyed our blind suspiciously. They looked like so many dinosaurs,—certainly *Stegosaurus* or *Tyrannosaurus* could have seemed no more weird,—the great horns on their snouts, the spines along their backs, the sharp black claws, and those little glinting eyes always staring at us gave us a thrill that we shall not forget for many days.

We had arrived in La Petite Gonaïves too late for the egg-laying season, and hence, after a week of searching for the eggs and additional life-history facts, we gave up and returned to the Haitian mainland.

Haiti is one of the most densely populated areas in the world. Though it is



GONAÏVES

The trade winds blow from the Atlantic and deposit their moisture on the eastern slopes of these hills, consequently the country about Gonaïves, on the western side of the hills, is comparatively arid, a fortunate circumstance for the lizards which swarm in the lowlands back of the town

but one third the size of the Dominican Republic, it has more than three times the population. While the natives are quite picturesque and very interesting, to one engaged in nature study they are sometimes extremely annoying. Wherever we went there was a gang trailing along to see what was going to happen. To get rid of them was almost impossible, for as soon as one crowd dispersed another collected. We once constructed a blind for observation but had to give it up in disgust. The natives hung around like leeches. Yet, they were so willing to help and so good-natured that we could not help but like them. They have a sense of humor and as a general rule are very courteous. Although extremely poverty stricken and decrepit in appearance, they are far

from being the mystical and vicious people that so many writers like to picture them. In fact, Haiti today, for all its voodoo and mystery, is one of the most peaceful spots on earth.

Further work in Haiti was begun in earnest near St. Marc, some 200 kilometers north of Port au Prince. As we walked across the arid hills, thousands of dragon flies seemed to dart at us from all sides. The reason soon became painfully apparent. They were attracted by the mosquitoes with which the district was infested. During a short jaunt into the hills our arms and legs became black with the pests. Finally, we could stand it no longer; we broke into a run and, dashing out upon the beach, we stripped and plunged into the water. For two



ON THE ALERT

The rhinoceros iguana receives its name from the three horns on its snout. Both sexes bear these structures, which function merely as ornaments, as they are not used in fighting or in burrowing. In fact, they would seem to be distinct hindrances in climbing among the coral cliffs. The iguanas of Petite Gonaives had their horns well worn from rubbing between the rocks



THE FISHING VILLAGE OF LA PETITE GONAIVES

The only inhabitants of La Petite Gonaives other than the rhinoceros iguanas are a few fishermen, together with their families and pigs

days we were thus tormented and then suddenly the mosquitoes disappeared and we were left to work in peace. We were never again bothered by noxious insects.

Our attention at St. Marc was soon attracted by the "mabouya," large sharp-snouted lizards which are common inhabitants of the Haitian roadside. These lizards, known as *Ameiva chrysolæma*, are among the most conspicuous lizards of Haiti. They have bright yellow stripes and polka-dots, and they live frequently in colonies near the rivers. As they are very nervous creatures, they are hard to approach and, when startled, they dash through the brush with apparent disregard for the thorns and brambles.

We were particularly interested in finding the eggs of *Ameiva*, so, for the better part of a week we searched over the valley back of St. Marc and pried into all kinds of burrows. As often as not we uncovered great ugly tarantulas. It is a queer sensation to thrust your arm into a hole and connect with a big hairy spider.

Fortunately we were never bitten. The eggs, however, eluded our most careful search. The tunnels into which we dug invariably ended in blank walls. By the end of the fifth day we were but little better off than when we had started, save that we had accumulated a number of notes on burrowing habits. On the following morning, however, we located a colony in a bank at the mouth of a short ravine. The holes in the bank were, to all appearances, the same as other burrows we had worked, but excavation showed them to be quite different. They were all placed in the same stratum of earth and their mouths formed a horizontal line along the face of the cliff. Several of these holes were larger than their neighbors. We chose one and dug. It ran straight into the bank for three feet and then widened into a large hollow or cavity. There it apparently came to an end. We looked rather hopelessly at each other, but acting upon a hunch, I had my native boy dig farther. He was thus engaged when I noticed that the end of his



THE HOME OF THE IGUANA

La Petite Gonaives is seamed with crevices. At the hunters' slightest movement the great iguanas would dash off and disappear among the coral crags. The tough hides of the rhinoceros iguana seemed to be impervious to the sharp coral edges, which quickly tore to shreds the hunters' shoes



A CURLY-TAILED LIZARD INVESTIGATES

The male *Leiocephalus schreibersii* is radiant in its livery of pink and green, but the female shown here wears a somber dress of grays and browns. The significance of the adornment of the male is not clear, for during courtship the females pay scant attention to the opposite sex



HAITIAN RUM

Ox cart on the road to St. Marc. Most of the native cane is used in the making of rum, very little being turned into sugar. In many cases the cane is ground in the same mills tha' the French colonists used more than 100 years ago

pick had suddenly become stained. Frantically yelling to him to stop, I seized a trowel and carefully cleared away the earth. In a few moments there came to light five eggs, four a beautiful white and one hopelessly crushed. The crushed egg contained a well developed, if somewhat mashed, embryo. The eggs had been laid in a little cavity just large enough to hold them and then had been walled in with a hard packed plug of earth. We carefully placed them in a container and continued digging. Now that the secret was out it was easy. From that burrow we took two more clutches and from the colony we collected a total of five. They were packed in moist wood pulp and rushed to the Marine Post Office in Port au Prince, whence they finally reached the American Museum.

These excavations and later study revealed an interesting group of facts. We found that there were two distinct types

of *Ameiva* colonies; one for shelter and retreat and another for purposes of propagation. The shelter burrows were occupied by either males or females, though only a single specimen occupied a tunnel. The propagation burrows were communal and were made use of by a large number of pregnant females, which left as soon as the eggs were laid. The young lizards when hatched, struggle through the layer of dirt that separates them from the outside world, without any assistance from their parents whatsoever. How they ever claw their way out without dying of suffocation en route, is something of a mystery.

One afternoon I was stretched out upon the ground, taking it easy, when I saw an interesting incident in the life of *Ameiva*. All around were strewn thousands of little yellow flowers whose bright petals raised themselves but an inch or so above the soil. They were constantly



CACTI ON THE ROAD TO ST. MARC

Haiti includes both desert and jungle. The expedition confined its efforts to the more arid regions, where lizard life was at its maximum. The officer is an American marine stationed at St. Marc



ON THE BEACH AT ST. MARC

Coconut chips proved to be the favorite hiding place of the *Leiocephalus schreibersii*, one of the "curly tailed" lizards of Haiti. These lizards receive their name from the fact that they frequently curl their tails up on their backs when preparing to run

visited by many bees, wasps, and other insects. As I watched, a lizard came into view, a full grown *Ameiva*. It was not rambling aimlessly around as is their usual wont, but was darting in a most businesslike fashion from yellow blossom to blossom, seizing the unfortunate insects that feasted thereon. In a moment it dawned upon me that this lizard had associated yellow flowers with the presence

of food, and now, instead of hunting his food, he was merely dashing from one yellow flower to another. Such powers of association in a mammal would not be surprising, but in so lowly a creature as a lizard, it was remarkable to find these mental powers so well advanced.

Another time, while I was trying to photograph an *Ameiva*, I managed to approach quite close to the beast without



SWIFT RUNNERS
OF THE HAITIAN
ROADSIDE

Working out for the first time the life story of this lizard, *Ameiva chrysolæma*, was one of the accomplishments of Mr. Klingel's expedition

HEADS DOWN

The Haitian chameleon, *Anolis cybotes*, hunts insects on roadside fences and trees. It frequently lies in wait with head down on the shady side of posts or trees



making it aware of my presence. I was about to press the shutter trigger when I noticed that its attention was attracted by something. Turning, I saw a good-sized cricket resting among the dead leaves that littered the ground. The insect was a full yard away from the lizard and was concealed from it by a high barrier of sticks and leaves. It made a slight noise and in a flash *Ameiva* had cleared the

obstruction and seized the unfortunate cricket. The performance was remarkable, because *Ameiva* jumped directly to the spot where its prey was sitting, although it could not see it.

As the days slipped into weeks and the weeks into months our study progressed evenly and smoothly. Although we had not succeeded in finding the eggs of the rhinoceros iguana, we had worked out the



ROADSIDE NEAR ST. MARC

The *Ameiva* lizards were abundant along this road, and at the slightest noise would dash into the thick shrubbery on either side. It was near this point that the *Ameiva* colony was found



ON THE TRAIL TO GOAVIER

The hills of northern Haiti were scoured for lizards. It was found that *Ameiva chrysolæma* had a particular preference for the bottom lands, ascending only a short distance into the hills. Goavier is a small plateau about 4000 feet above sea level



THE LIZARD NEST

The eggs of *Ameiva chrysolæma* were found concealed in the wall at the end of the *Ameiva* burrow. The little lizards, in escaping, would have to dig their way through several inches of packed soil



A LIZARD BURROW

It was found that *Ameiva chrysolæma* digs two kinds of burrows, one for sleeping and another for incubation of the eggs. The latter type shown here was often very extensive, running as much as nine feet into the bank



PREPARING THE EQUIPMENT

The first motion pictures ever made of the rhinoceros iguana in its natural habitat were taken by Mr. Klingel

life history of several other lizards and secured many eggs and adult specimens for investigation in the experimental laboratories of the American Museum. Here the eggs will be reared under controlled conditions, and many observations that were not obtainable in the

field will be studied.

Incidentally we have secured the first motion picture ever made of the rhinoceros iguana, in its natural habitat, and have presented the film to the Museum, where it will be used in the educational work of the Institution.



THE UBIQUITOUS CHAMELEONS, *Anolis*, ARE THE FIRST AND LAST LIZARDS ONE SEES IN HAITI



THE THEORETICAL CONTINENT

How Explorers, Since before the Time of Columbus, Have Been Busy Proving that the Antarctic Continent Is Actually Smaller than It Has Been Thought To Be

BY VILHJALMUR STEFANSSON

THE last region on earth to change from theory to fact lies in the farthest South. Once upon a time we "knew" it was the greatest of continents. A hundred years ago we were beginning to think that there was no continent at all; twenty years ago we felt sure of the main outlines of the continent; and now the solid land is beginning to break up into archipelagos, although it still seems as if there might be enough left to form a decent continent after all.

The Greeks were pioneers in southern theories, as in most doctrines which have swayed the intellect of Europe for two thousand years. But within the last two hundred, pioneer travelers from many nations have taken a hand in breaking down the Greek theories and the accretions to them that developed slowly through ancient and mediæval times.

The Greek beliefs about the South started in philosophical doctrines concerning simplicity, balance, and symmetry. Applying their principles, the Greeks viewed the Far North and Far South as

practically identical, differing only in that Europeans could approach or slightly penetrate the borders of the frozen North while they never expected any human testimony with regard to the frozen South.

For, said the Greeks, between us and the frozen South the tropics lie under the sun, forever impassable, with red-hot rocks and boiling oceans. The stories about Egyptians and Phœnicians who had crossed the tropics, if known at all, were considered to be folklore. This view held from around 400 B.C. to 1400 A.D. and was more orthodox in its time than the general doctrines of biological evolution are today.

The earth was spherical to the Greeks and remained so to the learned throughout the Middle Ages. The geographers of every century believed the time would come when someone would sail around the earth from east to west, or would sail to Asia and walk thence overland to Europe. But no one would ever go around the world from north to south, for about the earth's middle was the uncrossable burn-



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AN ANTARCTIC LANDSCAPE

No other land mass in the world is so devoid of life as is the Antarctic Continent. Around its edges birds, seals, and fish are to be found, but in the interior the hardy explorer is rarely heartened even by the sight of a bird on the wing



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SCRIPPS ISLAND

This photograph, taken by Wilkins, is of an island formerly thought to be a part of the Antarctic Continent. Under continued exploration the supposed area of the South Polar land mass has shrunk to only a fraction of the size it was once thought to be



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A WASTE OF ANTARCTIC SNOWS

Time was when much of Europe, Asia, and North America may have appeared in some such guise as this. Now, however, aside from the Antarctic, only Greenland carries an ice cap comparable to that of the Antarctic. This picture was taken from Sir Hubert Wilkins' plane



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WILKINS' PLANE AT ITS BASE

This base was chosen because of its location near a whaling station. In a couple of hours' flying, however, the explorers can be 200 miles or more nearer the pole, over a land where a base could have been established only with great difficulty



Underwood and Underwood



Underwood and Underwood

THE "ENDURANCE" DURING THE ANTARCTIC NIGHT

In this ship, Sir Ernest Shackleton spent the Antarctic winter of 1915 in the ice of Weddell Sea



THE "ENDURANCE" GOING DOWN

Crushed by ice in October, 1915, the "Endurance" sank, leaving the twenty-eight men of the expedition marooned on the ice

*Underwood and Underwood*

SIR ERNEST SHACKLETON SAILS AWAY FOR HELP

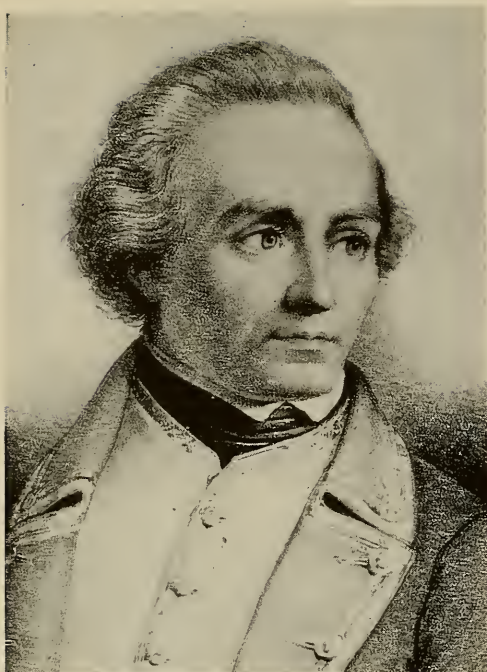
After drifting on an ice floe from October, 1915, to April, 1916, the "Endurance" party reached land. From there, Sir Ernest Shackleton and three others, in a whale boat set sail for South Georgia for help. Despite fearful hardships, no lives were lost

ing girdle and at either end were the snow caps, permanently frozen and everlastingly dead. The northern snow cap was supposed to begin not far beyond the north tip of Scotland. Those fringes a traveler might approach, no doubt, and send back descriptions. There would be in the South a similar ice cap, but this could be known only by theory and by analogy from the North.

The public still believes in a northern ice cap, or at least the newspapers still use the term, although it is really a hundred years and even more since geographers knew that there was no northern ice cap and could not be. True enough, snow does cap Greenland. But this does not correspond to Greek theory, for the philosophers believed that the center of the ice cap was at the North Pole. In reality, the center of the Greenland ice cap is more than a thousand miles from

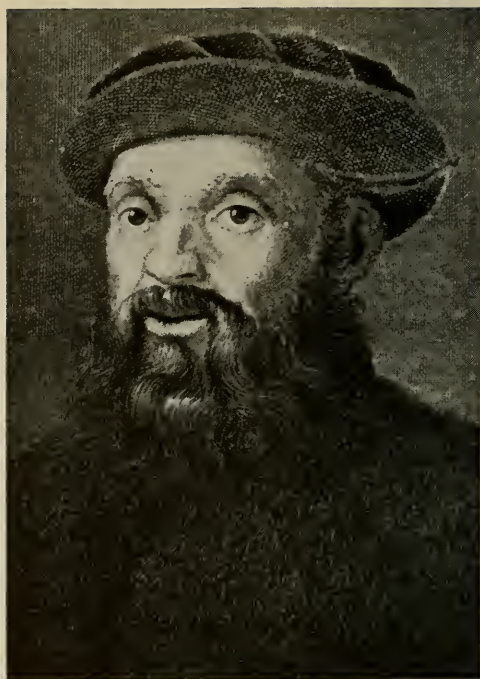
the North Pole, and even its northern tip is 400 miles from the Pole.

The burning tropics were conquered by a group of Portuguese sailors and by a man of genius who directed them, Prince Henry the Navigator. He, or somebody associated with him, developed one of the least precedented ideas that had ever come to Europe, and one of the most liberating that has come to the human mind. The Middle Ages conceived themselves as prisoners between a wall of ice to the north and a wall of flame to the south. Prince Henry was iconoclastic enough to wonder whether there really was an impassable tropic belt. He sent out ship after ship and they went farther and farther, some returning with gruesome tales of the burning death which they had narrowly averted. But they did come back, and so there were others who could be induced to venture, and at times some companies ven-



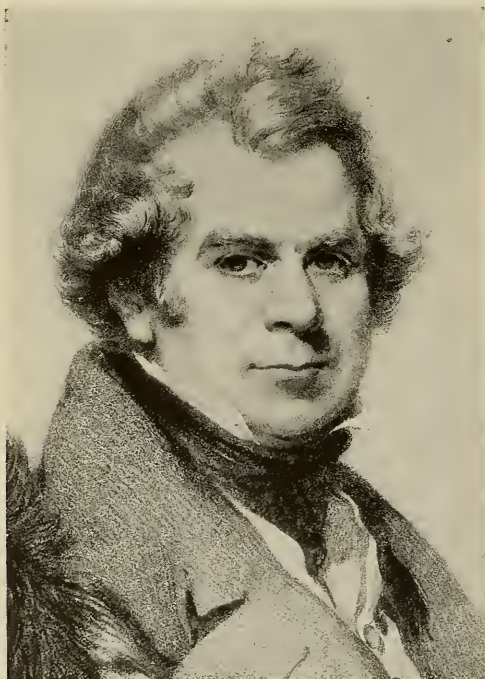
JAMES COOK

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FERNANDO MAGELLAN

Yale U. Press



JAMES ROSS

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ROBERT F. SCOTT

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FOUR MEN WHO HAVE TAUGHT US ABOUT THE ANTARCTIC

Magellan was the first man to circumnavigate the world, and proved that South America was not attached to the Antarctic land mass. Cook learned that Australia and New Zealand were separate; Ross discovered the Great Barrier, and Scott reached the South Pole only to find that Amundsen had been ahead of him



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ROALD AMUNDSEN



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SIR ERNEST SHACKLETON



Brown Bros.
RICHARD E. BYRD



Underwood and Underwood
SIR HUBERT WILKINS

FOUR PRESENT-DAY ANTARCTIC EXPLORERS

Amundsen, the first to reach the South Pole; Shackleton, leader of the heroic "Endurance" expedition; Commander Byrd, who is now in the Antarctic; and Sir Hubert Wilkins, whose remarkable flights in 1928-9 lopped still more off the Antarctic Continent. By the time this magazine is published it is likely that Byrd will have actively begun his work of aerial exploration

*Australasian Antarctic Expedition*

DOGS AND SLEDS

By this means polar exploration has laboriously been making headway for generations. The limitations of such methods, however, are obvious, and today dog teams are only incidental aids to explorers

tured again, until finally the sun was straight overhead without burning the ships or cooking the sailors. In fact, they returned with accounts of heat no greater at sea in the tropics than you find on land in Portugal during the midsummer.

This was the final conquest of the burning tropics but only the beginning of European attack upon the great southern continent, Terra Australis.

The Austral Continent, although it looks to us now like pure theory, was very real in the Middle Ages. Africa was a part of it. The first of many powerful blows against it was dealt by the Portuguese, under Dias, when in 1486 or 1487 he rounded the south tip of Africa, amputating a whole continent bigger than North America from the theoretical Land of the South.

The second piece of major surgery was performed by Spain. When South Ameri-

ca was discovered, it seemed to Europe obviously a peninsula running north from Terra Australis. Then came Magellan, Portuguese in blood but Spanish because of his flag, who sailed in 1520 through the strait that bears his name and cut off from the imaginary land a second continent.

Even so, Terra Australis remained the biggest of continents. When New Guinea was discovered, it was thought to be a northward peninsula, and next the land we now call Australia took up a similar rôle. In fact, so sure was Europe that now at last had their eyes rested upon the continent of theory, and so long did they remain assured, that, when the Hollander Tasman in 1642 finally sailed past on the south side, he cut off not only a land mass of continental proportions but also deprived the mythical continent of its ancient name, which hereafter clung to



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MOTOR AND PLANE

Where dogs and sledges could travel ten or a dozen or, with luck, twenty miles in a day, such a plane as this can travel 100 miles an hour, performing in one afternoon the work that dogs would take many weeks to accomplish

the great island which he had lopped off from the theoretical mass, Australia.

Nameless at last, and no bigger than real continents, the former Terra Australis was baptized Antarctica and continued to shrink until finally James Cook, the great navigator of England, sailed around it in an almost circular curve, crossed the mathematical south polar circle for the first time and returned to warn the geographers that, if there was any continent at all, it could not be larger than perhaps twice the size of Europe.

Thus far all discovery had been amputative, or negative. A positive contribution came when the Russians under Bellinghausen discovered the first land ever seen within the Antarctic circle, Peter and Alexander Islands, lying in a southerly direction from South America.

As we have said, many nations contributed to the breakdown of the original

Terra Australis and then to the building up of the more recent Antarctica, but foremost of them is Britain. For after Cook's two great achievements, the first crossing of the Antarctic circle and the first circumnavigation of Antarctica, came in 1831 the first sighting of what is still believed to be Antarctic mainland, and this was by Biscoe, an Englishman.

The great achievement to follow Biscoe was by an Englishman, too, James Ross, nephew of the equally famous John Ross. He was the first to navigate pack ice in Antarctica and first to see the Great Barrier, probably the most startling, or at any rate the least expected sight that ever has greeted human eyes. For nothing in the world differs so strikingly from things we may see in Europe or in other commonplace lands as the sparkling ice cliffs that rise perpendicular from deep water in the sea that has been named after Ross.

*Brown Bros.*

BARRIERS OF THE ANTARCTIC

Where the Arctic is, for the most part, merely an ice-covered sea, the Antarctic is an elevated continent with rugged mountains and high, wind-swept plateaus. The elevation in the Antarctic, therefore, adds still another difficulty for the explorer to overcome, while the mountains themselves form barriers that complicate the problem

We are trying here to show that many nations have furnished explorers, each of whom has been first to do some great thing in the Antarctic. For patriotic reasons and to get one more nation counted, we might like to put Wilkes, the American, ahead of Ross, for his contributions were notable and were earlier. But his Wilkes Land was not the first continental discovery. For a similar reason we have to omit from this particular list the conspicuous French explorer, D'Urville, who found Adélie Land. Later in our own time we shall have to omit similarly one of the great figures of southern exploration, the Australian, Mawson. It is especially trying to have to omit him, for, all things considered, he is probably the greatest of all Antarctic explorers.

In 1894, Borchgrevink, Norwegian by flag and blood, was the first to place a

human foot upon the Antarctic mainland. Five years later, then British because his flag had been changed, he was the first to spend a winter on land in the Antarctic.

But a year before that, in 1898, Gerlache, a Belgian, was the first to winter in the Antarctic pack ice, drifting about held securely between floes, as many ships had been in the Arctic but none before and few since his time in the Antarctic.

In 1902, Scott, British, was first to carry out land exploration on what we now call with a degree of certainty the Antarctic Continent. His farthest was only 380 miles from the base station but was, nevertheless, a remarkable feat, since it opened the way to his own later great work as well as to the expeditions of Shackelton and Amundsen.

Until the discovery in 1928 that Graham Land is an archipelago of islands



Australian Antarctic Expedition

ON THE ANTARCTIC ICE

Across such a surface as this no explorer can travel with ease, and because of the difficulties thus presented, Antarctic exploration has been retarded. Today, however, when dogs and sledges have so largely given way to airplanes, the explorer can accomplish rapidly the tasks that formerly were all but impossible



© Wide World Photos

COMMANDER BYRD'S SHIPS

Tied up to the Ice Barrier near the Byrd Base Camp at "Little America." This Ice Barrier does not mark the shore line of the Antarctic Continent. Instead, the ice is well beyond the shore line, and as it creeps slowly out to sea, it breaks off in gigantic bergs. Hundreds of these bergs are to be found drifting in the Antarctic Ocean, and ships sailing in those waters must be wary of such tremendous floating islands of ice

*Australasian Antarctic Expedition*

PICTURESQUE ICE FORMATIONS OF THE FAR SOUTH

In a whole continent of ice, many strange formations are naturally to be encountered. Ice caverns, precipices, crevasses and hummocks of every size and shape are to be found, with intervening level plains of ice and snow. Furthermore, during the short summers, innumerable icicles form, and drifting away from this world of ice is a constant procession of ice bergs

and not part of the Antarctic mainland, we had believed that Charcot, the Frenchman, in 1904, was first to see flowering plants on the Antarctic Continent, with his discovery of two such plants on the western coast of Graham Land. But since these are not on the mainland, so far as we know to the present there are no flowers on the southern continent, although there are more than 700 species of them in the northern polar region.

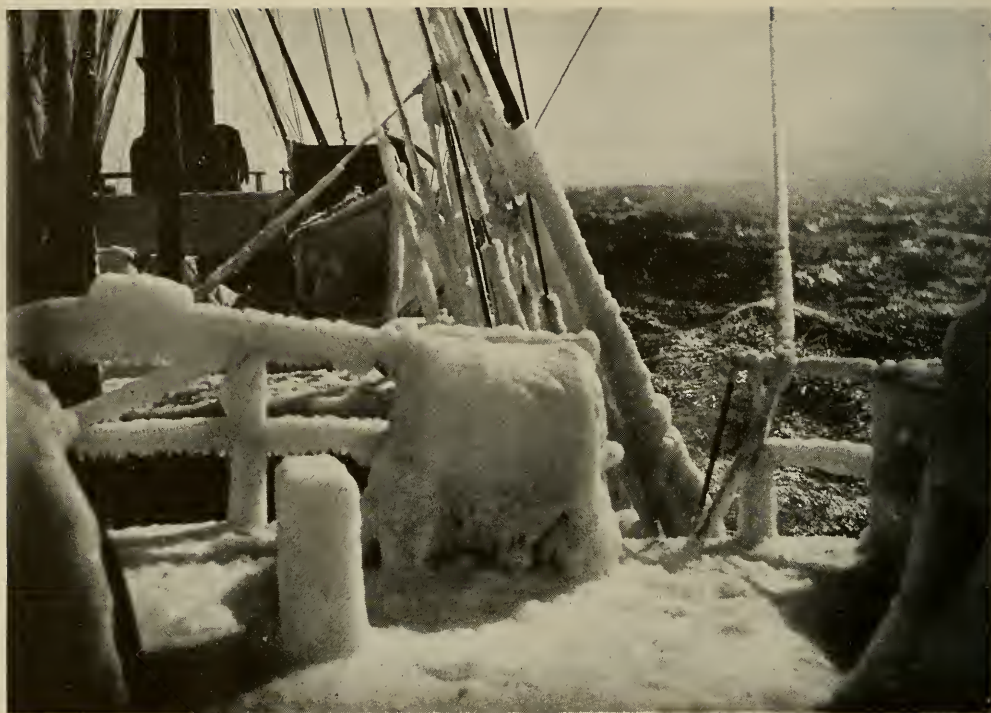
Shackleton had been with Scott's first expedition. In 1908 the British expedition which he himself commanded was first to use motor transport in the Antarctic, first to discover fresh water life in the previously thought to be lifeless Antarctic lakes, and was first to visit the actual locality of the south magnetic pole. In a way, however, the last achievement belongs to Australia rather than England,

for the real commander of the party was Sir Edgeworth David, the distinguished professor of geology from Sydney University.

In 1911 Amundsen, Norwegian, went 97 miles farther than Shackleton had gone and was first to reach the South Pole, December 14.

On November 21, 1928, in the southern hemisphere spring, Wilkins, an Australian commanding a British-American expedition and piloted by an American, Eielson, was first to fly in the Antarctic.

On December 21, 1928, the Antarctic midsummer, he and Eielson made the first discovery flight in the Antarctic, a great air voyage of 1200 miles in which they broke up the previously solid continental map of Graham Land into an archipelago of islands. Crossing what appeared to be the final strait, they flew

*Australasian Antartion Expedition*

THE FRIGID ANTARCTIC OCEAN

Probably there are few places in the world less given to high winds than the South Pole itself, but about the edges of the Antarctic Continent ferocious and frigid gales are perennial. Down from the icy heights of the continent the cold winds sweep, with the result that ships near the frozen shore sometimes find themselves "iced up" as is the one shown in this photograph

for half a hundred miles or so over gradually rising massive land that is, so far as we know, really continuous with the land on which the South Pole lies and therefore with the land at the far side where Scott, Shackleton, Amundsen, and Mawson have had their base stations and where Byrd now has his winter camp.

The Byrd expedition, although a few weeks only behind Wilkins, did not arrive in the Antarctic early enough for much beyond reconnoitering flights. The geographers had expected both Wilkins and Byrd to find continuous land, parts of one continent. The Wilkins flight disproved these views in the American Quadrant; the Byrd flights, so far as they have gone, have confirmed them in the Australian Quadrant, finding high land and mountain ranges spreading farther away

from the districts which Scott, Shackleton, and Amundsen had shown to be high and mountainous.

The first real season of Byrd's opportunity for air discovery begins around September or October, 1929. With his well equipped and competently directed expedition, he will doubtless add many things to our knowledge and probably give the final answer to the old question of whether there is in the Antarctic a single land mass big enough to be named a continent.

The chance is that this final determination will go to Byrd's credit, for this year he is likely to begin his flying as much ahead of Wilkins as Wilkins was ahead of him last year, for that is the advantage of Byrd's plan. He is spending the winter South, idle so far as flying dis-

covery is concerned but active in the routine scientific work of the staff. Wilkins has adopted the other method of spending his winters north, going South each southern spring. Before November, 1929, if both programs hold, Byrd will have a month or six weeks of flying to himself, and great things can be done with airplanes nowadays in much less time than that. But if there remain large areas still unknown by the coming November, they are likely to be cleared up through the rest of that month and through December and January by the coöperation of these two competently manned and well directed expeditions.

This possible finality applies only to large-scale or rough preliminary exploration. It would be the real beginning of, let us say, the end of the first chapter of scientific exploration. The second chapter will open in the southern spring of 1929 with a comprehensive national effort on the

part of Australia, under the leadership of the greatest of southern explorers, Mawson, who plans a campaign of many years

with winters spent at home in Adelaide and the summers on the Antarctic shore.

There is a logical progression in the talking points of the three expeditions. The Byrd program discusses chiefly geographic discovery and work in pure science. Wilkins is most concerned with the establishment of meteorological stations that shall in general give certainty to the weather predictions of the whole world and in particular a greater precision to the forecasts of the southern hemisphere. Mawson talks of weather and of pure science, too, but he adds a plan for summer

resorts on the Antarctic lands, and for December Midnight Sun cruises that shall be as accessible to Africa, South America, and Australia for their summer as the June Midnight Sun cruises to Spitsbergen and Alaska are to us in the northern hemisphere.



AMUNDSEN DISCOVERS THE SOUTH POLE

This picture is of Oscar Wisting when Amundsen and his party had reached the South Pole in 1911. But where Amundsen and his men made their painful way to and from the Pole on foot and with dog teams, Commander Byrd is shortly to make an effort to fly south by airplane from his base at "Little America" and, if conditions favor him, will be able to make in a few hours the distance that Amundsen covered in 55 days



ANDROS

AN ISLAND OF THE SUMMER SEAS

A Tropical Paradise Fringed with the Largest Barrier Reef of the Western Hemisphere—Its Corals, Sponges, and Fish, Natives, Birds, and Vegetation

By ROY WALDO MINER

Curator, Marine Life, American Museum

ACROSS the Gulf Stream to the eastward of the southern tip of Florida, a score of green tropical islands lie scattered over the summer sea, like stepping stones to the Greater Antilles. These comprise the Bahaman archipelago, together with about seven hundred lesser islets, or cays, and a couple of thousand rocks, just to make navigation perilously interesting.

Though small on the map individually, the Bahamas nevertheless are the outposts and milestones of American history. To one of the least of these, Guanahani, first came European civilization in the person of Columbus. His vessels followed the islands until they led him to Cuba, Porto Rico, and Hispaniola, where he established the first stronghold of Spain in the New World and opened the way to the golden treasures that made the Spanish Main famous. The pirates that preyed upon these rich fleets and on the commerce later established by the British with her colonies, found their hiding places in the multitudinous harbors and waterways of the Bahamas, and tradition fills their caverns with secreted treasure. After the American Revolution, the islands became the refuge of fleeing Tories and their slaves. During our Civil War the Bahamans were made temporarily wealthy through the operations of blockade runners, and in our present day another era of prosperity was assured them by the Eighteenth Amendment to our Constitution.

The islands of the Bahamas are merely the projecting portions of a number of submerged banks of "coral" limestone. In general, they are the raised northern and eastern edges of the banks, the single noteworthy exception being Grand Bahama Island on the southern edge of Little Bahama Bank. Hence, while the eastern and northern shores of the narrow strip-shaped islands rise somewhat abruptly from oceanic depths, they slope gently toward the south and east, almost insensibly passing below sea level to become continuous with the wide stretches of submerged shoals, which are often so shallow as to be navigable only for small boats. About sixteen of these islands are large enough to be inhabited, and all are low and flat, the highest elevation being not more than four hundred feet.

The most important banks are the Little Bahama Bank, the Great Bahama Bank, the Acklin Island, the Great Inagua, and the Caicos Banks, extending in this order from northwest to southeast. The Great Bahama Bank is the largest, lying opposite the Florida Straits and reaching almost to the coast of Cuba. It is shaped like a horseshoe with broad arms, open to the north. The cavity of the horseshoe is formed by the Tongue of the Ocean, an arm of the sea penetrating the Bank, ranging in depth from 700 to 1000 fathoms. The island of New Providence rises above the sea to guard the eastern side of the entrance to this



LOOKING ACROSS THE LAGOON TOWARD ANDROS FROM GOAT CAY

The lagoon inside the Barrier Reef is two miles wide at this point. The Cay is just inside the outer reef. The long line of snowy beach marking the distant Andros shore is clearly visible, as is also the flat character of the island's surface

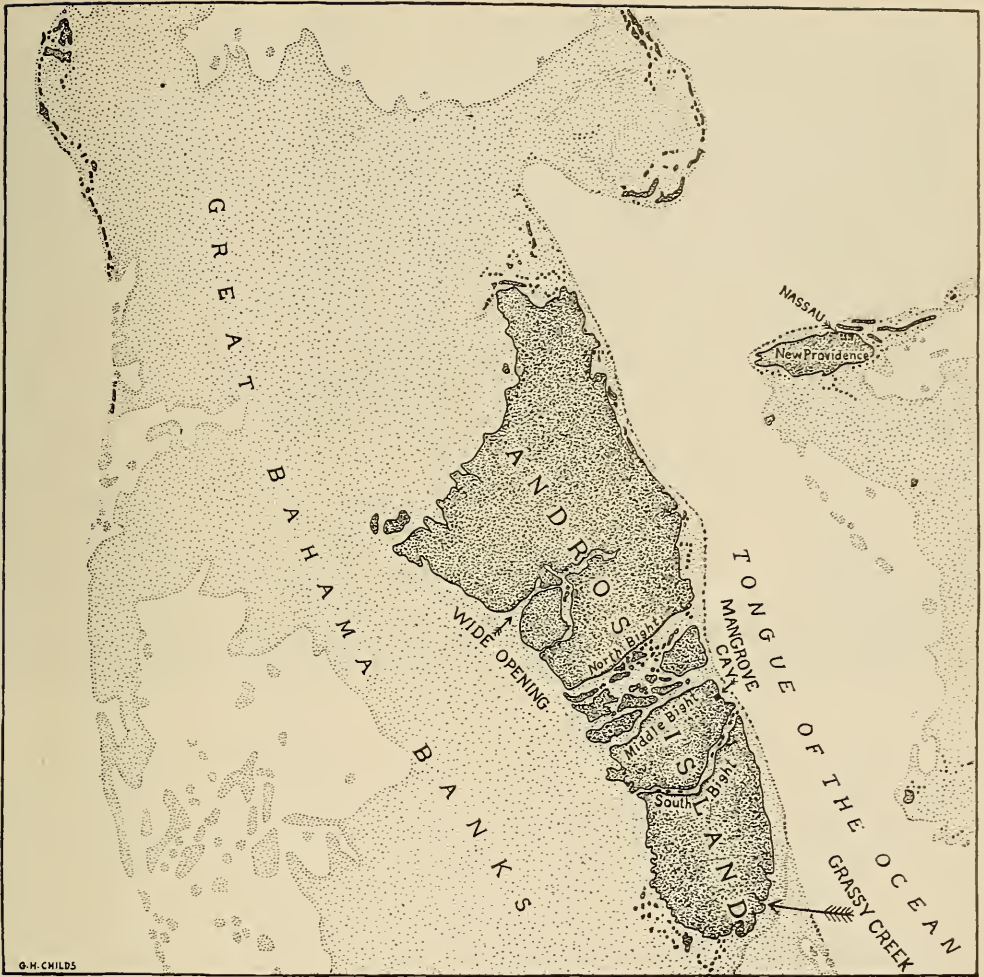
deep *cul de sac*, while Andros forms its western border.

New Providence, by no means the largest of the islands, nevertheless is the most important, for here quaint Nassau is located, the capital and chief port of the Bahamas. The Governor, appointed by the King of England, has his residence here, and along its wharves are the markets to which the chief products of the Out Islands are brought for export, including sponges, sisal, tortoise shell, tropical fruits, and cameo shells. Nassau is also famous as a winter resort, the balmy climate, fine hotels, and picturesque environment attracting many pleasure lovers and those anxious to avoid the severe winters of more northern climes.

The island of Andros is the largest land mass in the Bahamas. It extends for more than one hundred miles in a north-westerly direction, with its northern tip

lying nearly opposite New Providence. Its eastern shore is bordered by a magnificent coral barrier reef, 130 miles in length, almost overhanging the deep waters of the Tongue of the Ocean, and enclosing between its serrated submerged coral forests and the shore a lagoon of relatively quiet waters varying from a half-mile to a mile in width. This lagoon may be entered by channels at intervals and is generally navigable for vessels of light draft.

The island varies in width from twenty to forty miles and slopes gently from its eastern ridge to the western shore where, as in the case of the other islands, it becomes continuous with a submerged western bank, the Great Bahama Bank, extending about sixty miles toward the Florida Straits. This bank is floored with a very fine and soft calcareous ooze and is known by the Bahaman natives



MAP OF ANDROS ISLAND

The Great Bahama Banks to the westward of Andros form one of the chief sponging grounds of the Bahamas. The line of black dots along the eastern shore represents the location of the Andros Barrier Reef

as "The Mud." It is the chief sponging bank in the Bahamas, and together with the banks of the other islands, is the source of the chief product of the archipelago.

The principal varieties of commercial sponge secured here are the velvet sponge, the sheepswool sponge, the yellow sponge, the grass sponge, and the hardhead.

The sponging fleets are organized in Nassau and consist of sloops and schooners, manned by natives, many of whom

are from Andros. These vessels carry dories nested on their decks. Upon arrival at the sponging grounds, they are anchored, the crews being divided among the dories from which the actual fishing is done.

The spongers use buckets with glass bottoms, through which they can easily see the sea-floor, and thus locate the sponges. They then lower sponge hooks, long poles with two iron hooks at the end, by means of which the sponges are secured and brought to the surface and are loaded on the boats.



THE STAGHORN CORAL
(*Acropora cervicornis*)

In this species, the coral structure grows forward much more rapidly than the polyps reproduce by fission, or self-division, resulting in a loosely branching, tree-like coral skeleton

The commercial sponge is an animal colony of very low organization. The living portion is a black flesh perforated by thousands of pores opening into canals which penetrate every part of the sponge tissue and lead to numerous chambers where the food of the sponge is digested.

Sponges feed upon microscopic animals and plants, such as protozoa, diatoms, and the minute larvæ of larger forms. These are sucked in through the pores and drawn through the canals to the digestive chambers, where a lining of "collared cells" absorbs and assimilates them into the sponge tissues. These collared cells are so called because each is equipped with a tumbler-shaped collar

of transparent tissue from which projects a lashlike whip, or cilium.

The cilia of the thousands of cells lining the cavity beat in unison, and by their rhythmic action keep a current of water passing through the digestive chambers, drawing it through the pores and canals from the outside in the process, thus producing the suction.

After leaving the ciliated chambers, the water passes through other canals to be emptied into the main excurrent cavities and expelled from the sponge through openings much larger than the incurrent pores, known as oscula.

The living tissues of the commercial sponge are supported by a close network

THE BRAIN CORAL
(*Mæandra viridis*)

This coral receives its name from the convoluted appearance of its surface sculpture, resembling somewhat the convolutions of the human brain. The polyps reproduce by division so rapidly that they divide again before the previous divisions are completed, thus producing long, winding rows of individuals with connected stomach-cavities





TYPICAL CORAL POLYPS HIGHLY MAGNIFIED

These tiny creatures manufacture the great limestone growths composing the living coral reefs. Each is a sac-like animal with an oval mouth-opening at the top, surrounded by a circle of tentacles, armed with sting-cells. They have the power of transforming the dissolved carbonate of lime in the sea-water into the solid limestone on which the living polyps are seated in a continuous layer, and which they are perpetually building higher beneath their bodies. The polyps reproduce asexually by self-division, thus rapidly spreading over a considerable area. New colonies are started by sexually reproduced, free-swimming larvæ

of soft, elastic fibers, closely allied to silk in their chemical composition. Their substance is known as spongin, because it is found only in sponges.

In non-commercial sponges, the spongin fibers contain siliceous or calcareous needles of various shapes and sizes, sometimes being so numerous and closely welded that the spongin is reduced to a cementing substance, or, in the "glass" sponges, is lacking entirely. Naturally such sponges are useless for commercial purposes.

When the living sponges have been collected, they are exposed to the sun and air to kill the living tissues, which begin to decay and slough off. In order to hasten this result, the natives repeatedly wash the sponges and beat them

with clubs. They are then brought to a convenient locality on the shore and heaped in partly submerged enclosures, known as "crawls," where they are washed by wave-action. Later the beating process is continued until the soft skeleton is completely freed of animal substance. This is a very disagreeable process, as the decaying tissues naturally are malodorous, to say the least.

After the sponges are thoroughly cured, they are brought to sponge houses, where they are trimmed for market. The vessels then transport them to Nassau, to be spread out under the sheds in the sponge exchange, where they are auctioned to the highest bidder. Later they are further sorted, trimmed, and shipped abroad.

Andros Island is really an archipelago.



A REMARKABLE VISTA THROUGH LUXURIANT CORAL GROWTHS

Photographed from the floor of the sea. Tangles and clusters of sea bushes and sea fans rise among the closely crowded heads of various coral species in the clearings between the coral groves

Three straits, known as bights, intersect it from east to west, dividing it into four main portions, of which the northern and southern divisions are the largest. These straits are called North Bight, Middle Bight, and South Bight, respectively, and lead in turn into numerous subsidiary channels winding in labyrinthine fashion among picturesque, low-lying islets, covered with dense growths of tropical vegetation, where it is easy to become completely lost unless one is accompanied by a native pilot. In northern Andros, there is a great inland fresh-water lake approached by a number of these channels, and especially by a channel from the western shore, known as the Wide Opening. Here wild duck, herons, and other birds abound in great profusion, so that the region is a favorite resort for sportsmen. Much of the interior surrounding this lake and its complicated waterways has been little explored, and tradition has

it that it was one of the rendezvous of the buccaneers of former days, and that its forest tangles still hold the secret of buried treasure. Some well-known works of fiction have been founded upon these legends.

Many land-snails of the genus *Cerion* are found on the islets with which the waterways are sown. Their shells are extremely variable in color, sculpture, and proportions, and the animals interbreed in various complicated ways. Since they cannot cross the channels, every cay has its own peculiar varieties and sometimes separate species. For this reason they are quite interesting to naturalists.

Southern Andros is one of the best forested parts of the island. Many hardwood trees grow here to a considerable height, including mahogany, logwood, cedar, madeira, horseflesh, lignum-vitæ, and mastic. Here also there are extensive swamps in the interior. Through



SUNLIT CORALS ON THE BOTTOM OF THE SEA

Among scattered, dome-shaped heads of green brain coral (*Mæandra viridis*) and purple *Siderastræas*, bright yellow nodules of *Porites* completely cover the ocean bottom, gleaming like nuggets of gold in the sunlight

Grassy Creek, so called because of the great stretches of green grass growing over its bottom, there is an approach to an extensive mangrove swamp in the interior, where one of the best-known flamingo swamps is located, made famous by Dr. Frank M. Chapman's investigations and by the flamingo group in the bird gallery of the American Museum, which was one of the results. A quotation from a visitor to this colony gives a vivid picture of the region and its remarkable bird population. "As the boat glides over a wonderful and fantastic growth of sea anemones, coral, and a multitude of fishes, each turn of the creek reveals a new picture of interest. The visitor is greeted all along the shore by cranes, pelicans, cormorants, cuckoos, black parrots, and mocking birds, until at last far across the swamp a wonderful sight, which might be taken for a regi-

ment of scarlet clad soldiers, bursts into view, for here is the breeding place of the flamingo, and hundreds of birds may be seen stalking about in a most stately fashion until they become aware of the arrival of visitors, when, at the signal of one screaming honk, the whole flock rises into the air in a flaming cloud."

Though there are various forested tracts like those above mentioned, a large part of the island is covered with dense tangles of scrub vegetation, largely of a xerophytic character, such as prickly pear and other species of cactus and thorny plants of many kinds. The soil is either limy or black and rich where it occurs, and is rather thin, often giving place to the underlying bare rock.

The foundation rock of Andros, like that of the rest of the Bahamas, and, in fact of the whole southern portion of the peninsula of Florida, is a hardened lime-



A NATIVE CORAL DIVER RESTING AFTER A PLUNGE

A submarine tube and diving helmets were used by the men composing the Museum's expeditions, but partially nude native divers were also utilized to secure corals in shallower waters. This diver has just brought up, by repeated plunges, a boatload of finger corals, *Porites clavaria*

stone partly compacted of wind-blown sand formed from the shells of marine protozoa, and the reduced fragments of the limy skeletons of coral, deposits of calcareous algæ, the shells of mollusks and other marine creatures, and partly of oölitic limestone originating in the soft limy mud or marl such as is found over the sea bottom on the western side of the island. This is considered by many to result from the chemical precipitation of calcium carbonate directly from sea water due to the action of bacteria.

Larger fragments of coral, limy shells, and the spicules of gorgonia also take part in forming the substance of the rock. Frequent rains falling on the rock surfaces and washing through the acids of

the decaying vegetable soil dissolve the alkaline rocks so that they become at first pitted and then porous with cavities that unite beneath the surface to form a rock looking like magnified and hardened sponge. Near the shore, the superficial portion of the rock becomes eroded away by wave action so that the underlying cavities are unroofed, leaving sharp irregular pinnacles that make walking difficult. In many places, these smaller cavities have become enlarged to form subterranean passages and caverns.

Here and there, circular pits resembling potholes have formed, several feet in diameter, which penetrate the depths and have subterranean connections with the sea, either at its present or its former levels. These pits are often called "banana holes" by the natives, because they are occasionally filled with black and fertile earth, washed into them by rains, in which clumps of bananas are readily cultivated.

In wild places, tangles of tropical vegetation grow in them most luxuriantly. Many of the connecting caverns are said to have been utilized by pirates.

Andros was doubtless much more elevated than at present, and there are indications that partial submergence has taken place at a comparatively recent date. Out in the lagoon inside the coral reef there are submerged pits, similar to the terrestrial pits, and called by the natives "blue holes," because the deep water in them appears bluer than the surrounding shallow water of the lagoon. These are more or less circular wells often many yards in diameter extending down to considerable depths and lined with coral growths. Usually there is a

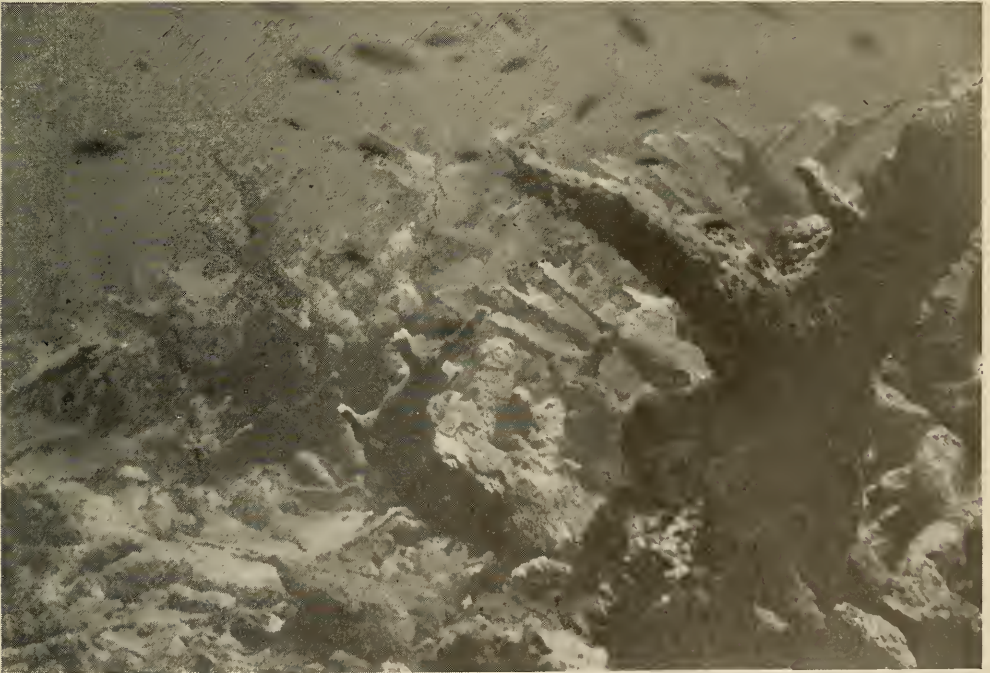
submarine connection with other "holes" and often with the open sea outside the reef. Gibson Cay, which is an islet a short distance inside the outer reef, has two land-locked blue holes, like circular ponds in the midst of the low, porous rock of which the cay is composed. Each of these is alive with large marine fishes, which could enter only by a submarine passage. Each of these blue holes has a corresponding submerged blue hole in the shallow water outside the cay and close to the summit of one of the reefs.

When the tide is flowing, it is sucked into the outer holes, and rises in the land-locked pools on the cay. When it is ebbing, the water-level sinks in the inner pools, and rises boiling out of the submerged holes outside. These blue holes were doubtless formed by rain erosion and solution when they were elevated above sea level, and have been enlarged

by wave and current action, and perhaps by the grinding of loose coral heads since they were submerged. At this time, of course, they received their lining of living coral growths.

The coral reef of Andros, which borders its eastern shore, has been described in a previous issue of *NATURAL HISTORY*.¹ Exposed as it is to the trade winds blowing steadily against it from the east, and the upwelling currents from the depths of the Tongue of the Ocean, plenty of microscopic animals and plants are washed within the reach of the millions of tiny tentacles surrounding the hungry mouths of the polyps which crowd the coral growths. The dashing waves are loaded with oxygen and all the conditions are favorable for the growth and propagation of the forms associated in the life

¹"Hunting Corals in the Bahamas," By Roy W. Miner, *NATURAL HISTORY*, Sept.-Oct. 1924.



THE ANDROS BARRIER REEF FROM THE SEA FLOOR

The elkhorn coral (*Acropora palmata*) rises like huge marble trees with interlacing branches, tinted with saffron and terminating in broad, palm-shaped fronds. Extensive groves of these corals dominate the Barrier Reef, which parallels the eastern shore of Andros for 130 miles



THE ERODED ROCKY SHORE ON THE OUTSIDE OF LITTLE GOLDING CAY

This islet is on the line of the outer reef, and its windward shore is exposed to the surf driven upon it by the trade winds. The attacks of the waves break down the roofs of the miniature caverns with which the rock is completely permeated, and leave behind sharp eroded pinnacles standing so close together that the rock is difficult to walk upon

of the reef. Hence its development is unusually prolific.

The coral polyp is not much more than a sac-like stomach with a mouth surrounded by tentacles. The tentacles are furnished with sting-cells which kill or stupefy the minute prey, which is then drawn into the stomach and digested.

The polyp has the power of precipitating the calcium carbonate dissolved in sea water so abundantly in the tropics, and of laying it down beneath and around its body to form a cuplike skeleton or calyx. This is continually built higher, the polyp always being perched on the top. As the polyp feeds, it grows, and, after reaching a certain size, starts to divide into two polyps, the growing skeleton dividing with it. This process is repeated again and again with the result that huge limestone structures are formed with myriads of polyps over their surface.

If the upward growth is more rapid than the division, a tree-like coral skeleton is formed. If the division of the polyps keeps pace with the upward growth, a massive or dome-shaped coral head results. The staghorn coral (*Acropora cervicornis*) is an example of the former method of growth, and the star coral (*Siderastræa radians*) of the latter. The brain coral (*Mæandra viridis*) is a species in which the division is so rapid that before a polyp is completely divided the two halves divide again. New colonies are started by means of free-swimming larvæ, hatched from fertilized eggs.

Millions upon millions of polyps, each building a limestone castle, and continually increasing in geometrical ratio by self-division, in the course of time erect enormous and extensive reefs, the number of individual coral growths being spread and multiplied by the sexually formed free-swimming larvæ. These

reefs, in turn, are shattered by storms, the fragments being heaped up and consolidated until their substance is added to previous accumulations upon the shallow bank forming their substratum. When these heaps are raised above the level of the sea, the fragments are further broken up and amalgamated with drifting or windblown sand, while chemically precipitated calcareous mud from the warm and shallow waters of the protected lagoon infiltrates the crevices and becomes a part of the whole. The shells of mollusks and other marine creatures contribute their quota as do the calcareous plants. An islet is thus formed subjected to weathering and wave erosion. Soil and seeds, including coconuts, are washed upon its shores, tropical vegetation springs up and various forms of animal life come to dwell upon it, and

finally perhaps man. Thus our coral polyps qualify as world builders.

The dominant corals of the Andros barrier reef are the great palmate, or elkhorn corals (*Acropora palmata*), which grow up from the submerged platform as groves of gnarled and twisted limestone trees, towering to a height of ten or twenty feet, with closely interlaced branches, tan in color, with snowy white tips, the longest of which always grow away from the prevailing winds and currents and thus point toward the land. The ends of these branches tend to reach the surface at low water, while those that grow toward the open sea are more stunted, so that as one views the barrier reef from the surface, the tips of the corals all seem to point in the same direction.

The elkhorn coral groves are often triangular in shape, with the apex



A WEIRD LANDSCAPE ON GIBSON CAY

Illustrating the eroded and cavernous character of the limestone rock composing many of these islands. The view is taken not far from the border of one of the land-locked "blue holes" described in the text. Underneath the surface of the rock, complicated miniature caverns and passageways give it the appearance of a huge stony sponge



A SAIL CONSTRUCTED FROM FLOUR SACKS

The native boats are usually homemade, and are often crude affairs, but they form the only effective means by which the negroes can get about from island to island or secure the large proportion of their food that comes from the sea. The dusky crew of this craft manipulates it with amazing skill

pointed toward the open sea, and with reëntrant angles between them. At one place twelve of these huge groves were counted adjoining each other within the space of three-quarters of a mile, making a zigzag outline, like the teeth of an enormous saw.

In front of these groves, as we viewed them from the sea-bottom through the windows of the Williamson submarine tube, we could see close-set thickets of staghorn coral, their tapering branches bristling in all directions, interspersed with frequent clumps of the closely related *Acropora prolifera*, the delicate tracery of its finer branches forming symmetrical fan-shaped clusters that seemed too fragile to withstand the currents of their exposed position, while here and there loomed the domes of brain corals and purple *Siderastræas*. In the reëntrant angles between adjacent groves,

groups of short columnar growths, with rounded tops or mushroom-like caps were visible. These were the orb corals (*Orbicella annularis*), their green and pink tops adding touches of soft color to the scene. Here the sea floor was heaped with nodules of golden yellow *Porites astræoides*, resembling nuggets of gold as the flickering light of the sunbeams penetrating the ocean surface played over them. Hosts of purple and yellow sea fans waved back and forth in unison. Magenta sea plumes, brown sea bushes, and purple sea whips diversified the scene with their soft plantlike colonies. Scarlet sea anemones, gray, red and green sponges, the spirally unfolding gill-circlelets of the *Spirographis* worms, with their purple and gray filaments, like pulsating passion flowers of the sea, enlivened with their bright colors the softer hues of the corals. Above, around and

through the coral branches darted schools of brilliantly colored fishes, their striking, iridescent patterns flashing like jewels in the sunlight which streamed down upon them.

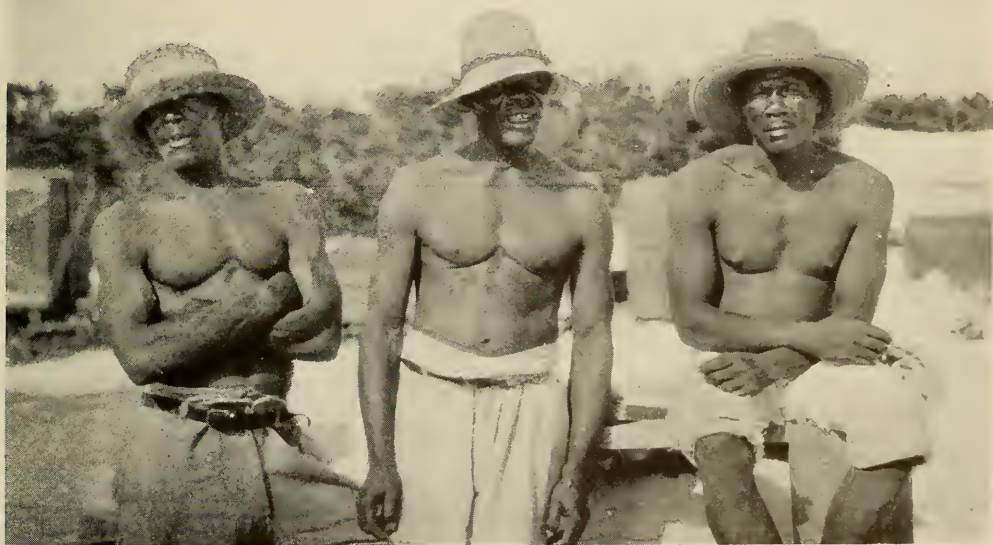
The onlooker, gazing at this scene from the ocean floor, seems to be transported into a new world of strange and weird beauty, a world of tinted marble forests, where interlacing fronds intercept the dancing sunbeams penetrating the watery atmosphere, clear as crystal in the foreground, but melting into a soft powdery blue haze here and there shot with flickering gold where the sunlight illumines it; a world in which deep but colorful shadows alternate with motile areas of contrasting brilliancy, punctuated by the kaleidoscopic swarms of gleaming and darting fish forms. Humanity, with its troubles and complexes, seems far away and of no importance. However, after a time, we remount the tube, come out

once more above the surface of the waters, and turn our faces toward the land.

It is very interesting to a person from northern lands to approach such an island as Andros from the open sea. The shore lies so low that the first glimpse of land reveals only a long line of tiny spikes, irregularly spaced like the broken teeth of a fine comb, appearing and disappearing momentarily among the dancing waves on the horizon. Soon these resolve themselves into distant palm trees, which rapidly become larger and more plainly visible as the boat nears the shore.

Now it is possible to see the waves breaking against the exposed tips of the coral barrier in long lines of white foam which contrast vividly with the ultramarine blue of the open sea and the brilliant green slicks of quieter water covering the sand bars within the lagoon.

As one enters the channel, above the settlement of Mangrove Cay, the shore



THREE TYPICAL NATIVES OF ANDROS

These brawny men were used as divers during one of the Museum's expeditions. The original inhabitants of the Bahamas were Carib Indians. They were early exterminated by the Spanish settlers, and the islands were later repopled by negro slaves brought from Africa. There are now about 7000 negroes on the island of Andros



CLIMBING FOR A DRINK

Groves of coconut palms grow luxuriantly along the shore of Andros. The meat or "jelly" lining the interior of the nut is most nutritious, and, when picked at the right time, the central cavity is filled with a cool and most refreshing fluid, the coconut "milk"

still seems far away across the two miles of lagoon, but when closer, the band of snowy beach becomes visible with the plumes of the coconuts tossing above it, overhanging thickets of sea grapes and clumps of bay lavender, while, here and there, the dense glossy foliage of almond trees relieves the monotony of the coconuts.

Beyond rises a low ridge partly bare and partly clothed in verdure, dotted with the huts of native settlements, while on the crest of the hill the red roof of the more pretentious Residency of the Commissioner is visible. Toward the south, a cluster of stone houses surrounded by a wall, with the Union Jack

floating over it, proclaims the location of the Government Offices. Soon we are anchored off a little wooden pier extending far out into the water, but as it is now low tide, it is too shallow for our boat, and we are obliged to land in a dinghy. A shout from the shore attracts our attention, and presently a tall, thin, white man comes running out on the pier, followed by a straggling line of negroes of assorted ages. We are soon shaking hands with Commissioner Forsythe who greets us most cordially and offers us the hospitality of his home.

Andros was originally inhabited by Carib Indians like the rest of the Bahamas, or the Lucayos, as they were called by Columbus. The Spanish conquerors enslaved the entire population of the archipelago, numbering about 40,000, and transported it to Hispaniola, where it was soon exterminated. Now the only traces of the aborigines consist of skulls and other bones found in some of the

caves of southern Andros, where also remains of a canoe with paddles were discovered. The present population consists of about 7000 negroes, the descendants of slaves brought from Africa. The only whites are the Commissioners of Northern and Southern Andros, and their families, and a few missionaries. Commissioner Forsythe, of Southern Andros, acts as the representative of the Governor at Nassau and rules over his negro wards with a firm but kind hand. He is also Justice of the Peace, and, as such, holds court and sentences offenders. The jail is in the walled compound with the executive offices. When I visited the building, there was one prisoner there.

He was sitting on his cot in a most comfortable cell with the outer door wide open and the sunlight streaming in. He seemed quite happy. I asked him what he was put in there for, and he said he didn't know. He said he went out whenever he pleased during the day, but was always on hand for meals. In the evening he came back promptly in time for dinner, and was locked up for the night. He said he thought he was well treated.

Of course, the Commissioner performs the marriages for his black subjects. When asked how he could arrange it for so many, he said he married all he could and the rest "just got along."

Among other duties the Commissioner is Warden of the Flamingoes, and makes periodical visits to the colony at Grassy Creek, endeavoring to enforce the gov-

ernmental protection over the practically defenseless birds. Otherwise natives would exterminate them.

Most of the able-bodied men of Andros engage in sponging, and are away with the fleets a large part of the time. Agriculture suffers in consequence, though the island is capable of growing tropical fruits. Plantations of these linger here and there and are carried on in a desultory sort of way. The negroes are happy-go-lucky and support themselves on what they earn sponging, or living on coconuts, fruit, and by fishing. There are plenty of fine food fishes in the lagoons and around the reef. Bone-fishes, barracudas, red snappers, trunk fishes, jacks, green turtles, spiny lobsters, and conchs abound and may be secured with little effort. Iguanas live in the interior and are so much prized



PICTURESQUE CLUMPS OF BAY LAVENDER ADORN THE UPPER REACHES
OF THE OCEAN BEACH

This decorative plant (*Suriana maritima*) has a gray-green foliage and gives the impression of having been sprinkled with a white, powdery dust. Great mound-shaped clusters grow on every sandy beach and add much to the beauty and diversity of the shore vegetation. The burrow-openings of land crabs are often overshadowed by their leafage

for food that they are now becoming scarce.

"Diving conchs" is a favorite occupation. Natives often may be seen with their boats anchored in the lagoon, engaged in diving down into the clear waters for these huge sea-snails of which they are very fond. The flesh though edible, is quite tough. It is often cut up and eaten raw. It also forms an excellent bait for fishing.

One of the methods of catching the sea turtles is interesting. When one of these huge creatures is seen rising toward the surface, a native will suddenly dive from his boat and seize it firmly by the front edge of the shell just above the turtle's head. The creature will immediately dive, and the negro, holding his breath, will cling for dear life and manage to get his feet on the hinder part of the shell, so that he can throw his weight backward, and thus turn the turtle's head toward the surface. This causes the turtle to swim upward. When the head of the negro breaks through the waves, he takes a quick breath. The turtle turns and dives downward again, and the process is repeated until the turtle is

tired out, and can no longer dive. He is then hit over the head with a hatchet, killed, and hauled aboard the skiff.

The native boat is usually homemade and is a very crude affair, with sails constructed of odds and ends. I have occasionally seen the latter made of four old flour sacks sewn together. The negroes are expert sailors and can keep tiny boats upright in a stiff wind with a large spread of sail, while the same boat will immediately capsize in the hands of a white man.

They are a simple but very kindly people, living in a region of perpetual summer, and lead happy lives as a rule. At times, however, devastating hurricanes descend upon them, swamping sponge fleets, drowning crews, destroying houses and crops, and blowing down the precious coconut palms. The poor natives then suffer every hardship. But the Colonial Government steps in with food, clothing, and medicines, and through the agency of the Commissioner, alleviates their sufferings. Huts are rebuilt, more crops are planted, crude boats are pieced together, and soon the troubles are forgotten. Andros once more resumes the aspect of a tropical island Paradise.



NOSES

How Nature Adapts and Develops Noses to the Needs of
Her Creatures—Queer Uses for Queer Noses

By ROBERT T. HATT

Assistant Curator, Mammals of the World, American Museum

SMELL and taste are but slightly differentiated branches of one sense.

Violets and vinegar produce sensations of smell and taste that are quite similar, and thus we are given an opportunity to take more delicate samples of many objects by smelling than by tasting. Taste is the chemical informer to the brain, located in the mouth, which acts as messenger concerning whether or not things introduced there may suitably be swallowed. In both the water-living vertebrates and land mammals the sense of smell samples the air or liquid environments, and gives the brain information of what lies about that the eye may not see nor the ears perceive. In this same way the housewife usually selects melons by odor, and a careful cook will not use an egg until the nose has verified the diagnosis of the eyes. Unfortunately some things, such as salt, produce no volatile odor, and must be dissolved to give their information.

In many lower animals, amphibians, reptiles, and marsupial mammals, there is a passage between the nasal chamber and the roof of the mouth, the function of which, in the lower animals, may be

the sampling by smell of things that have been taken into the mouth.

Our delicate odor receptive cells lie within a moist chamber, and, as in the fishes, all stimuli must be borne to them first through a liquid medium. In most fishes the olfactory nerves ramify over a rosetted membrane lining a small pit on the under side of the rostrum. As fish are not lung breathers, they have no occasion to pass the air or water on to the pharynx, as we have. Their noses are but pockets to guard these most important sense perceptors.

It is likely that this chemical-receptor sense is the earliest of all developed, or at least concurrent with the sense of touch. Give a baby a new object. What does he do with it? Usually he carries it directly to his mouth. Thus he gets his first information about things.



"Mrs. Murphy" is submersible and has her nose where it alone can be out of water

What's in a nose? In truth the interior of the nose is equipped to perform two vastly important functions other than smell. Firstly, it must remove all impurities from the air and kill the harmful bacteria before they reach the lower respiratory passages. Secondly, it must warm the usually cooler air to body temperature.



GORILLAS HAVE LOW NOSES

Note the great contrast between the nose of the gorilla above and that of the proboscis monkey on page 499. The first foreshadows the nose of man, while the other is probably only for display

For this there is an elaborate and beautifully delicate set of turbinate bones that are covered with a richly vascular membrane. Through the small channels in these bones the air must pass and in the process it is quickly warmed. The all but extinct sea otter which lives in the cold waters of the North Pacific is the best equipped of all the mammals in this regard. When one looks into the nasal chamber of a sea otter's skull, he sees a set of these turbinates that have the complexity of a sponge.

One might expect to find in whales the best set of turbinates, but strangely enough they have none at all! This is somewhat compensated for in the sperm whale by a set of air chambers which doubtless aid in warming up the air.

These scroll-like turbinates vary considerably in their complexity in different kinds of animals. There are in the main,

two pairs of them, the ethmo-turbinals, which grow out from a median bony septum in the nose, and the maxillo-turbinals, which grow inward from the upper jaw. The olfactory nerves are said to be distributed largely over the first set, while the lower set are chiefly concerned with air warming. Thus cats, whose sense of smell is poor, have small ethmo-turbinals, while dogs such as bloodhounds have them well developed. It will be noted that the breeds of dogs whose sense of smell is best developed have deep muzzles, accommodating large ethmo-turbinals, while dogs that hunt by sight, such as the borzoi, are very shallow here.

The better to detect a subtle odor we breathe deeply, or, in doglike fashion, sniff the air, thus sending a better draught into the olfactory chamber.

The keenness of scent among other

animals is a thing that human beings can scarcely appreciate. Hounds, dogs which have been developed for ability to detect and follow the faintest odors, are probably among the best equipped of all. A good dog may be put on a rabbit track and, by examining its odors over but a few feet of the trail, will know which way the animal traveled. He can also, of course, distinguish between many kinds of animal trails. A good coon dog will not follow a possum or a rabbit trail. The mysteries which a dog can unravel by nosing his signal stations, we can but speculate on.

The keen scent of both dogs and pigs has been utilized in France in the hunting of truffles. The dogs used for this are usually poodles, white by preference, as they are used at night. These dogs are trained to dig up the truffles and carry them to their masters. In Anjou and in America the squirrels dig up foul-smelling false-truffles of several species and use them as food.

Squirrels have often been supposed to find their myriad buried nuts by scent, yet squirrels consistently failed to find



Photograph by Herbert Lang

FACIAL ADORNMENT IN AFRICA

The sense of smell is highly developed in savage peoples because of the thousand and one ways in which they are daily dependent on this sense for survival in their primitive environment. Under similar conditions the white man's sense of smell would probably again become as keen as theirs

nuts which were covered by but a very thin film of sand in a tray from which they were fed every day. These squirrels would, on the other hand, find at least some of the nuts which they themselves had buried. Memory doubtless plays an important rôle in the location of their stores.

There are numerous instances in which scent has apparently led animals to swim great distances in search of food. Red squirrels often are seen swimming Lake George, it is said toward the chestnut crop on the other side, but scent may or may not be the agency that induces the adventure. I have been told of wild pigs which swam several miles through salt water to an island on which coconuts were ripening, and in this instance the wind was from the island to the mainland. I have traced a skunk two miles upwind, and I have detected a whaling station at a much greater distance, but our noses are of little service to us in connection with less spectacular phenomena.



Photograph by Le Gros Clark

A PROBOSCIS MONKEY

This gaudy, leaf-eating monkey of Asia is notorious for his pendulous nose and tremendous stomach



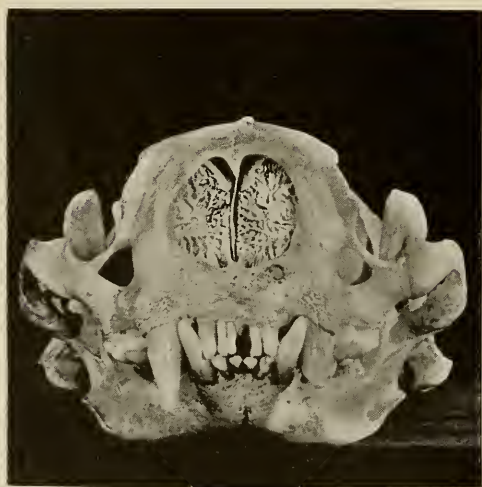
NATURE'S BEST NOSE

A gatherer, bath spray, weapon, and bugle all in one, the elephant's trunk is his priceless possession

Noses take many shapes. Among men they are to a high degree diagnostic of races, and through this, to some extent are guides to character. The straight

and narrow nose of the Nordic and the low broad nose of the Negro are contrasting features of races whose psychic traits are in bold contrast. Among other primates the gorilla and the proboscis monkey offer the greatest contrast in development, though not in underlying structure. The nose of the gorilla foreshadows the nose of man, while the nose of the proboscis monkey (developed strikingly in the old males only) is probably but a feature for display.

Many peoples, feeling that nature could be improved upon, have decorated their noses with tattooing and painting. Among the European races, it is not uncommon among the fairer half of the population to restore the lost lanugo, or "bloom of youth" with finely powdered rice. Certain South-Sea Islanders and some African tribes pierce the septum of the nose and here introduce such glorious jewelry as shafts of ivory, bone, or wood. Re-



THE SEA OTTER'S NOSE

The sea otter has an elaborate air-warming sponge-like structure in his nose

cently our pugulists and actresses who, through accident or inheritance, had noses unpleasing to them, have had their profiles altered the better to suit their tastes.

Externally our noses have little function other than protecting their two openings, the nares, and guarding the eyes. Size alone means little. Early in the Eighteenth Century there lived in Yorkshire a man named Thomas Wedders whose nose had the unequalled length of seven and one half inches, yet the only benefit which he derived from this remarkable feature was a meager livelihood by exhibiting it. But, as we shall see, to many other species of mammals the form is most important.

The nasal region of the head (everything in front of the eyes) has been hypertrophied in numerous creatures for different purposes. The elephant's trunk compensates for his unparalleled combina-



Photograph by Donald B. MacMillan

THE NOSE EQUIPMENT OF THE WALRUS

Whiskers like a steel brush on the walrus' broad muzzle are supposed to aid him in finding mollusks buried in the mud

tion of great stature and short neck. Thus he can feed from the ground and drink



Photograph by Jenness Richardson

A CAT'S NOSE-GUARD

Members of the cat family and their old acquaintances, the mice, carry long whiskers on their noses to help them feel their way in the darkness



Photograph by C. H. Townsend

MUSIC HATH CHARMS

A male sea elephant inflates his cavernous proboscis to trumpet his message to the beach colony

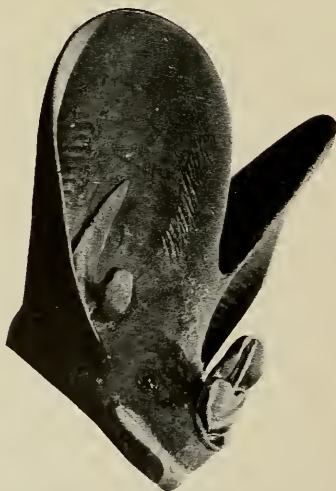
without bending his knees. With this mighty nose he can pull down trees, shower himself with water or dust, feel the air in all directions without moving his great bulk, and trumpet to his heart's content. In short, it is his priceless treasure and he guards it as such. But we know that it took the elephant a long time to get this and the "crocodile of the great-green-greasy Limpopo river" had nothing to do with it.

The tapirs have developed along the lines of the elephants, but as their noses are shorter, these lack the versatility of the trunks which they slightly resemble.

The giant anteater has developed a long tube in front of his eyes, too, but this is more than a trunk. The skull itself is

elongated almost to the tip, and the head acts more as a scabbard for the long exploratory tongue, than as a face of any other legitimate excuse. In all this long mouth there are no teeth, for his mymecophagous diet does not require them. One famous French anatomist found that even in the case of dogs, those whose teeth were pulled at an early age developed larger skulls than did their litter mates.

The sperm whale has a great square nose that houses a reservoir of spermaceti oil, which in all likelihood is there as a buoyant mass to aid in control of the over-



From a Model by G. R. Miller, Jr.

THE LEAF-NOSE

The exuberant nasal exfoliation of this insect-eating bat carries a special set of sense organs essential to its insect-catching habits

heavy head. From this nose emerges but a single nostril, and from this nostril rushes out the warm air from his lungs, heavily laden with a water vapor that condenses as it strikes the cold air and forms a great shower of spray. It is this sight that moves the man in the crow's nest of a whaler to cry out "Thar she blows," with which cry the chase begins.

The male sea elephants have a large sinusoidal proboscis which they inflate and with which they trumpet. So far as we know, it has no other use.

Pigs, coati-mundis, aard-varks, and others, whose calling is to root up the earth, have strong, long snouts and the



Photograph by R. C. Andrews

(Right)

USELESS NOSES

The borzois with heads high above the ground have shallow nasal chambers and a poor sense of smell, for they hunt by sight



Pamela and Parma O'Valley Farm

(Above)

"THAR SHE BLOWS"
A finback whale empties his lungs within sight of a whaler. The fountain is formed of the condensed vapor as it strikes the cold air



(Below)

AN EARTHLY DOUBLE STAR

Twenty-two fleshy feelers halo the nose of the star-nosed mole



Photograph by M. C. Dickerson

will to use them. A pair of wild pigs in the New York Zoo ripped up the entire asphalt floor of their outdoor enclosure, and under this probably found nothing to justify their labors.

Some noses are seemingly made as living probes. Australia's spiny ante-eater, the moles and many other insectivores, have noses with which they probe loose earth and insect burrows in quest of their elusive delicacies.

The *ne plus ultra* of all probes is borne by the star-nosed mole of the United States. This animal's most forward point is encircled with twenty-two fleshy probes which give him great advantage over



Courtesy N. Y. Zool. Soc.

ASPHALT PLOWS

These hogs have done with their noses that for which we would use pneumatic drills. To help them there is a plate of bone within the nose pad

kindred burrowers that search the soil for worms.

When in search of sensitive noses, though, we find their optimum not in the earth-heaving insectivora, but among our finest fliers, the bats. Large numbers of species of the leaf-nosed bats have elaborate yet delicate foldings of naked skin about their noses, and these structures are equipped with delicate nerve endings which are believed to pick up vibrations in the air caused by insect wings or by the echo of air waves initiated by the bats themselves. Their nightmarelike physiognomies are scarcely excelled in grotesque features by the ceremonial masques of primitive men. Only one group of the fruit-eating bats even approaches the elaborate facial make-up of its carnivorous allies, and this is the tube-nosed bats of Malay. The nostrils

in these forms open out from long fleshy tubes whose function may be the furnishing of an outlet for air when their muzzles are buried in a large fruit.

There are in several desert-living animals—animals whose noses are frequently subjected to the unpleasant blasts of sand and dust—sphincter muscles about the nostrils which close these when the need arises. Similar constriction occurs in such aquatic animals as the beaver and the hippopotamus.

Position of the nostril means everything to aquatic air breathers. Hippopotami, crocodiles, frogs, whales,—all have their nostrils so located that these parts emerge first from the water—and too, that the animals may lie hidden except for their nostrils and their eyes, which project up above the general level of their heads.

At the other end of the scale from all these glorious noses we find some that are sadly deficient, but man, not Nature,



After Gould and Pyle

THOMAS WEDDERS

The Yorkshire man whose seven and one-half inch nose was his means of livelihood



THE ANT BEAR
Myrmecophaga

A nose that roofs a record tongue. Note the smallness of the creature's mouth

has been responsible for this deficit. Those achondroplastic dwarfs, the bull dogs and Japanese spaniels, are equipped with noses so poor that they are subject to respiratory diseases more than is the common lot of dogs. Without the solicitous care of men they could not survive as a race.

Noses of most mammals are equipped to a variable degree with long stiff hairs that telegraph touch impulses to the body coming in contact with another object. Rabbits, mice, and cats, whose

habits are largely nocturnal, find use for their whiskers in warning them of things they do not see. The meadow mice find their vibrissæ of use to them in following tunnels when they are in haste. Squirrels are guarded by these hairs in their precipitous flight among the branches. The walrus may find his stiff imposing brush of service to him when raking among the mollusks of the muddy ocean floor.

What's in a nose? More than at first sight appears!



Florida During the Pleistocene or Ice Age. From a Drawing by M. Flinsch

HUNTING EXTINCT ANIMALS IN FLORIDA

The Difficult Science of Finding the Remains of Animals of Ages Long Past,
and the Reconstruction of Pictures of Those Ages

By GEORGE GAYLORD SIMPSON

Associate Curator of Vertebrate Palæontology, American Museum

THE Beastes best known in this Country are Stagges, Hindes, Goates, Deere, Leopards, Ounces, Luserns, divers sortes of Wolves, wilde Dogs, Hares, Cunnies, and a certaine kinde of Beast that differeth little from the Lyon of Africa."¹

Lovers of warmth, escaping from snow and ice by migrating to Florida, follow an example hundreds of thousands of years old. In the Ice Age, when great glaciers gathered and slowly pushed their way southward, the animal life of our continent was compelled to surge southward before them. Even in that cold time, the ice sheet at its farthest advance was some five hundred miles north of

Florida, and that favored peninsula, while doubtless less clement than now, offered to life a haven from the devastating cold. In the West, a pathway lay open to the tropics, but in the East, Florida, jutting into the sea, was the last refuge for southward migrants. Here were impounded myriads of animals, some familiar, many strange in this setting. Recent field and laboratory work has been devoted to bringing to light the remarkably rich and varied extinct faunas of the State.

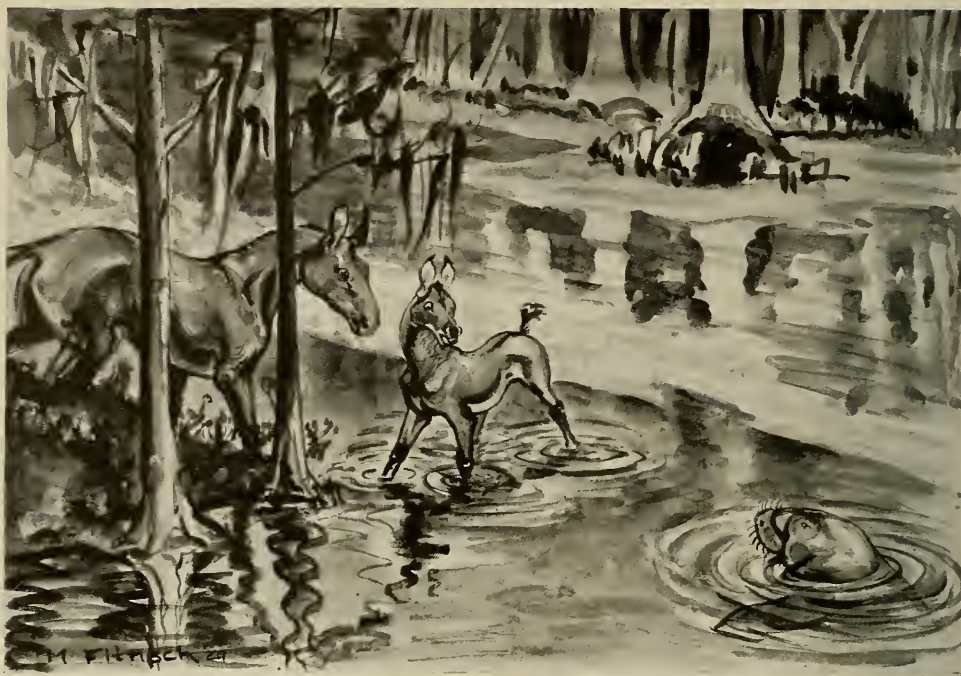
This conception of an ancient prehistory in this part of North America will be novel to many. It is a common idea that Florida is an appendage, a sort of happy afterthought, recently constructed

¹Hakluyt "The Beastes of Florida," *Principal Navigations, Voyages, Traffiques and Discoveries of the English Nation*, Hakluyt Society Edition, Vol. VIII.



SABER-TOOTH TIGER AND CAPYBARA

One of the most ferocious of Pleistocene mammals was the terrible saber-tooth tiger. In a cave in Citrus County, Florida, remains of this animal have been found, and this drawing suggests such a situation as might have caused the saber-tooth to entrap himself in a cave from which, after his meal, he was unable to escape. From a drawing by M. Flinsch



MIocene THREE-TOED HORSES AND A SEA COW

The three-toed horse flourished during the Miocene period that preceded the Pliocene and Pleistocene. It was not until the Pleistocene, many millions of years later than the Miocene, that the horse finally became one-toed, practically as we see him today. Drawing by M. Flinsch

of mud and sand, shell and coral. In reality, it is built on rock and even its surface formations record a geologic history of millions of years.

The oldest of these surface formations is of Upper Eocene Age, perhaps fifty million years old. This formation, a limestone slowly soluble in percolating ground water, is responsible for some of the most characteristic features of Florida, including many of the lakes and most of the large springs, and it also furnishes most of the underground water supply for communities and farms. To the student of extinct life, however, it is of little direct interest. Deposited in the sea, far from land, it contains only one known mammal—a primitive relative of the whales (*Basilosaurus* or *Zeuglodon*).

Deeply buried where only the deepest wells reveal its presence, there is a land surface beneath Florida much older than

the marine rocks of the Upper Eocene, but the definitive emergence of the peninsula probably did not begin until after the Eocene. Since that time, land and sea have fluctuated greatly, but the land has generally tended to increase to its present area.

Four successive vistas of land life in Florida are afforded by the fossils so far found. Most recent and most complete is that of the Pleistocene, or Ice Age, which ended only some twenty-five thousand years ago. Far older than this are the mammals from the earlier part of the preceding epoch, the Pliocene, and finally, still earlier, are two little known faunas from the next older epoch, the Miocene, one from the early and one from the middle part of this division of geologic time.

About fifteen years ago the first glimpse of the oldest of these land faunas



AN AMPHIBIOUS RHINOCEROS OF THE PLIOCENE AGE

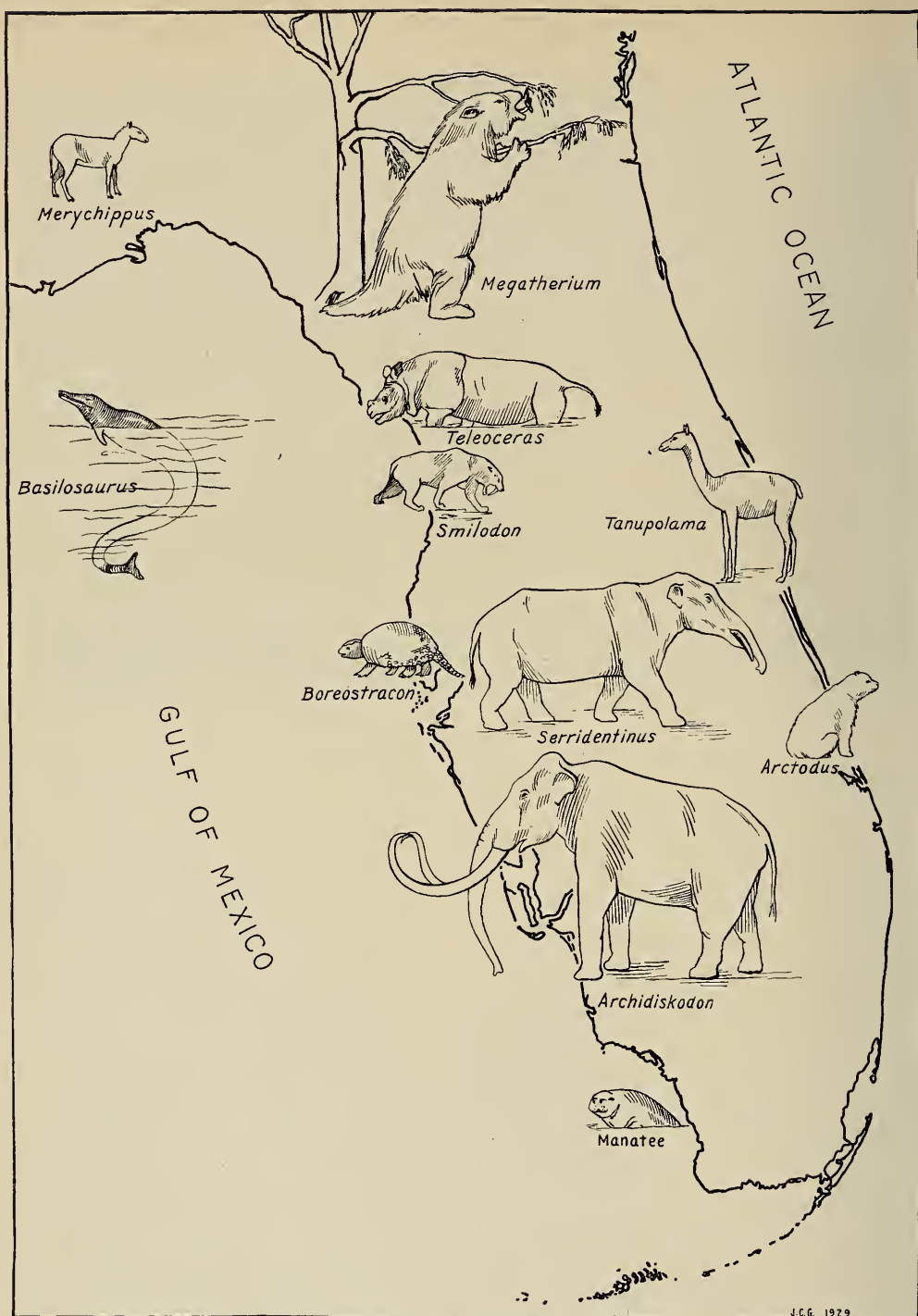
The Pliocene, preceding the Pleistocene or Ice Age and following the Miocene, also preceded the appearance of man upon the earth, but mammals of many species and of great size were common. From a drawing by M. Flinsch

was accidentally gained in digging a well north of Tallahassee. Here three-toed horses, primitive deer, and an ancient type of dog were found in rocks of lower Miocene Age. Logically beginning a prehistoric hunt here, we recently re-located the spot after much search and inquiry—only to find the well filled in and neatly covered with grass! Ruefully the state geologist, Mr. Herman Gunter, and the writer gazed at the spot, where fifty feet below an important fossil stratum lies buried.

Incidentally, fossil hunting in Florida often calls for all the talents of a sleuth, but fortunately is not always so futile as in this case. For instance, we almost revived the reputedly riotous past of Mulberry when we searched through the town with the police force guiding us from the running board. With this help, we located a fine serrate-toothed mastodon

jaw which had been found some time before and now was in private hands. After some persuasion it was transferred to the ownership of the American Museum. But this belongs some weeks later in our journey and some millions of years later in geologic history.

For our next vista of ancient land life, that of the middle Miocene, we went to the fuller's earth mines northwest of Tallahassee, which are also (but quite unintentionally) fossil mines. In certain strata just above the fuller's earth or between two beds, fossil bones and teeth are fairly common. Here we found bones and teeth of a Miocene type of three-toed horse, *Merychippus*, as well as remains of primitive deer, camels, and rhinoceroses, and of a large doglike animal of a type previously unknown in Florida. These beds were laid down in the sea, or in estuaries, and the remains of land animals



J.C.G. 1929

SOME PREHISTORIC ANIMALS OF FLORIDA

Drawing by John Germann

Here are given restorations of some of the many fossil animals of Florida. Those on the land stand near points on the map where their remains have been found. From the oldest deposits of the state, those of the Eocene, comes the aquatic, whalelike *Basilosaurus*, here shown as swimming in the Gulf of Mexico. *Merychippus*, a small three-toed horse, is the commonest mammal of the Miocene Epoch. From the next epoch, the Pliocene, came the amphibious rhinoceros, *Teleoceras*, and the serrate-tooth mastodon, *Serridentinus*. Of the very numerous Pleistocene, or Ice Age, animals, a giant ground sloth (*Megatherium*), a saber-tooth tiger (*Smilodon*), a long-footed camel (*Tanuolama*), a glyptodont or tortoise-armadillo (*Boreostracon*), a short-faced bear (*Arctodus*), a mammoth (*Archidiskodon*) and a manatee, or Florida sea cow, are shown.



Photograph by George Gaylord Simpson

EXCAVATING A MAMMOTH

Carl Sorensen, of the American Museum staff, is shown beginning work along a canal bank near Bradenton. From this spot were recovered parts of two or more Columbian mammoths, as well as remains of a fossil horse, a bison, and a capybara

must have been drifted in by streams and currents, a fact which explains their scattered and usually broken condition.

More complete, because it lived in marine or estuarine waters, was a skeleton of a Miocene sea cow. This had been exposed, just before our visit, by the rude touch of dynamite and a steam shovel. When we arrived, work here was suspended, a trainload of dirt was dumped into the water below it to give us footing, and then a spur of the mine railroad was moved out of the way in order that we might salvage this important specimen,—unusual coöperation for which we have to thank the mine superintendent, Mr. R. H. Hopkins, and others.

Fragments of sea-cow ribs, easily recognized by their plump shape and extremely dense bone, are common in many Floridian deposits from the Miocene

onward. The lagoons and estuaries of the State have long been inhabited by various species of these ungainly but inoffensive aquatic beasts, as some of them still are today.

Knowledge of land life in Florida toward the beginning of the succeeding epoch, the Pliocene, is chiefly a by-product of mining for phosphate rock. In the north central part of the state (where the rhinoceros is shown on the accompanying figure) these are of land formation, but the more southern phosphates (where the serrate-toothed mastodon is shown) although probably found in a shallow sea near the shore, are equally productive of land mammal remains in places. A relatively small part of the life of that time is known, but it reveals an even stranger fauna than the previous epoch and well illustrates some principles



Florida State Geological Survey

WHERE FRAGMENTS OF THE THREE-TOED HORSE WERE FOUND

In this abandoned and mined-out pit of the Cummer Lumber Company near Newberry, Florida, was found part of the upper jaw with four teeth of *Merychippus*, the three-toed horse. The specimen was presented to the Museum of the Florida Geological Survey by Mr. Weston in March, 1929



Photograph by George Gaylord Simpson

ENTRANCE TO SABER-TOOTH CAVE

This cave near Lecanto in Citrus County was explored for fossil animals in 1928 by Walter W. Holmes, who stands at the head of the ladder. There are two openings on the surface that lead into a large subterranean chamber



AN OPEN PALMETTO GLADE IN FLORIDA

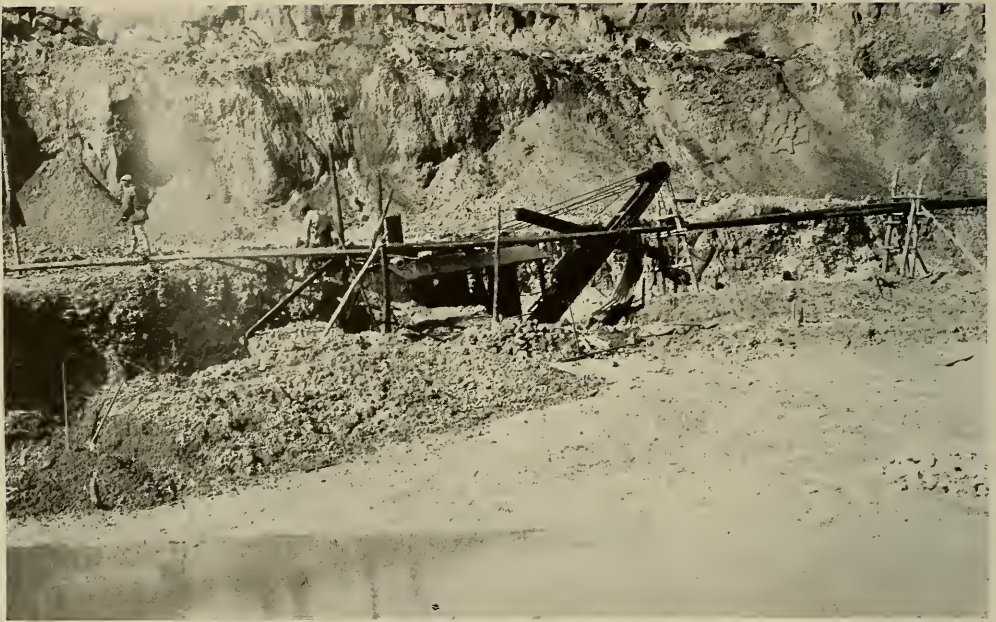
A typical scene in Florida. While many fossil remains may lie beneath surfaces such as the above, it is only by finding actual signs of the bones in eroded sections or in mines or other diggings, that the palaeontologist can complete his investigations



Florida State Geological Survey

A HAMMOCK NEAR PORT ORANGE, FLORIDA

Such heavy growth as this often proves a serious handicap to the fossil hunter, for it may easily conceal important remains that otherwise would help to piece out the record of life that existed during past ages



Photograph by George Gaylord Simpson

MINING FULLER'S EARTH AND *MERYCHIPPUS* TEETH

This line at Midway is operated for fuller's earth, but to the fossil hunters its most important products were the teeth and bones of *Merychippus*, a three-toed horse of the Miocene Epoch, which were found just above the fuller's earth on the level of the bench seen above the steam shovel

of life succession. Three-toed horses remain, but they have evolved into a new type, *Hipparion*, last of the fully three-toed horses. Similarly the rhinoceroses and camels are larger and more highly developed. These are old American families which antedate Florida itself. At this stage first appears a new group, wandering far from its original home in Africa by way of Europe and Asia, that of the mastodonts. These animals have not been found in any earlier deposit in Florida, probably because they did not reach this part of the world until well into Miocene times, but here they are fairly common. Two types occur: a primitive true mastodon (*Pliomastodon*) and several closely related species of serrate-toothed mastodonts (*Serridentinus*). The former was a forerunner, perhaps a direct ancestor, of the well known American mastodon (*Mastodon americanus*) of the Ice Age. It differed from this later type most noticeably in retaining small tusks

in the lower jaw, as well as the large tusks in the skull. The serrate-toothed mastodonts also had four tusks, of more nearly equal size, long lower jaws, and complex cheek teeth especially adapted, in the Florida species, to crushing and grinding fibrous vegetation. A large bear-dog (*Hyænarctos*) nearly completes what is known of this fauna.

Relatively scanty as our knowledge is of these earlier land faunas of Florida, its importance is great. By comparison with fossils from other parts of the world, they fix the age of the deposits in which they occur, deposits of economic as well as scientific importance because of the fuller's earth and phosphate rock. From a broader point of view, this is almost all that we know of mammalian life in the eastern half of the United States before the Pleistocene. It is reassuring to find that they agree in a general way with the much better known contemporaneous faunas of the western half of the conti-

ment. This indicates that Florida was then already a connected part of North America, and also that what we know of western fossil mammals probably gives us a fairly adequate idea of at least the plains life of this climatic zone throughout the breadth of the continent.

One question is so often asked that it demands a digression. Since fossil animals are usually sought in deserts and among dissected hills, how does it happen that so many are found in humid and low Florida?

In order to find fossils two things are necessary. In the first place, obviously, the animals must once have been present, and their remains must have been buried and fossilized. Florida was exceptionally favorable in these respects. Its mild or semi-tropical climate and its abundant

verdure were peculiarly adapted to supporting great numbers of animals. Furthermore, the first essential of fossilization is rapid natural burial, and this is much less likely to occur in an upland, which is being eroded, than in a lowland, like Florida, where deposition of mud and sand is more rapid and permanent and where marshes and sluggish streams abound. The conditions which still prevail in Florida today are probably very like those which obtained in many of the richest fossil areas when the fossil-bearing beds were being deposited, even though the region be elevated or arid now.

The second essential for finding fossil animals is that their remains must be partly exposed and visible. Paleontologists possess no mystic sixth sense



Photograph by George Gaylord Simpson

PEACE RIVER

Peace River, between Gardner and Zolfo, is well named. The rock ledge along the bank of this beautiful stream is of limestone, formed in the sea during the Miocene Epoch. Lying on it may be seen a bed of gravel which contains numerous fossil sea-cow bones and teeth of extinct mammoths, horses, bison, and other animals of the Ice Age



Photograph by George Gaylord Simpson

WAKULLA SPRING

Where soft, easily soluble limestone lies close to the surface, the underground formations of Florida are almost like a sponge, and from them flow some of the largest springs in the world. In the clear water of Wakulla Spring the bones of a mastodon were found some years ago. Even today the spring has a weird almost prehistoric aspect with its fringe of gaunt, moss-hung cypresses crowded with perching buzzards

which enables them to find hidden bones. They never dig unless they know very well that bone is there, and they usually have no way of knowing except by finding some exposed. In humid regions fossils may be abundant, as they are in Florida, but very difficult to find because of the absence of eroded "bad land" areas which are often so common in a drier climate. Most of Florida's ancient fauna would still sleep undisturbed were it not that man has dug into the ground so extensively for other purposes. Although usually little suspected, Florida supports a considerable mining and quarrying industry.

The essential part that mining has played in the discovery of some of the older fossils has already been suggested. The hundreds of drainage canals that cut through the superficial strata are equally important, especially for Pleistocene remains, which here are often (but not necessarily) less deeply buried than those of the Miocene or Pliocene.

So we come once more to the oldest winter residents, the animals of the Pleistocene Epoch, which was an Ice Age for much of the rest of the world. Remains of Pleistocene mammals are very widely scattered through the relatively shallow deposits of sand, clay, and muck of the State, and they reveal an amazingly rich fauna. For instance, about five years ago, Mr. Walter W. Holmes found near St. Petersburg a few fragments of fossil bone in a canal spoil bank. Following this up for several successive seasons and digging into the bank where the dredge had thrown out most bones, he uncovered a fauna at one locality which includes nearly fifty species of land mammals. In recent times the entire peninsula of Florida has been inhabited by less than thirty species.

Perhaps no better idea of the amazing life in Florida during the Pleistocene can be given than by a synoptic list of the species of land mammals so far discovered.

Such a list looks formidable and dull, but a moment's thought should find much that is interesting in it. Space is lacking here to do more than suggest a few of these points. For one thing, the length itself is of interest, since it shows that in the Pleistocene there were more than twice as many different kinds of land mammals in Florida as now. The very presence of lions, saber-tooth tigers, camels, mastodons, and mammoths, among others, is striking. Then there is the picture of

animals now characteristic of other parts of North America crowded in here during the Ice Age, such as the western pocket gopher, beaver, red fox, elk, and bison, to mention only a few. Other animals were immigrants from South America, including the porcupine, capybaras (largest of living rodents), and all of the edentates, while some, although anciently natives of North America, have their nearest relatives of today in Central or South America, such as the short-

PLEISTOCENE LAND MAMMALS DISCOVERED IN FLORIDA TO DATE

*Species extinct or no longer living in Florida

MARSUPIALS—

Didelphis virginiana, the common opossum.

INSECTIVORES—

Scalopus aquaticus, common mole.

Cryptotis floridana, Florida short-tailed shrew.

Blarina brevicauda, Everglade short-tailed shrew.

RODENTS—

Sylvilagus floridanus, Florida cottontail.

Sylvilagus palustris, marsh rabbit.

Sciurus carolinensis, gray squirrel.

Geomys floridanus, Florida pocket gopher.

**Thomomys orientalis*, an extinct relative of the western pocket gophers.

Reithrodontomys, a species of harvest mouse.

Oryzomys palustris, rice rat.

Sigmodon hispidus, cotton rat.

Neotoma floridana, Florida wood rat.

Neofiber alleni, round-tailed muskrat.

**Synaptomys australis*, southern mouse-lemming.

**Castor*, a species of beaver.

**Castoroides ohioensis*, the giant beaver.

**Erethizon*, a species of porcupine.

**Hydrochoerus holmesi*, Holmes' capybara.

**Hydrochoerus pinckneyi*, giant capybara.

CARNIVORES—

Euarctos floridanus, black bear.

**Arctodus floridanus*, extinct short-faced bear.

Procyon lotor, common raccoon.

**Procyon nanus*, extinct dwarf raccoon.

Mustela peninsulæ, Florida weasel.

Lutra canadensis, otter.

Spilogale ambarvalis, spotted skunk.

Mephitis elongata, striped skunk.

Urocyon cinereoargenteus, gray fox.

**Urocyon seminolensis*, extinct gray fox.

**Vulpes palmaria*, extinct red fox.

**Canis ayersi*, dire wolf.

**Canis rivveronis*, extinct coyote.

**Felis veronis*, extinct Florida lion.

Lynx rufus, bobcat.

**Smilodon floridanus*, saber-tooth tiger.

EDENTATES—

**Megatherium*, a species of giant ground sloth.

**Megalonyx*, probably two species of large-clawed ground sloths.

**Myiodon harlani*, Harlan's ground sloths.

**Tatu bellus*, armadillo, like that still living in Texas but larger.

**Chlamytherium septentrionale*, giant armadillo.

**Boreostracon floridanus*, glyptodont or tortoise-armadillo.

UNGULATES—

**Equus*, probably three species of one-hoofed horses.

**Tapirus*, two or three species of extinct tapirs.

Odocoileus osceola, white-tailed deer.

**Odocoileus sellardsiae*, extinct deer.

**Cervus*, a species of elk.

**Platygonus*, a species of extinct crested-toothed peccary.

**Mylohyus*, four or five other extinct species of peccaries, mostly of this genus.

**Tanupolama mirifica*, extinct, small, long-footed camel.

**Camelops*, a species of larger, heavy-footed camel.

**Bison*, a species of extinct bison.

PROBOSCIDEANS—

**Mastodon americanus*, American mastodon.

**Archidiskodon columbi*, Columbian mammoth.

**Archidiskodon imperator*, imperial mammoth.

faced bear (related to the South American spectacled bear), the peccaries, and the camels (related to the llama). Any one of these, or of a dozen other points that might be mentioned, is full of interest, but each would require an article longer than the present one for its discussion.

The hunter of fossils brings animals back to life, rather than killing them. In Florida he finds an unrivaled field for big game and small, and from his trophies he slowly reconstructs a picture of Florida during the Ice Age. The setting is probably not very different from that of today: pine and palmetto flatwoods, jungle-like hammocks, cypress-bordered lakes and ponds, sluggish streams and lagoons, rolling dunes and low hills.

Through these scenes move myriads of animals large and small. Along water-courses and in the marshes and prairies

rodents are especially numerous, the most exotic being the large water-loving capybaras and still larger giant beavers. Herds of horses, bison, camels, and mammoths thrive in the grassy prairies and open woods. Browsers and more strictly forest-loving animals, such as the peccaries, deer, tapirs, and mastodons, are scarcely less abundant. Ungainly ground sloths walk about on their knuckles. Glyptodonts and their smaller cousins the armadillos are common in the more open country. All is not paradisaical, however, for flesh-eaters of all sizes and tastes also abound, from the small gray foxes and tiny weasels to the packs of great dire wolves, the lions, and the saber-tooth tigers.

Florida is now civilized, but beneath her paved roads and her subdivisions lie the relics of a more savage—and a more interesting—past.



Photograph by George Gaylord Simpson

EXPLORING AN ANCIENT SEA

Some millions of years ago this spot near Quincy was a shallow sea where sea cows, forerunners of the living manatees, went their calm ways. In this fuller's earth mine was discovered an unusually complete specimen. Mr. Gunter is pointing to the few protruding rib fragments which betrayed its presence

ANIMALS IN ORCHESTRATION

How Musicians Have Used, in Their Music, Interpretations of the Sounds
and Movements of Animate Nature

By MYRON ACKLAND

WERE all the popular writings on natural history to be compressed within some enormous work, it would not be a complete edition unless one short chapter were devoted to a recital of the part animals have taken in the compositions of the world's better known musicians.

It is possibly a novel idea to some that animals have taken any appreciable part in the mental imagery of the musician; but that this has been frequently done is not news to the observant and confirmed music lover. It is true that not all composers of merit have utilized animals, or the sounds and movements of animals, in the development of their themes. The notable exceptions are the three big B's of music,—Bach, Brahms, and Beethoven. In this trio of greatest musical genius, Beethoven alone used an animal motif and he did so only twice. These appear in his "Song of the Skylark" and in his well known "Pastoral Symphony" in which is heard, from wind and string, imitations of the nightingale, the cuckoo, and the quail (genus *Coturnix*).

It is a well-known fact that Beethoven was a lover of nature; yet who can attempt to explain why this great love was allowed to voice itself in but two of the products of his genius? Bach and Brahms may have been as profound in their love of nature as Beethoven, but it was never revealed in any of their works.

In contrast with Bach and Brahms, there was a perfect marvel of versatility in the musical treatment of animals by Saint Saëns. This composer not only admired nature and animals, but knew

them, perhaps not in a scientific way, but in a supremely poetical way. In his "The Carnival of the Animals" there are represented not less than a dozen members of the animal kingdom. He introduces the King of Beasts, which, to the rhythm of a "Royal March," seems to be striding majestically up and down his cage, roaring as only he can. There is a swiftly moving passage intended to suggest the rapid pace of the wild ass. One hears also the musical cackling and crowing of hens and roosters. A much retarded passage is reminiscent of no one else than His Slowness, the Turtle; and, in a different passage, gracefully bounding chords call to mind the kangaroo. A lumbering, clumsy movement is, for the nonce, an elephant. A bray from the brasses can mean none other than he of the "Long Ears." Sinuous and full of grace are the bars that suggest the fishes. A "cuckoo, cuckoo," as plainly as one could desire, together with an entire chorus of other musical chirps and warblings, transports the hearer for a moment to a veritable fairy forest of feathered songsters. Finally, in this symphony, a soft, low, but majestic movement conjures up in one's mind a vision of that epitome of elegance—a swimming white swan.

Birds are found frequently in the realm of music. Quite often, as might be expected, they go hand in hand with the author's reaction to the advent of spring: witness, "On Hearing the First Cuckoo in Spring," by DeBussy; "Spring," by Vivaldi; and "Woodland Sketches," by MacDowell.

Among other notable pieces containing the bird motif are "Sounds from the Forest" in Wagner's *Siegfried*: "The Pines of Rome," by Respighi; Franz Liszt's "The Nightingale"; and Beethoven's "The Song of the Skylark." Caesar Franck in his "St. Francis of Assisi" has written perhaps the most delightful composition of all in which birds play a predominating part.

In the order of frequency with which animals are met in the realm of music, horses rank next to birds. Peculiarly, though, with the possible exception of Wagner in his "Troll King" (Erkönig), no one seems to have used the horse in the singular; rather always in pairs, teams, or galloping troops.

In "Phaëton," by Saint Saëns, by the use of pure tempo, employing all the instruments of the orchestra, the composer has powerfully wrought the picture of Apollo's runaway steeds, as with galloping gait, heaving hoofs, and foam-flecked sides, they draw the great sun-chariot in a mad, dangerous race across the sky. Not less vivid than in "Phaëton" are the horses of Richard Wagner which are the central motif of his "Ride of the Valkyries" as they plunge, under the wild and eager urging of the flying-haired Amazons, down the vale of dead and dying heroes to the famed Valhalla of Scandinavian mythology. Similar in treatment to these two compositions is "The Ride to Hell" by Berlioz. In Mendelssohn's "Midsummer Night's Dream" there is a remarkably lifelike "hee-haw, hee-haw" suggesting unmistakably a near relative of the horse, and coming from poor Bottom.

Among the daintiest, lightest, and, in a way, the most "fetching" sketches are those in which musicians have given us their understanding of insects. There are two of these on the bee, "Bombola" by Hadley, originally a conductor; and Rimsky-Korsakoff's "The Flight of the Bum-

ble Bee." The latter, especially, remains virtually unmatched for its scintillating airiness and sheer charm of expression. A darting, zigzag piece indeed is the "Dragon Fly" by Josef Strauss. And Liadow, by means of a highly pitched violin score, has rendered both suggestively and humorously "The Dance of the Mosquito." In this category, though it may not be strictly an orchestral selection, belongs also Chopin's "Papillion"—the nearest that we shall ever come, perhaps, to a musical butterfly.

It is strange, in view of the fact that the sheep is such a well known and almost ubiquitous animal, that its bleating is encountered only once in music and that is in Richard Strauss' "Don Quixote."

Some animals have been suggested by inference. For instance, in both "The Hunt in the Black Forest," and in MacDowell's "Woodland Sketches" there is sounded the huntsman's horn. From this there can be envisioned at the listener's discretion the fleeing quarry,—fox, stag, or boar.

Erik Satie, a satyric from the modern French school, has given us something rare from the annals of nature, "The Laugh of a Lobster." And Stravinsky, borrowing from a page in a book of folklore, has painted in most lurid tones, a most marvelous "Firebird."

Another musical curiosity is Kodály's "Harry Janos Suite" in which is heard a very disdainful *sneeze*—one instance of the direct imitation in music of the human animal.

This by no means purports to be a complete list of instances in which musicians have honored animals by weaving them into the fabric of their dreams,—for the artistic and æsthetic works of man have borrowed, and will continue to borrow, for dramatization in music, as well as in other arts, the freedom, majesty, beauty, power, and grace of the animal world.



A photograph of the model of the new Arctic bird group in the American Museum

BIRDS OF LITTLE DIOMEDE

How the Newest Group in the American Museum Was Erected. Gathering the Data. Work in the Field. The Problems Faced by the Artist in Transferring His Impressions of a Remote Arctic Island to the Museum Visitor Through the Medium of Paint, and Plaster, and Mounted Birds

BY FRANCIS L. JAKUES

Assistant in Preparation, American Museum

IN Bering Strait, a few miles south of the Arctic Circle, lie two granite islands.

The larger, the Big Diomedé, seven miles long, is Russian; the Little Diomedé, much smaller, is American. Here where the East and the West are but little over two miles apart, the East is to the West, and the West is to the East! The International Date Line, here a line of convenience, swings east of the 180th meridian and passes between the two islands. The days are born on the Big Diomedé, follow the sun around the earth and end forty-eight hours later on the Little Diomedé!

Here probably, was the site of the land bridge where man crossed from Asia to America. Here the walrus, which pass

northward at the edge of the ice in the spring, and southward in the autumn, are intercepted by the Eskimos, who have a village on each of the islands. Here we saw great rolling windrows of shearwaters, in the flight peculiar to them, passing through the Strait into the Arctic Ocean in July. These were visitors from the far southern oceans spending with us the southern winter. Here also, at the Little Diomedé, was collected the material for the Bering Strait Bird Group with which this article is concerned. This will complete the series of habitat groups of North American Birds at the American Museum of Natural History, under direction of Dr. Frank M. Chapman.

The collection of this group, among



THE ROCKS OF LITTLE DIOMEDE

One of the numerous photographs taken by Mr. Jaques as studies on which to base the group

the time which could be given to the collection of materials for a bird group promised to be short. Furthermore, an anchorage near an exposed island might have to be abandoned quickly if the wind changed. The wind was high and the water rough when we arrived. No landing could be made. Passing between the islands, we lay overnight in the shelter of the Big Diomedé. Once we nearly lost the island in the fog, as the tide,—which ran continuously from the southwest during our entire stay,—and the wind, proved almost too much for us. The cold gray heights of East Cape could be seen occasionally through the mist and rain, twenty miles to the northwest.

The following day was reasonably calm, how-

others, was made possible through the generosity of Mr. Charles H. Stoll and Mr. Harold McCracken, in the summer of 1928. Mr. Harold E. Anthony, curator of mammals, Edward Weyer, archeologist, and Andrew Johnstone and myself from the department of preparation represented the Museum on the Stoll-McCracken Expedition to the Arctic on the schooner "Morrissey," under command of Captain Bob Bartlett.

We first approached the Diomedes July 27. Due to a broken propeller shaft which delayed us at Teller, Alaska, for more than two weeks, we were behind our schedule. The short Arctic summer waits for no one, consequently

ever, and in the late afternoon we anchored near the Eskimo village on the Little Diomedé, there to remain until early the second morning.

At a distance the island seemed disappointing group material to an artist who hoped for beauty as well as realism. The slopes looked gray and colorless: their size we could not judge, since there was nothing with which to compare them. Only when we approached the base of these rocks in a small boat did the majesty and beauty of these gigantic granite cliffs impress us.

What had seemed from a distance dull and drab, now proved to be many-colored and beautiful. Rich green vege-

tation followed the rock slides down from the upper slopes toward the water's edge. At the base the slow rise and fall of the dark water was transformed to green and white where it met the opposing granite. Myriads of birds flew overhead and around the great walls, or perched in long lines on the ledges.

Kittiwakes, slim, graceful birds, which made the larger gulls look awkward, had the preferred nesting sites. They selected the most inaccessible projections on the verticle rock faces at the base of the slopes. The murre, which build no nests, had selected ledges sufficiently flat so the single egg would not roll off and be smashed on the rocks below. Often, on a single ledge but a few inches wide, scores of murre were seen, standing shoulder to shoulder. These and the kittiwakes were intermingled on the cliffs, the presence of either due to the nature of the projection on which it rested.

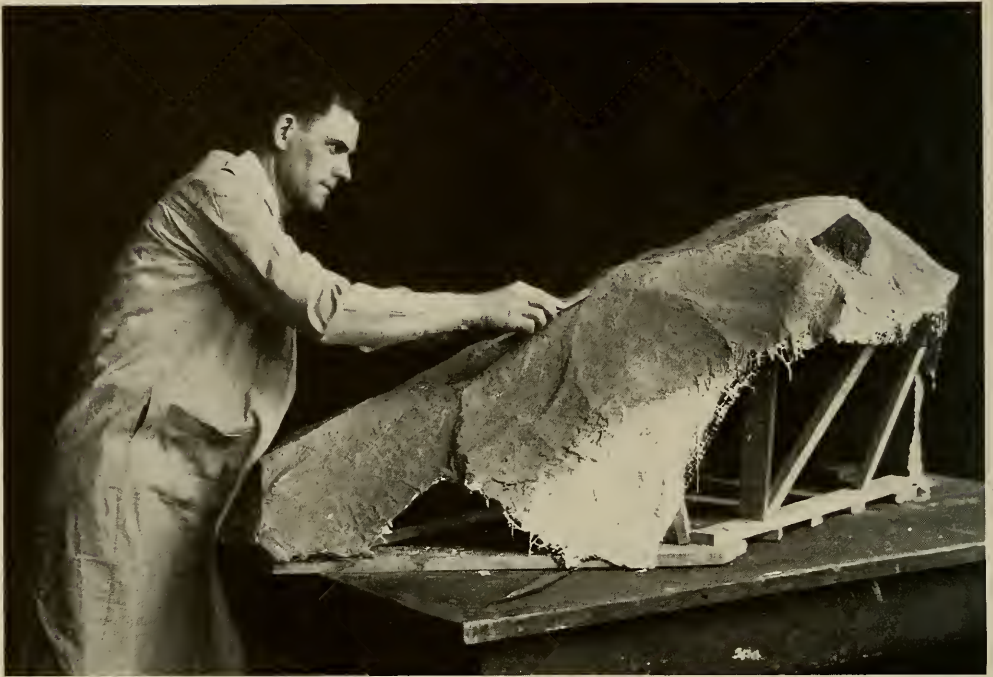
The puffins, of which there were two species, nested in crevices or burrows which could not be seen from the water. We saw them singly or in small groups as far up the sides of the slopes as the binoculars made them visible. Pigeon guillemots were more often near the water on projecting rocks. They, too, nest in inconspicuous places. Their numbers were not great. The birds previously mentioned, together with a few glaucous gulls and cormorants, made up the conspicuous large birds of the lower slopes and verticle cliffs.

Above, over the entire surface, in crevices and beneath rocks, were the invisible nests of the auklets. There are three species of these, the crested, the least, and the paroquet. Their numbers were legion. "Millions" seems an inadequate word. At dusk, which comes late here in July, and during the morning hours, the noise of their wings was like



PREPARING BIRD SKINS ON BOARD THE "MORRISEY"

The birds collected for the group were taken near that portion of the island that is depicted in the group



MR. JAUQUES PREPARING A PART OF THE FOREGROUND

Habitat groups are generally made up of a foreground and a painted background. Here the artist is constructing a "granite" rock from a wood frame, wire mesh, plaster, and paint

the sound of a gigantic surf. The air as high as they were visible was filled with their fluttering forms. Never before had I seen so many living creatures,—never before had numbers been so impressive.

A landing here was quite impossible. There above me, almost in reach of my hand, was the elusive material which I hoped to reproduce in a museum group. How was I to secure it?

The impressions of what should be shown come through all the senses. They must be given to the observer through one sense only, that of sight. The image which greets him must necessarily be static also, quite different from the living, moving panorama which greets the observer in the field.

My problem was to suggest to the museum visitor, through sight alone, some sense of the flying gray clouds, the wind-whipped sea, the cool salt air, the

towering cliffs with their teeming bird life, and the savage loneliness of the scene.

The group space is 20 feet in width, 7 feet from front to back, and 12 feet high. If all this space could be used for rock work, upon which was placed the mounted birds, the maximum area would be no more than 12×20 feet, pitifully small in comparison with the great rock masses before my eyes. Furthermore, such a group would have no background, and no indication of the sea, since a nest within that distance of the water would be washed away by the frequent storms. If we chose the opposite extreme and looked outward to the sea, our group would be all painted background. Obviously we must combine the two, looking along the face of the rocks from a point several feet above the water.

A landing was possible only at the Eskimo village. From there an attempt

to reach, overland, a suitable locality might result in the loss of precious time, possibly in failure. I chose a method which seemed to promise more immediate results. In a launch, with two men from the vessel, we approached the most promising localities as closely as possible. The water was deep, and as in deep water alongshore a heavy swell may rise and fall without breakers, we viewed some magnificent spectacles as the great masses of green water rolled in and out of grottoes and crevasses, and over the masses of broken rock at the cliff base.

From the launch many photographic exposures were made, the character of the rocks closely studied, and sketches and color notes secured. The birds could be studied best from the launch, and their habits noted. We created much less disturbance than would have been the case had we been ashore, and their

behavior was that of a normal colony. These few hours spent in a tossing launch off the shores of an Arctic bird rookery I shall always remember as one of the most interesting experiences of my life.

In the meanwhile Mr. and Mrs. Stoll and Mr. Anthony had collected sufficient birds for the group, and all members of the party used every available minute in the preparation of the skins. So our mission was accomplished.

Three times we returned to the islands, once to find them surrounded by ice which had been driven down from the northern coast of Siberia by the storms, once to anchor overnight off the village, and once, on our parting visit, to seek their shelter in a storm.

Back in New York again at last, we faced the problem of how best to use the material we had obtained. The first step in making a museum group is the



MOUNTING THE BIRDS IN THE MUSEUM

Raymond B. Potter, who was responsible for the proper mounting of the birds of the group, is shown here at work in the Museum's department of preparation



AT WORK ON THE GROUP

This gives a good idea how the plaster "rocks" look during the process of building the group

construction of a scale model. The model made for this group was about 30 inches long, or one and one-half inches to the foot. Modelling wax was used for the rocks, the birds carved of balsa wood and colored, and the background painted in miniature. Most of the major problems can be solved in the model, as it is tractable, and changes are readily made. With this as a basis, construction of the large group was much less difficult.

We have placed the rockwork which represents the cliff to the left-hand side of the space. This is carried back, in the painting or background, to the middle distance. In the foreground, more rocks,

low down, cover the remainder of the floor space.

The rock which composed the cliff to the left was built in three sections, arranged to fit together when placed in position. The frame work is of wood, over which a coarse wire netting is placed. Shaping this was one of the most difficult parts of the work, for the netting tends to take geometrical forms. It is modelling with a very refractory material whose surface contour is not easily seen. Measurements from the scale model were of great value here.

This netting was covered with burlap and plaster, and the surface modelled in plaster. Later it was surfaced and colored, and the rockwork was complete.

The problems of design in this rock were complex. It was necessary that it afford numerous horizontal ledges for the birds, which had to be placed in an advantageous position as seen from the front of the group. It must also give the effect of height and verticle cleavage. The birds are arranged in closely massed groups, leaving much of the rock surface free, to increase the apparent height and size.

The painted background must carry a large share of the burden in this group. The area shown is many times greater than that of the foreground. Where sixty birds are shown in the foreground, hundreds will be painted into the background.

We chose to represent a day when

spots of blue show through a gray sky, with the threat of misty rain. The site of the group is the south end of the Little Diomede, looking southeast. A fresh wind is blowing from the south, and a pale sunlight falls on the rocks of the foreground. In the distance Cape Prince of Wales, the northwestern extremity of the North American mainland, is visible, "hull down" across the Strait.

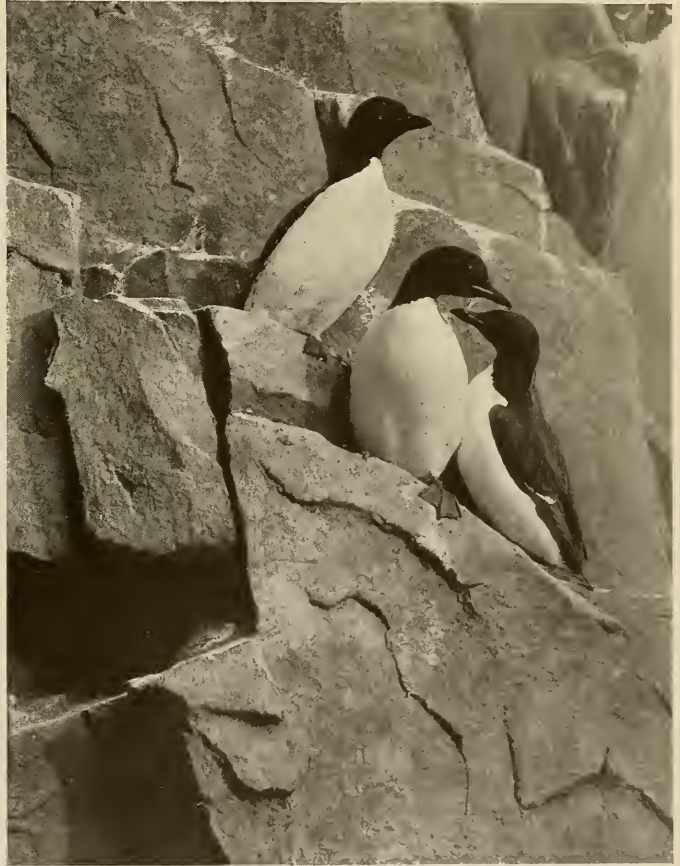
About sixty-five mounted birds will be used in the group. Each bird is mounted to fill a certain place according to the scale model. It is fitted to the rock in its proper position and allowed to dry, after which it is numbered according to a chart. Then it is removed, to be replaced in position later, when the final assembly of the group material is made.

Few people realize the amount of skill and patience required to produce a well mounted bird. Every feather must be scraped free at the base, inside the skin, to permit it to be adjusted properly, and remain so, when the specimen is finished. The feathers must be thoroughly washed and cleaned, and afterward dried with the aid of sawdust and much beating, until every feather once more spreads itself as it did on the living bird. The preparator must not only know exactly the effect he wants, and the somewhat indirect methods he must use to secure it, but he must have great skill with his fingers, a deftness which can come only

through years of experience. My colleague, Mr. Raymond B. Potter, who mounted the birds for this group, has done splendid work from the rather indifferent looking material with which we returned. If the group falls short of perfection it will not be due to the appearance of the birds.

The group will be opened for exhibition at about the time this article is published.

Problems to be met and solved in the making of museum groups are many and varied. Not only does the preparator have the same problems of composition and arrangement that the artist has, but the composition, as viewed through the



A DETAIL OF THE GROUP

A bit of the group that has practically reached completion. The birds are Pallas murres (*Uria lomvia arra*)



A PHOTOGRAPH OF THE AMERICAN MUSEUM'S NEW ARCTIC BIRD GROUP

Complete though this scene may appear, the finished group shows many additions that have been made since this photograph was taken. By comparing this photograph with that of the model of the group which appears above the title on the first page of this article, the additional work that must be done can readily be visualized



MR. JAKES AT WORK ON THE BACKGROUND

In the lower right foreground can be seen the scale model from which the larger group is being erected. In this photograph, too, it is easier to differentiate the painted background from the imitation rocks of the foreground .

opening, changes with the position of the observer, and with the distance at which he is viewing the group. The physical difficulties of construction are infinitely greater. In place of the single medium of paint or clay, he must work with a great variety of mediums and materials. While it is theoretically possible to reproduce any outdoor locality, this is not always practical, and the preparator should select such arrangements as can be most successfully shown.

Lighting is important, and correct lighting is much more difficult to secure in a group than in most of its other uses. Shadows of accessories upon the painted background immediately destroy the illusion. The lights should be separated from the group space by dust-proof, but not light-proof divisions, and they must be accessible at all times to permit changing the lamps. The group itself must be dust-proof, though provision should be made to permit entrance if necessary.

There is no place for 'style' or individual technique in background painting, as it must join on to actual accessories in the foreground. The area represented in the background is much greater, and it bears, accordingly, the greater part of the burden of giving the observer the correct impression of the locality represented. If then, a group is scientifically correct, if the specimens shown are prime, and as well done as modern methods per-



AN INCOMPLETE DETAIL OF THE GROUP

The birds themselves—a horned puffin, three kittiwakes, and two tufted puffins—are as they will appear when the group is finally completed. The nests, however, still require some finishing touches

mit, if the composition and arrangement are pleasing, if the habitat is that which is most characteristic of the specimens shown, and if, in addition, we get an impression of light and air, of wind and weather, the group will have approached the fulfillment of its mission.

The American Museum has a large staff of preparators and artists under the direction of Mr. James L. Clark, and a number of habitat groups are now being prepared, each with problems of its own as difficult, or more so, than those of the group described in this article.

We may hope to see in the near future many groups whose standards are higher than anything heretofore attempted.

A MASTERPIECE OF
THE SCULPTOR'S ART



EARLY PERIOD
POTTERY HEAD, TYPE D,
ZACATENCO. ACTUAL SIZE

ON THE THRESHOLD OF NATIVE AMERICAN CIVILIZATION

By GEORGE C. VAILLANT

Assistant Curator of Mexican Archæology, American Museum

THAT aspect of historical research known as archæology may be said to begin when man ceases to speak for himself and must be spoken for. In the actual garnering of materials for the history of peoples, archæology comprises the acquisition of data not contained in libraries or governmental archives. Modern history, as the term is commonly used, describes the economic and political development of peoples. Art, science, and literature are placed in different categories as parallel to but not necessarily unified with, the social unfolding of a nation. This distinction is more a convenience in understanding than a grammatical or a philosophical definition.

The mass of documents contempora-

neous with the events described humanize the past through the depiction of individuals and social groups. Going backward into the ages, through the exigencies of faulty preservation of archives and a natural blurring of detail due to chronological distance, the individual and the political party become obscure and merge in with the civilization, material and spiritual. The shift from the archivist to the archæologist occurs at this point as an almost imperceptible transition.

The interpretation of the history of Ancient Greece is a good example of the case in point. There is an elaborate political and social history preserved by Roman and Greek commentators, that gives a full and precise story of the fortunes of states, parties, and individuals,



EARLY PERIOD POTTERY

L. to R. 1, trade piece, Red and Orange on White, $\frac{1}{4}$; 2-5, bowl sections White on Red, $\frac{1}{4}$; 6, small bowl, Black, $\frac{1}{4}$

but these accounts do not persist very far back. The material remains of the Greeks are gathered by excavation. Really from Roman times there has gone on a continuous effort to identify the written social histories with the monuments. It becomes gradually evident that the political history does not coincide entirely with the development of culture. As the formal history of Greece dwindles off into the *Iliad* and the *Odyssey*, in the absence of a precise time count the cultural background of the peoples described in the epics rests on the identification of remains as their handiwork.

When we begin to consider peoples whose written records have disappeared or who, like the majority of the nations and tribes who have populated this globe, had no writing at all, it is the material culture which we study to try to find the man behind. In contemplating human history as a whole, it is what man has achieved that tells his story long after he has disappeared. Primarily, however, it is the living being and not his handiwork that interests us, and the most difficult task that the archæologist has to

face is the reconciliation of the surviving examples of the handiwork of man, with his vicissitudes and triumphs as a living being.

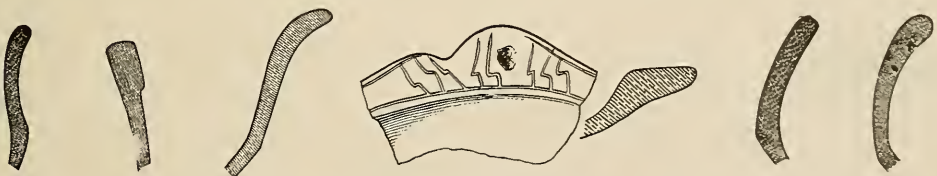
At the outset, the student of the past suffers the handicap of having to derive his knowledge of a given people from less than a twentieth of their total material possessions. Except in a very excep-

tional case, only relatively imperishable substances like stone, pottery, bone, and, rarely, shell, survive. Naturally the immaterial remains like social organization, mythology, language, philosophy, have disappeared. The tribes of the Northwest Coast whose art as seen in totem poles, chests, and baskets, together with a complicated social structure and a rich mythology, forms an interesting human development, would be completely unknown to us had they disappeared five hundred years ago. Their art is expressed on perishable substances, like wood, which would not have endured for long on the



PEELING THE DÉBRIS
Trench D. The workman is standing on the seventh of the ten cuts made before reaching bottom

damp coasts of Alaska and British Columbia. The stone work of these people, which alone would have survived, is in no sense commensurate with their



EARLY PERIOD POTTERY

Sections of bowl rims. L. to R. 1, Black; 2, 3, Bay Ware; 4, 5, White; 6, 7, Bay ollas. 4, 5 about $\frac{1}{4}$; rest about $\frac{1}{2}$



MIDDLE PERIOD ORNAMENTS

Top row, L. to R.:
stalactite ring, jade
ear-plug, shell, pot-
tery whistle

Bottom row: pot-
tery ear-plugs, jade
pendant, and hemi-
spherical ornament
of pottery

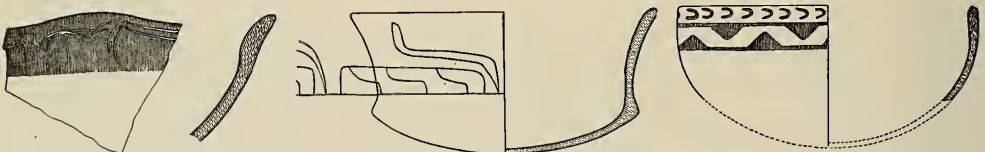
Scale shown in
photographs, 10
centimeters or 4
inches

wood carving or their social organization. The Basket Makers, the first race to occupy Arizona, dwelt, however, in dry caves. This choice of habitation, coupled with the aridity of the region, preserved their remains. They made some stone tools, had not invented pottery, and had just crossed the threshold of agriculture. They had, however, a great skill at weaving from yucca and *Apocynum* fiber, baskets, nets, waterproof woven bottles, sandals, and many other things. Had they lived in the open, all these possessions would have disappeared, and an interpretation of what survived would show them to be much less developed than was really the case. One wonders in this connection whether the people of the European Upper Palæolithic were not much more advanced than their stone work indicates them to be.

The archæologist in his reconstruction of history must then, primarily, discover a sequence of events and some sort of a chronology; secondly, he must try to

interpret the remains encountered by him to throw some light on the social and political life of their makers; and thirdly, from these remains he must attempt to appraise the extent of their perishable possessions. Archæology, briefly, becomes in practice a sort of algebra, where formulæ are sought for the equation of man's total development with his remains. Bearing this conception in mind, the apparent puttering of the archæologist with stocks and stones becomes dignified into an arduous means to a very worthy end.

The perfect formula has not been devised. The most serviceable medium developed to date is pottery. Among most primitive people it is a household art like cooking or weaving. It is, therefore, strongly subject to the control of communal custom. At the same time it can perform its functions without being subject to rigid controls of form like a stone tool. Hence, fashions in shape and decoration can be readily expressed



MIDDLE PERIOD POTTERY

1, 2, incised Red on White; 3, incised Black; 4, Red on White. About $\frac{1}{4}$

LATE AND
MIDDLE PERIODS

Stone Implements

Top row: knives,
arrowheads, small
sling stones

Middle row: sling
stones of lava,
quartz, marble

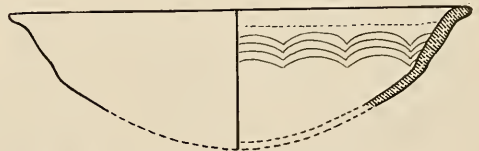
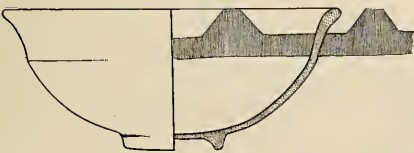
Bottom row: pestles
of lava; nos. 4 and
5, jade axes



on pottery, so that one may see rigidly local styles changing with the years. Furthermore, a well made pottery vessel is a desirable article of trade. When a pot is broken, the fragments are virtually indestructible, and by studying the sequence of their types in rubbish heaps one may in this way erect a chronology. This conservatism in adhering to local styles defines a tribe and its movements, while stray pieces from other localities indicate trade relationships. At the same time these trade pieces by their position in a site of known stylistic succession give a basis for a future sequence in their site of origin. As deeply stratified archaeological sites are rare, the value of dating single occupation sites by the position of their traded sherds in a locality where such a chronology exists, is readily appreciable. Furthermore, temples and pyramids may be arranged in chronological series, by the potsherds found in the adjacent débris.

The work of the division of anthropol-

ogy of the American Museum in the Valley of Mexico the last two winters serves as an illustration of the values and the limitations of archaeological method. Broadly speaking, three civilizations, or cultures, are known in the Valley of Mexico: that of the Aztecs who were living there at the time of the Conquest by the Spaniards; that of the Toltecs who built the famous Pyramids of San Juan Teotihuacan; and finally, a very much cruder civilization, of whose makers there is no record. Objects of this last culture have been found in river gravels overlaid successively first by Toltec and then by Aztec remains. Somewhat similar material occurs under a thick flow of lava to the south of Mexico City, in one case, at Copilco in the débris of a camp site, wherein also are found burials, and in another, at Cuicuilco, associated with a huge pyramid of adobe, around which the lava flowed, sealing in the contemporary detritus, as well as covering the lower slopes of the pyramid. Thus, the history



MIDDLE PERIOD POTTERY

1. Red on Yellow. 2. incised Black. About $\frac{1}{4}$



CHIPPED
IMPLEMENTS
OF OBSIDIAN

Top row mainly
Late Period;
second and third
rows, Middle and
Early Periods

of the material culture of the Valley from the coming of the Spaniards to the remote past is expressed by three groups of remains: Aztec, Toltec, and the cruder material of earliest date.

From Spanish accounts, from codices, and from the writings of native historians a generation after the Conquest, a social history has been composed for the Aztecs, in which the varied tribal histories of what we know to have been many groups, have been welded into the synthetic evolution of a single group. This account carries us to about the twelfth century after Christ. There is a scattering legendary mention of the Toltecs as having an empire of which, after it fell about the tenth century, more or less isolated elements survived until the infiltration of Aztec tribes. Yet these Toltecs have no very definite history; and the pyramids, sculptures, and pottery assigned to them with every probability of correctness, are not classified to reflect an historical development. The student

finds preserved for him, as it were, a static civilization. Similarly the cultures called "Archaic" are dismissed thus, in a name, with some figurines classified as transitional between them and Toltec.

On examining the remains of pottery and figurines from the earlier cultures, it was evident that there were several different types of figurines, so distinct that they could not have been contemporaneous, or, if made at the same time, must have been the product of several local cultures. The figures found in the excavation at Cuicuilco, the pyramid under the lava, were quite unlike those found at Copilco, the camp site covered over by the same volcanic flow. The pottery likewise fell into at least two styles.

Doctor Clark Wissler, chief of the division of anthropology, and Mr. C. L. Hay, a Trustee of the Museum and Research Associate in Middle American Archaeology, decided to undertake a series of excavations to expand the chronological sequence of the cultures



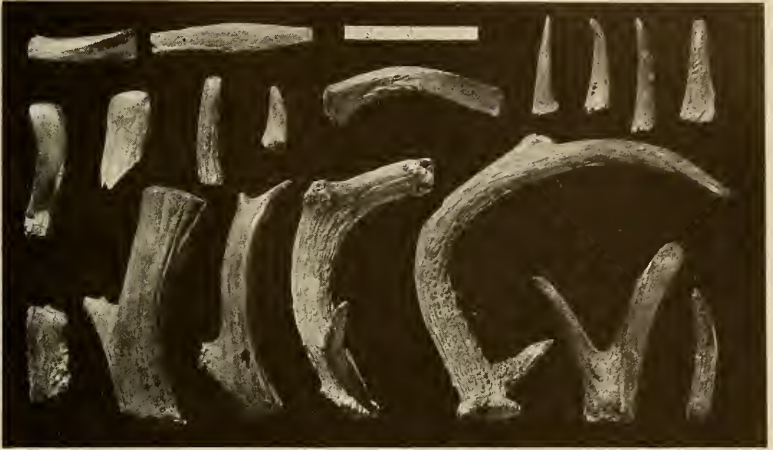
MIDDLE PERIOD POTTERY

1, 2, Black Ware like Copilco, about $\frac{1}{2}$; 3-6, Bay olla neck sections. About $\frac{1}{4}$

ANTLER TOOLS

Top row, chisels for
graining hides and
flaking obsidian;
awls.

Bottom row, pest-
les and picks

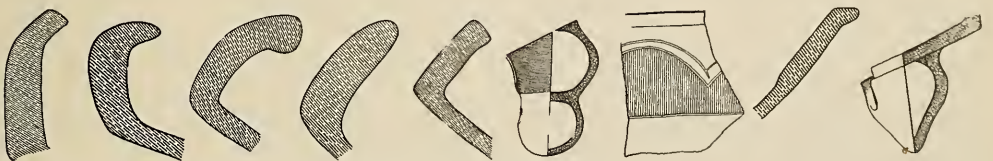


of the Valley of Mexico, and to supplement the splendid work of the department of archæology of the Mexican Government in its preservation and uncovering of the major ruins. The Museum proposed to make stratigraphic studies in rubbish heaps, and by segregating the pottery types found at different levels, make a chronological and ethnological skeleton to aid the broader elucidation of Mexico's past, which the Mexican Government was ably carrying on.

Doctor Wissler and Mr. Hay chose the earliest remains as a point of departure to find the sources of the subsequent Toltec and Aztec civilizations. Mr. Hay, a student of Valley of Mexico problems and an authority on the early cultures, graciously supported the work and collaborated in its execution. To the writer fell the details of excavation.

After a season's inspection of sites containing early culture material, a deep bed of débris was chosen, which lay on the outskirts of Zacatenco, a hamlet

just north of Guadalupe Hidalgo, a suburb of Mexico City. Trenches were sunk immediately to find bed rock or the undisturbed soil. Once bottom was discovered, the trenches were extended to cross section the mound. Objects were carefully recorded as to their source of provenience, and maps which followed the daily progress of the work in plan and in section, controlled still further the cataloguing. A small gang of six men was trained to dig carefully, and a judicious system of bonuses whetted the sharpness of their eyes. The handling of the excavated earth was a problem; but by means of scaffolds the men were able to remove it far enough not to interfere with their work. Since the deepest cut was about twenty-five feet deep and the most of the digging was between twelve and fifteen, successive layers were removed. The trenches drifted in against a vertical face, and the strata were thereby visible on three sides of the trenches. The results were not



LATE PERIOD POTTERY

1-5 Bay olla necks; 6, leg of Red on White bowl; 7, 8, bowl incised Red on Yellow; 9, leg, Brown. 1-5 about $\frac{1}{3}$. 6-9 about $\frac{1}{2}$



FIGURINES

Early Period.
Type C. Note
development of
features by fillets
of clay.

Top rows Zaca-
tenco.

Bottom row, other
sites in Valley of
Mexico; 3rd
figure, Azca-
potzalco gravels

immediately visible; three months of study and interpretation of material after excavation had ended brought the following facts to light.

The site of Zacatenco lay on the south-east slope of a rocky peninsula that extended into a lake. The southerly exposure ensured warmth; the almost complete surrounding of the knoll by water was a protection against enemies; the lake itself yielded a valuable part of the food supply in the fish and ducks that frequented it. The presence of grinders and grinding stones indicated the growing of grain, undoubtedly corn, and the quantity of fragments of storage vessels shows that it must have been the staple food, for there would be no need to store water on the borders of a lake. The presence of deer bones shows that the chase also added variety to the larder. Thus, in every way the locale was favorable for occupation.

As time went on, an enormous accumulation of débris was formed from piles of corn husks, adobe washed from the houses, and the soil that the heavy showers of the rainy seasons was constantly eroding from the hill. We find low revetments of stone laid up to hold these loose accumulations in place and to provide level spaces on which to build

houses. Finally, owing to the softness of the dirt underfoot and perhaps because of a rise in level of the lake, the people moved from the gently sloping glaciais of rock at the foot of the hill on to a low cliff. We find a repetition of conditions, for débris accumulated against the ledge of rock. The occupants moved down hill as the rubbish leveled off the contours of the slope. There was a constant use of retaining walls to prevent the formation of gullies, during the rains, which would undermine living surfaces and wash away houses.

Finally, so much dirt and rubbish accumulated at the foot of the hill that the slopes became gradual. The occupants then moved out on these surfaces which had covered completely the original contours of the hill. By studying these occupations in the manner described we find three quite clear phases of occupation, Early, Middle, and Late.

The Zacatenqueños had no knowledge of metals. But lava, obsidian, and quartz were excellent substances for the fashioning of tools. From lava they made quadrangular metates bordered on their long axes by ridged sides and supported on three stubby legs. Manos or grinders for use in connection with them were like a triangle in cross section and the

long sides of the triangle formed the grinding surface. This perfect serviceability brought no need for change with the lapse of time. In the second period of occupation lava was further employed in the making of small spheres possibly for use in games but more probably for missiles for a sling.

Obsidian, or volcanic glass, was made into implements by two main processes, flaking and chipping. The flakes were struck off from a conical core and received little further treatment. They must have been used as razors, or knives for fine cutting. The chipped tools seem to have been made from breaking up the core after it was too small to yield flakes. The pieces were chipped into projectile points. In the early level the shapes were simple but later on in the upper cuts tangs were added and the chipping became more even.

Quartz was used little in the Early Period, only cores and spalls occurring, but in the Middle Period it was fashioned into well polished balls, by what must have been an exceedingly laborious process. These spheres were perhaps for use in slings though it is difficult to conceive of such well finished specimens being put to so plebeian a use. In the Late Period use of quartz was less frequent.

Other stones occurring in the excavations are granite, marble, diobase, and sandstone. The first two were used in making the missiles just described.

The Zacatenqueños of the Middle Period traded to some extent, for we have in jade, two axes, a pendant, and a part of a lip- or ear-plug. This is the earliest recorded occurrence of jade in an archæological site in Mexico.

It is obvious that the Zacatenqueños had at the outset a fair mastery of stone manufacture, but that the simplicity of the forms which are at the same time perfectly serviceable, is not capable of reflecting very much the passage of time. Bodkins, needles, and awls of bone show the same changeless quality. Antlers were fashioned into chisels, into tools for flaking stone by pressure, or utilized as handy instruments wherever a point or a blunt end was required. The inflexibility of the material, together with the unchanging nature of their function, makes them poor guides of development. For arrival at a certain degree of culture all people must sew leather, weave baskets, or make tools.

Shell is perishable and rarely preserved. We did find one or two fragments that might have been ornaments. The figurines are adorned with amulets, necklaces,

FIGURINES
Early Period. Type D. Note finesse in execution.
Toprow, Zacatenco. Bottom row, other sites Valley of Mexico. 4th figure, Azcapotzalco gravels



and ear-plugs. But our excavations yielded almost no examples of these save for a ring and a bead of stalactite, and the few other trinkets described. Presumably the ornaments were of shell and disintegrated in the humid earth during the lapse of centuries. For the same reason apart from flakes of charcoal no trace remains of the use of woods for tools or sculpture. House types are likewise unknown to us. The great mass of adobe in the soil suggests simple dwellings of wattle and daub.

The textile art also has left almost no remains. A tiny worn fragment, by a freak of nature, was preserved in the rot of a child's brain, whose skeleton had disintegrated into the consistency of cheese. Two perforated discs of clay and one of sandstone are probably early forms of spindle whorls. A cast of the base of a coil-weave basket gives a tangible basis for the usually incontrovertible assumption of the existence of basketry. A whitish coating on the sides of one or two graves indicates perhaps the use of mats or perhaps blankets of bast. The figurines from the earliest period wear elaborate turbans which could only have been made of textiles, and some few specimens wear little skirts. What other clothing they wore

is problematical. The depiction of clothing is so great an obstacle to the sculptor that even now our æsthetic tends to demand as an ideal, nude rather than draped figures. Hence we cannot expect to tell much about the clothing from the sculpture, but it might be remembered that the climate of Mexico is temperate.

Pottery is found in the greatest profusion, literally by the cart load.¹ Over ninety per cent of the vessels are for storage, cooking, and similar humble uses. They are made of a coarsely kneaded clay that burns, when fired, to a reddish-brown, approximating a bay color. The shapes are ollas, deep pots for the storage of grains and liquids, and large wide-mouthed bowls presumably also for storage. The vessels are perfectly adapted to their purpose. There is no decoration. Changes, therefore, are not violent. In the Early Period the neck of the olla is not treated as a particularly distinct unit. There is a flat inward curve from the mouth out into the fullness of the body of the pot. In the Middle Period one observes a tendency to make the body more globular, until in the Late Period we find the ves-

¹Only two whole pots were recovered. The vessels illustrated in this article are reconstructed from sherds.



FIGURINES
Middle Period
Type B. Note stylization.
Top rows, Zacatenco.
Bottom row, 1, Copilco; rest mainly Zacatenco

FIGURINES

Middle Period
Type F. Observe
crudeness.
Toprow, Zacatenco.
Note Madonna, last
on right.
Bottom row, other
sites in Valley



sels predominantly globular in shape with the necks well defined by flaring outward from the body, by being reinforced into a thick curved lip, or by having straight necks surmounted by a flat lip. The bowls or cajetes suffer almost no change, but in the Late Period for some reason the manufacture stops.

A number of wares might be classified as for the service of food, such as small vessels convenient for holding the noon-day meal. In the Early Period we find a thick black clay formed into bowls, a chalky white ware into shallow dishes, and a red ware, simply ornamented with geometric patterns in white paint and fashioned in more or less straight-sided bowls with rounded bottoms. Throughout the period we see that the black ware becomes increasingly fine and decoration enters by the incising of vague meanders on the walls of the vessels. Red paint and incision embellish the white ware which gradually supplants the red ware painted in white. Sophistication of ornament is absent. The decorative sense is latent to the point of non-existence. As a surprise we find traded in from some more advanced neighbor, a white vessel with designs in red and orange.

In the Middle Period the practice of

decorating the white vessels with red paint disappears about half way through the deposit. The incised black ware still progresses technically, and as decoration, besides incisions of the walls, the bottoms are occasionally stippled by tiny gouges. New forms appear like gourd-shaped vessels and shallow dishes with handles supported on high ring bases. Bowls of cream-colored ware with no decoration, and ollas of a thin granular white ware decorated crudely in maroon, supplant the white wares of the Early Period. A yellow flaky ware is formed into bowls on a low ring base decorated with stripes of red paint. Trade is seen in the presence of hard, well fired, orange ware, and of another the slip of which is so much harder than the body paste that it is well described under the name Orange Lacquer. With the exception of the trade wares, the pottery is homologous with the pottery of Copilco, under the lava, but Copilco, lacking development of white pottery adorned by red paint, is probably coeval with the latter half of this Middle Period.

At the same time the people began to make balls of pottery, which might be for slings in spite of their friability. We find one or two ear-plugs and fragments of gorgets representing pathetic attempts



FIGURINES

Middle Period
Type A. Like Type
B. Common under
lava at Copilco.
Top rows mainly
Zacatenco.
Bottom row, other
sites in Valley.
Note bird headress
on number 2 of
bottom row

at adornment. Whistles, sometimes adorned with animal heads, also occur. Ladles and pottery rattles fill out our list still further. Potsherds are rubbed into circular shape for a presumable employment in games of chance.

In the Late Period these service wares all disappear. The principal ware is a yellow-brown pottery with heavy, solid, triangular and stepped patterns in thick red paint. Sometimes the designs are outlined by incision. More developed but still unsophisticated patterns are outlined by white paint in the case of somewhat better made bowls. This is the first appearance of polychrome decoration. The shapes are shallow dishes resting on a hollow tripod support with a flat, slightly thickened rim. Another distinctive type comprises deep bowls with the traditional Early Period format of bottom and wall elements. The bottom is expanded now, however, and the side contracted into an ornate rim which is covered with a highly polished red paint. This same shape is seen in a ware varying from chocolate to brown. Sometimes in this case the rim is simplified into a sharp incurve. The tripod support is common. Eccentric and ornate shapes obtain more frequently than in the preceding periods. The elements of

hollow tripod supports, of polychrome decoration, of reduction of the walls of bowls to rims, together with the development of the necks of ollas, constitute in tendency an approximation to the finds at the lava-buried pyramid of Cuicuilco. But morphologically the two ceramics are not identical.

We see in the pottery of Zacatenco, wares that are distinctly associated with different periods. We gather the impression of a conservative people whose ideals seldom in practical life passed beyond the utilitarian. Not until the last period, in spite of trade relationships, did they seem to accumulate ideas from other sources, when they altered completely the shapes of this service pottery, and even began to make a few halting steps toward a decorative art.

Against this drab and comfortless background of daily necessities treated with unrelieved practicality, we find an amazing diversity of treatment and vitality of expression in the little clay figurines. Presumably they are associated with the practice of some cult. This variability seems to preclude the representation of a divinity clearly defined into attributes. Yet, considering the cultural level of the people, they are too well made to be toys. They are ubiqui-

tous, being found in fields and in rubbish heaps rather than being confined to some tomb or shrine. They are distinctly anthropomorphic, showing as they do a range of individual costume, and positions varying from an erect posture to a seated mother nursing a child. Two types are found in the Early Period. The chief, Type C, comprises slim-waisted figures, usually erect, with pointed faces the features of which are indicated by fillets of clay. Details of dress and adornment are indicated in the same manner, like the folds of a turban, a bird headdress, or a bead necklace. Contemporaneous with these are very much more sophisticated examples, Type D, of which the elements expressing the features are smoothed down into the unit-mass of the head. Their casts of countenance are brought out with a care almost meticulous. The bodies of this latter type do not differ from the former. Some sporadic examples not classifiable into the preceding categories comprise dogs, snakes, and monkeys which are modelled with some realism. Types C and D are widely distributed in the Valley of Mexico. C is almost, and D completely, absent at Copilco, but they both occur in the Azcapotzalco River gravels.

The Middle Period deposits contain

three types different in style from the preceding. A flat-faced type, B, meant to be seen only from the front, has some diversity of pose and seems to develop out of Type C. The execution is carried out in a hasty slap-dash manner. Contrasting strongly with this class is Type A, which probably gives us the best idea of the look of the people inhabiting the Valley at that time. The fleshy contours of the face receive careful attention, and to soften the lines about the face and mouth, a space is gouged out and in it are laid a roll of clay for the nose, and two for the lips. The modelling of the limbs and torso is coarse. Contemporaneous at Zacatenco with Types A and B, is the gross and crude type F. The figurines are hardly distinguishable as human beings, but the repeated occurrence of the same style shows it to be a conscious manner of expressing the human or humanly divine form. It is difficult to say whether the appeal of Type D shows superior artistic skill to Type A wherein there is a definite attempt to solve problems in the depiction of the human face. We notice, though, that the figurines of the Middle Period are much more stylized than the varied representations grouped as Types C and D. Types A and B pre-

FIGURINES

Late Period Type E.
Observe the degeneration of the plastic.

Top rows, Zacatenco.

Bottom row, chiefly other sites in Valley of Mexico



dominate at Copilco so that their presence, coupled with the pottery, shows a definite contemporaneity with Zacatenco. But Type A must have been conceived and developed outside of the Valley, as there have been discovered no transitions between it and the other examples.

The last occupation shows a predominating type, E, that is inferior to the plastic preceding it and also technically to the pottery associated with it. An examination of the technique shows the hasty execution of a strongly conventionalized type. Associated with Type E are many other styles of sculpture in clay. In some of the specimens there is an improvement in paste and finish over the earlier styles, but in actual representation of the human form most are inferior. The majority of these other groups, which are broadly grouped under the succession of letters from G to M, are too rare to be anything else than trade specimens. From their occurrence in other sites like the Pyramid under the lava at Cuicuilco, we may assume them to be traded pieces or perhaps examples of types from an ultimate surface of occupation at Zacatenco, that has eroded since the abandonment of the site. The Late Period at Zacatenco must be, therefore, anterior to Cuicuilco.

Perhaps, as Professor Kroeber thinks, in these little figurines, growing more conventionalized through the ages, we may discern a growth toward a for-

malized religion that culminates for these early periods in the pyramid at Cuicuilco, and later expands into the elaborate theological arts of the Toltecs and the Aztecs. We have seen how, as in the case of these Zacatenqueños, a well balanced material culture does not lead necessarily to an art, and it is probably true that the distinctly artistic manifestations in Mexico followed in the train and under the stimulation of the growth of religion and priestcraft.

Thus we observe in the interpretations of these broken fragments the beginning of a history. The aim of this survey in its next season's work is to extend the Zacatenco sequence up to the time of the Toltecs and later to the Aztec period. Speculation is futile as to the absolute age of the lava flow and the cultures beneath it, until we have a continuous building of cultural development, divided off into the floors of consecutive typology. With this as a basis, we can extend our studies south until connection with the Maya and their calendar based on the absolute recording of time, will render possible the resolution of our history into dates. During this research we have to face changes in archæological thought, interpretation, and method. Archæology is still in its infancy, but when it reaches an adult stage, we may expect a wider and a truer conception of man in the fuller perception of his past.



LATE PERIOD POTTERY

1 and 4 polished Red bowls; 2,3 polychrome bowl, Red and White on Yellow decorated inside and out. 1 about $\frac{1}{4}$; 2, 3, 4, about $\frac{1}{8}$



"MAN O' WAR"

HOW ANIMALS RUN

Some Interesting Laws Governing Animal Locomotion, and an American Museum Exhibit That Illustrates How Certain Bones Function During Speedy Action.

By S. HARMSTED CHUBB

Associate Curator of Comparative Anatomy, American Museum

ILLUSTRATED WITH PHOTOGRAPHS BY THE AUTHOR

SINCE the beginning of osteological work, exhibits of mounted skeletons in museums and elsewhere have been objects of questionable interest even to specialists who might wish to examine and compare individual bones. But for the student who would like to be informed as to the presence or absence of clavicles, vestigial fibulae and digits, sesamoids, certain teeth which are slowly becoming extinct, the presence and arrangement of hyoid bones and ear ossicles, or other anatomical structures, such exhibits were useless or misleading. All of those minute details, which are of paramount importance, were considered by preparators to be quite unessential or were not considered at all, being entirely overlooked and lost during preparation, while proportions were incorrectly represented and bones were made to assume positions that would be impossible in the living creatures.

It would never have occurred to the artist, desirous of studying the bony framework of man or horse so that he

might the more truthfully portray his subject in sculpture or on canvas, to visit a museum of natural history in his quest for the truths to which bones might be expected to testify, for the skeletons to be found there had little suggestion of the form of the living creature in which they once made animation possible.

Neither had it occurred to the preparators that these "dry bones," as they are often, but unjustly, called, could be placed in positions which they had constantly assumed in life, and thus express beautiful movements, animation, and even mental emotions, so that not only the student and artist but the casual museum visitor would discover beauty in them. It was small wonder that the department of skeletons was considered a place to be shunned by those of refined tastes.

Dr. E. W. Gudger of the American Museum has published a very interesting paper in *Annals of Medical History* for May, 1929, entitled "Some Early and Late Illustrations of Comparative Os-



RUSSIAN WOLFHOUND

In the "flexed" phase of the stride. This photograph shows clearly how, in this position, the hind legs pass on the outside of the front ones. The dog is "Cerebro of Romanoff," owned by Louis J. Murr. Compare with running bulldog on page 545

teology" which describes in a most able and graphic manner some of the advances in osteological work from early days.

At the American Museum an earnest effort is being made to create what might be called a hall of "living skeletons" where the young student, the comparative anatomist, and the artist may come to study and find help. It is with great satisfaction, therefore, that we see, almost daily, students seated in our hall diligently sketching these skeletons.

In this hall there is a collection of specimens, most of which are members of the Equidæ or horse family. These subjects have been prepared and mounted to show the action characteristic of different breeds or types of animals. "Sysonby," one of America's famous race horses, and "Lee Axworthy," the world's champion trotting stallion, form a part of this distinguished assembly.

The latest addition to this exhibit is the skeleton of a Russian wolfhound, represented as running as if his life, or the safety of his master's flocks, depended upon the immediate capture of a marauding wolf. In earlier days on the Russian



RUSSIAN WOLFHOUND "BORIS"

Hounds, as a group, are the fastest of dogs, and while it cannot be said that Russian wolfhounds are the fastest of the lot, they are wonderful running animals. Owned by Charam Kazanjian



ENGLISH BULLDOG

"Suncrest" owned by Percy Maude, in a position corresponding to that of the running wolfhound on page 544. Though the bulldog finds it difficult to follow the rules of the race and pass his hind legs outside his front ones as he runs, this picture plainly shows that he insists upon doing so

pasture lands, the ancestors of these dogs were trained to protect the defenceless flocks and herds from depredations by hungry packs. There are few animals of its size which can acquire greater speed than the wolfhound. Even the race horse

only slightly exceeds the speed of this fast running dog.

The preparation of this specimen is based upon anatomical study, careful observations of living animals on the race track, and a great many photographs of animals running at high speed. These pictures were taken with an exposure of $1/1000$ of a second in order to record the exact position of every part of the subject during this extremely rapid action.

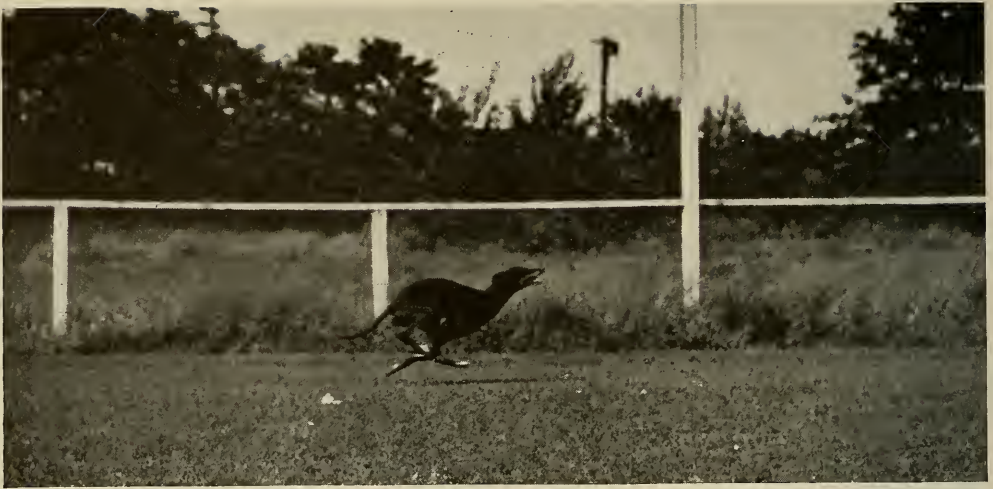
The object of this exhibit is not only to show the function and behavior of the bones during an intensely speedy action, but also to point out certain interesting rules and regulations which are strictly adhered to by nearly all terrestrial mammals. Even animals so totally different as the dog, horse, cow, or pig, all follow similar rules in the progressive movement.

The moment in the stride which has been selected for mounting the wolf-



"SUNCREST"

This picture plainly shows how much farther apart are the bulldog's front legs than are his hind ones. Despite this fact the hind ones are spread, in running, to take the outside place

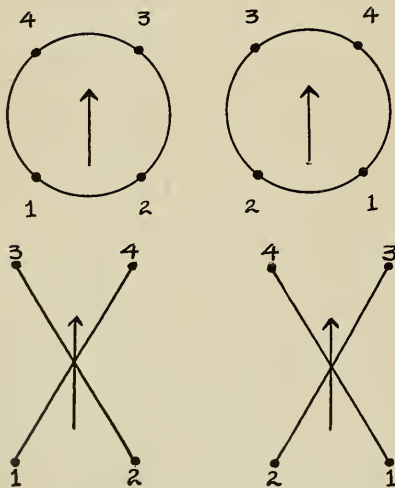


THE RACING GREYHOUND "BLACKIE"

This photograph was taken at the moment of maximum flexure with all four feet off the ground. This animal has run one quarter mile in 26 seconds—a speed of 34.61 miles per hour. "Blackie" is owned by L. I. DeWinter

hound skeleton is approximately the same as that chosen for the race horse, "Sysonby," which is in an adjoining case.

Most mammals have three natural gaits, the walk, the trot, and the run.



HOW DOGS AND HORSES RUN

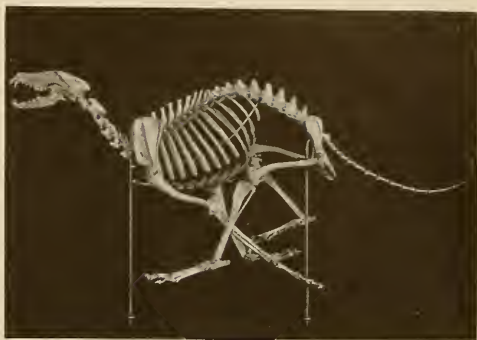
The upper half of this diagram illustrates the rotary action of a dog's feet as he runs. The feet move in the order of the numbers, and although the action may be in one direction or the other, it is always as shown by one circle or the other. The lower half of the diagram shows the diagonal action of the horse's leg movements

These respective methods of locomotion vary so slightly in different animals that it will be interesting to point out some of the minor differences. The dog, a much smaller animal yet almost equalling the speed of the horse when running, must necessarily acquire a much more extreme action than does the latter, but the differences are mostly matters of degree. For instance, at the moment when the limbs are drawn together the spine of the horse is slightly arched. Compare this with the very strongly curved back of the dog. And, while the hind toe of the horse comes in line with the pastern of the front foot, the limbs of the dog cross almost at the knee of the hind leg and the elbow of the front. It is also found that when the horse is under full speed he is entirely free from contact with the ground approximately one-fourth of the time, that being the moment when the limbs are drawn together, while the dog is suspended in air about one-half of the time, being free from the ground twice during each complete stride, once when the limbs are drawn together under the body and again during the extended position.

There is but one technical difference between the running action of the horse and that of the dog, that of the succession of footfalls. Let us compare the action represented by these two skeletons. In each case, the next foot to strike will be the left hind foot and then the right hind, but the horse will follow the right hind foot with the left front, and then the right front foot. Hence it may be called the diagonal run.

The dog, on the other hand, prefers the rotatory run, striking the right front foot after the right hind, and so on around as shown in the diagram (page 546), so that at the moment when the limbs are drawn together under the body the two which come most nearly in contact with each other are those of the same side, while with the horse they are of opposite sides. As shown in the diagram, the succession of footfalls may be reversed.

Again it must be borne in mind that, while our diagram arbitrarily begins the stride with the hind foot, the animal may fall into this succession on any foot, as he breaks from a slower gait or starts off with a sudden spring.



A MOUNTED SKELETON OF A RUSSIAN WOLFHOUND

The movement in the stride which has been selected for mounting is approximately the same as that chosen for the skeleton of the race horse "Sysonby," pictured on page 551

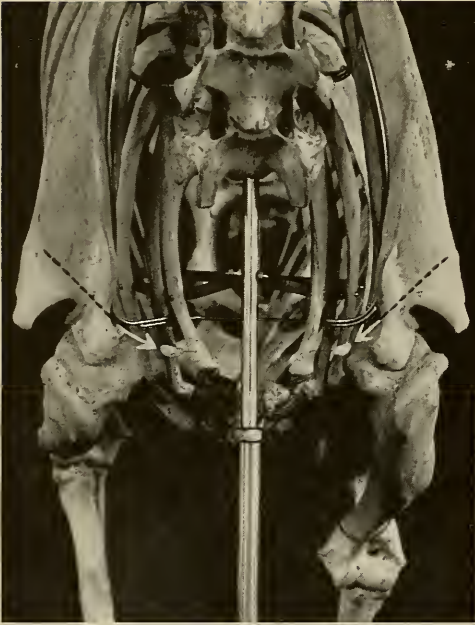
While the respective members of the Equidæ family, also the cow, buffalo, goat, bear, and others employ the diagonal run, some of the ruminants, or cud-chewing animals, such as the deer, elk, and antelope, adhere to the rotatory system of the dog.

To explain more clearly the running action of the horse two interesting photographs of the great race horse, "Man o'



GREYHOUND "GIRLEY" IN THE EXTENDED POSITION

The position in which the dog is shown appears to be almost identical with the position of the race horse "Man o'War" shown in the picture at the head of this article. Despite this apparent parallel, however, the succession of footfalls of the two animals is different as is explained by the diagram on the opposite page. "Girley" is owned by Mrs. Alfred W. Seeler



FRONT VIEW OF THE WOLFHOUND
SKELETON

In these highly specialized running animals many changes have naturally taken place. The arrows, for instance, point to the vestigial clavicles which, because they are no longer useful, are slowly disappearing

War," are shown, one in the extended position with two feet on the ground and the other in the flexed phase of the stride with all four feet high in the air.

One of the laws of progressive movement which all running mammals seem obliged to obey is the manner in which front and hind feet pass each other during the moment of maximum flexure. As the hind feet reach forward for another spring, they always pass, not toward the median line, but outside of the front feet. This interesting fact is nicely demonstrated when we walk out after a fresh fall of snow and examine carefully the tracks of a rabbit, squirrel, or mouse, and on these occasions we may also read the written answers to many of Nature's secrets.

But for one question we do not seem to find a satisfactory answer either in the freshly fallen snow or the tide-washed

sand, and that is: Why is it so imperative that a creature must pass his hind foot in a course lateral to his front foot?

There is one very striking example of the universal application of this law which has come to my notice. The English bulldog, poor creature, has been so distorted by man's breeding and selection that he can hardly be called a normal animal. His measurement through the shoulders is two or three times that of the hips, and as he stands, the distance between his front feet bears a similar proportion to that of the hind, so that we might suppose it to be quite impossible for him to reverse the measurement between front and hind feet in any position that he assumes. Yet, when he can be induced to run with sufficient speed to bring his hind feet in any proximity to his front feet, he follows the well established and time honored traditions of his ancestors, passing his hind feet outside of his front—a most interesting example of the way that exacting old "Dame Nature" demands observance of certain rules which might seem to us quite arbitrary.

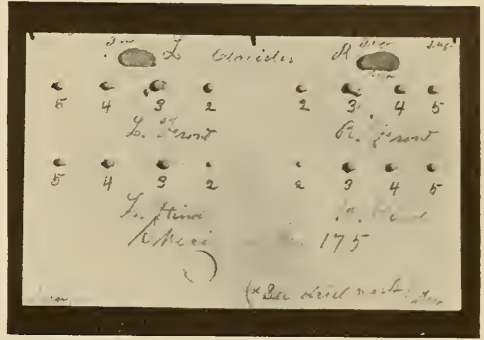
From an anatomical point of view the wolfhound skeleton shows several interesting features. In many animals the clavicle or collar-bone is an important and highly functional organ, particularly in man, where it is well developed, while in most of the large mammals it is entirely extinct, there being no bone connection between the body and the fore legs. The weight of the animal's fore quarters instead is suspended by muscles and tendons between two pillars formed by the leg bones and shoulder blades.

In the dogs, as is the case with most of the carnivorous animals, the clavicle seems to be in a transitional stage, being very small and quite without function. It has no direct connection with the rest of the skeleton but is simply lodged among the muscles of the shoulder and was, no

doubt, functional in some remote ancestral form but is now as useless, though not so mischievous, as the human appendix. We have reason to expect that this small vestige, handed down from the remote past, will, in ages to come, be entirely eliminated from the dog's anatomy.

While these clavicles are in the last stages of a slow decline, there is another set of bones shown in the wolfhound skeleton which must be placed in a very different category, as they are now in their early infancy, and may be regarded as modern improvements,—of course, using the word modern in a comparative sense. These bones, owing to the nature of their development, must be classed as sesamoids. Dogs and their wild relatives are particularly well provided with these small bones, having from sixty-two to seventy-eight located on the feet and legs.

The largest and most highly developed sesamoid in the animal system is the patella or kneecap, which is present in nearly all mammals. But the smaller sesamoids vary considerably in number in



RUDIMENTARY SESAMIODS AND VESTIGIAL CLAVICLES OF THE WOLFHOUND

These small bones, because of their size, are generally overlooked. The sesamoids, however, are highly important parts of the mechanics of running. They are shown fastened on a card where they have been placed in order to prevent their loss while the skeleton is being mounted

different species and a slight irregularity may be observed even among different individuals of a species. These bones always occur near a joint where much violent action is required and are formed in a tendon which has strenuous work to perform, thus reducing friction and increasing power.

As human anatomy was studied before any serious attention was given to the structure of the lower animals, the term sesamoid was first applied to bones of this character which occur in the human hand and foot, and which in size and shape slightly suggest a grain of wheat. But as the knowledge of general anatomy has increased, we find that some of the bones of this class might more properly be compared with "a grain of mustard seed," while others would be more comparable to a horse-chestnut or even a very large-sized potato.

The particular sesamoid bones here to be considered are of special interest because of the fact that they are not generally known, although some of them were figured by De Blainville as long ago as 1839. They are, no doubt, of comparatively recent origin, having been developed as a part of the speed mechan-



THE BONES OF THE WOLFHOUND'S FOOT

The four arrows point to the sesamoids, which are rudimentary bones within tendons. In dogs, these bones have probably been developed in comparatively recent geological time, and they seem destined to continue their development. The human kneecap is an example of a highly developed sesamoid

ism in the course of the evolution of these fast running animals, as the wild ancestors of our domestic dogs pursued their prey.

They are to be found at the ends of the metacarpal and metatarsal bones of the feet on the dorsal surface. Being very

on the end of a very fine wire and held in the position they occupied in life. Likewise the sixteen rudimentary sesamoids were safely attached to their respective places on the feet near the first joints of the toes.



Wide World Photograph

"MAN O'WAR" LEADING "SIR BARTON" BY EIGHT LENGTHS

"Man o'War" appears in the flexed position of his stride with all four feet high in the air. "Sir Barton's" position is intermediate, and he is shown coming into a position which is the opposite extreme of that in which the camera caught "Man o'War." This photograph was taken during "Man o'War's" last race, at Windsor, Ontario, October 12, 1920

small, ranging from 1 to 3 mm. in diameter, it is not surprising that they have been so generally overlooked in the dissection and study of these animals.

In the preparation of the present wolf-hound specimen this set of sixteen bones was very carefully worked out of the surrounding tendons, then pasted on a card together with the precious clavicles, where they were labeled and numbered for safe keeping, awaiting a convenient time for placing them in proper position.

After much time-consuming labor in the general preparation of the bones, the study of animal action to be applied to those bones, the devising and construction of mechanical means to hold every bone permanently in the desired position, and the removal of many temporary accessories, the mounting of the skeleton was nearly complete. Then the clavicles were taken from the card and suspended

There is still another set of sesamoid bones which frequently occur at the second joint of the toes, but these are extremely small and quite irregular and were found absent in this specimen.

In the first paragraph of this article reference is made to hyoid bones. It might be fitting to say a few words about these interesting and important organs without which we would suffer much privation in not being able to enjoy the sound of our own voices or those of our talkative friends and neighbors; our pet would not greet us with his friendly bark and our neighbor's cur could not mar our nocturnal rest, which would surely be another great privation.

The hyoid apparatus is an essential part of the larynx and tongue system, the hyoid bones being embedded in the tissues at the base of the tongue, partly surrounding the larynx and taking part in its operation.

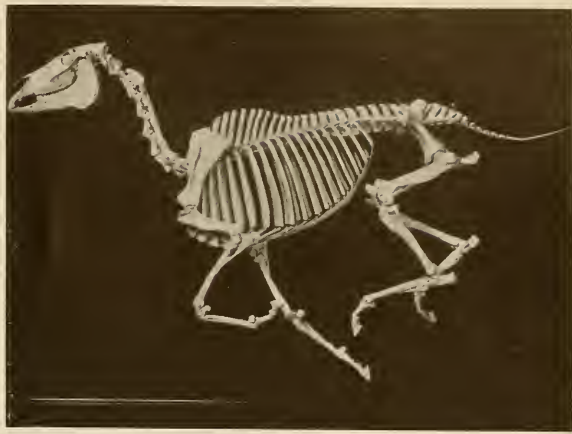
These bones also control, to a great extent, the movements of the tongue. As we look at the mounted skeleton of the wolfhound, we are to assume that the tongue is hanging far out of the open mouth, as is usually the case with a running dog. How different is the horse, who runs with closed mouth, breathing through widely dilated nostrils. Unfortunately, perhaps, for the osteologist, there are no bones in the dog's lolling tongue to add facial expression to the skeleton. To some extent, however, the hyoids come to our rescue. On close examination of the mounted skeleton it will be seen that these bones are thrust forward into the back of the mouth.

Whereas if the tongue were withdrawn into the closed mouth, the hyoid bones would move back more into the throat.

Now passing to the other extreme let us consider the caudal vertebræ. Without this appendage, which is regarded by many as an undesirable accessory, our

"MAN O'WAR"

The greatest of all race horses. This picture was taken three months after his owner, Mr. Samuel Riddle, had taken the animal from the race track



THE MOUNTED SKELETON OF "SYSONBY"

Twenty years ago "Sysonby" was known as one of the finest of race horses. The skeleton shown here is on exhibit in the American Museum and illustrates the flexed position somewhat the same as that illustrated by "Man o'War" on the opposite page. By comparing this skeleton with that of the wolfhound shown on page 547, it is easy to see how much more extreme is the action of the dog

happy and demonstrative friend would be robbed of his chief power of expression by which he so eloquently conveys to us his feelings of joy, remorse, or fear. While the tail of a living wolfhound does not so successfully express his emotions as does that of most breeds, to the osteologist it is

really a boon, for, when the animal is running fast, the tail is apt to switch from side to side in an interesting manner. This justifies the placing of a few artistic curves in the caudal vertebræ of the mounted skeleton which, I think it will be conceded, adds much to the esthetic value of the exhibit.

It is hoped that exhibits of this nature may overcome a popular prejudice against collections of skeletons, and that the American Museum's osteological hall may become increasingly interesting and valuable, not only to the casual visitor but also to the student, the anatomist, and the artist as well.

the collection. Negotiations in the conferences between Doctor Andrews, Minister MacMurray, and the Cultural Society having failed to bring about an agreement, Doctor Andrews cabled to President Osborn and the matter was taken up in Washington with the Chinese Ambassador, Dr. Chao Chu Wu, a graduate of the University of London, and with the State Department through Secretary Stimson and Assistant Secretary Nelson Johnson. For several weeks conferences were held in New York, in Washington, in Peking, and in Nanking, with an idea of securing a modification of the terms formulated by the Cultural Society. With the authority of the Trustees, President Osborn renewed and extended the offer he made during his Peking visit in 1923 to establish a natural history museum in Peking out of the materials collected during fifteen years of exploration in China and Mongolia, provided the government would set aside a building for the purpose; also to take two Chinese students into the field to be selected by the Geological Society of China; also to bring a qualified Chinese student to this country for a year's education in Columbia University and the American Museum in the whole art of vertebrate palæontology with the expectation of establishing this historic branch of science through highly trained students in China. The Trustees of the American Museum treated the matter as one of prime importance between the government and educational system of China and the government of the United States. This point of view was strongly sustained by Secretary Stimson. Finally a conference was held in Peking between Minister MacMurray, Doctor Andrews, Foreign Minister Wang, and representatives of the Cultural Society in Peking, at which the Chinese condition of a co-director was waived by the Cultural Society, but the other conditions remained substantially the same. On receiving cabled information to this effect, President Osborn instructed Doctor Andrews to abandon the expedition of 1929, to send all the American members of the party back to the United States, to remain himself in Peking, to retain the equipment, and to push forward as rapidly as possible the writing of the initial volume of the published series.

Meanwhile ten boxes of the 1928 collection arrived in this country on July 1, 1929, and the fossils are now being prepared in the laboratory of vertebrate palæontology. The remaining twenty-seven boxes which were held by command of the Cultural Society, were shipped from Shanghai on June 26 and are now on their way to this country. It is expected that Assistant Chief Granger and Messrs. Young and Thomson will return to the

Museum in September and will immediately take up work on the restoration and description of the collection of 1928 which will occupy the entire winter.

The President and Trustees of the American Museum will take up through the State Department at Washington arrangements for the field expedition of 1930. Minister Chao Chu Wu is confident that a bill will be introduced in the Chinese Legislature distinguishing between geologic specimens including fossils and petrifications and flint objects representing the paleontology of man, all of which belong to the world of science, and objects of ancient art, sculpture, and pottery, all of which belong to the early history of the great races of China and Mongolia. President Osborn strongly supports the world-wide movement for the retention of these objects of ancient art and archaeology in the country in which they originated. He also very strongly supports the system of free scientific exploration which has prevailed through all the civilized countries of the world since the year 1754, when the first French exploring parties made collections of fossil mastodons on the banks of the Ohio River, which were sent back to France for description by Buffon and other great naturalists who rendered the close of the Eighteenth Century so illustrious in the scientific history of France.

THE latest word from the Columbia University-American Museum African Expedition states that the party has now arrived in the Kivu district, where it has established its base camp.

ANOTHER expedition is being sent into the South American field by the American Museum on October 24, when Messrs. Gilbert Ottley and H. E. Anthony sail for Mollendo, Peru.

This expedition is made possible through the generous financial assistance of Mr. Ottley, who was a backer of the Museum's Porto Rico and Virgin Islands expedition of 1926 and a volunteer assistant in the field. Mr. Anthony, curator of the department of mammals, is in charge of the expedition, and Mr. Ottley will assist in making collections of mammals, taking photographs, and recording observations.

The primary purpose of the trip is to make a biological reconnaissance through southern Peru, Bolivia, Chile, Argentina, Paraguay, Uruguay, and southern Brazil. Localities of especial significance, the places where the types of new species have been taken, will be visited, and collecting will be carried on to secure topotypes (specimens from the same locality as the type) for the Museum series. Because the Museum lacks mam-

mals from these key localities, such a collection of topotypes will be especially valuable as the basis for comparisons on the mammals of the whole southern half of South America.

The field observations made by the party will be of great assistance to Mr. Anthony, not only for the identifications and reports upon mammals already in the Museum, but also for the data which will be gathered for future field work in South America. Because of improved modern methods of transportation, the expedition will be able to carry out an itinerary which not many years ago would have required a much greater expenditure of time than the five or six months now planned.

The expedition will use railroads and automobiles for moves of any distance, and mules or horses for the side trips into the more inaccessible regions. One of the items in the plan is the gathering of accessory material for the Mt. Aconcagua group, the studies for which were made by Dr. Frank M. Chapman and F. C. Walcott at the base of Mt. Aconcagua in Argentine. The group shows the condor and will be a feature of the Hall of Birds of the World. It can be completed in the near future after the specimens of the shrubbery, grasses, mosses, etc., have been collected.

THE Sanford-Legendre Expedition has returned to New York after a nine months' collecting trip in Abyssinia. Most important of the material collected by the party are eleven specimens of nyala. Many fine specimens of other mammals were also brought back, including an Abyssinian red wolf, Soemmerrung gazelle, tora hartebeest, kudu, waterbuck, aard-wolf, and oryx. About 120 birds were also collected.

NATURAL HISTORY hopes to publish an account of this expedition in a later issue.

AN expedition has left the American Museum for Yucatan to collect the mammals of that Mexican state and to explore the numerous caves of the country for remains of fossil animals. These caves occur chiefly in a low range of limestone hills known as the "Yucatan Sierra."

The expedition, which will be in the field about three months, is supported by the Angelo Heilprin fund, and consists of Robert T. Hatt and his wife, Marcelle Roigneau.

THE American Museum has sent Myron Ackland, of the department of mammalogy, to the Okefenokee Swamp of southern Georgia to collect a representative series of mammals from that region. The territory is one of the few regions left within the borders of the United

States where natural conditions little altered by man's agency still prevail. Its mammalian fauna offers to the collector a range in size from the tiny shrew to the comparatively huge bulk of the bear. One of the objectives of the trip is the round-tailed muskrat, *Neofiber alleni*. It is also hoped that the fairly uncommon Rafinesque bat, *Nycticeius humeralis*, will find its way into the Museum's collections.

THERE has recently been devised in the department of herpetology and experimental biology of the American Museum, a method of infiltrating whole animals with paraffin in such a way that they retain their original color and form. Mr. William G. Hassler left in September for Santo Domingo, where he will employ the new method for the first time in the field. Mr. Hassler hopes to obtain several large species of lizards and snakes, as well as a number of frogs. These will be prepared in the field in such a way that they may be infiltrated when the expedition returns to New York. Mr. Hassler hopes to work out the life histories of several rare lizards while securing the exhibition material. He will also send live reptiles back to the Museum for study in the new laboratories of experimental biology. The expedition is supported by the Angelo Heilprin Expedition Fund.

THE Bernheimer Expedition.—Mr. Charles L. Bernheimer, who has led a number of American Museum expeditions to southern Utah and northern Arizona, during May and June, accompanied by Mr. Barnum Brown of the Museum staff and Mr. Earl H. Morris of the Carnegie Institution, visited the region in the triangle formed by the junction of the San Juan and the Colorado rivers. On previous expeditions Mr. Bernheimer explored the country south of the San Juan River, making important archaeological discoveries respecting the Basket-Maker and other early types of civilization in our Southwest. The expedition this year located additional Basket-Maker remains and cliff dwellings belonging to later culture periods in the Southwest.

Among the finds of special interest were extensive carvings on the walls of a cliff in Moki Cañon, at least one thousand feet above the cañon floor. Some of these carvings appeared to be sun symbols, others appeared to be mountain sheep, and others were unexplainable shapes.

It is a curious fact that the Indians living in that country during the Basket-Maker period did not use the bow and arrow, but were dependent upon darts thrown with an atlatl. Mr. Bernheimer found the skins of mountain sheep, well

preserved in the dry caves, in which the wounds made by atlatl darts were plainly visible.

Also, in one of the burial caves was found a mummy in good condition, together with ears of corn, golden-brown in color, baskets, and other articles used by the person in life.

THE department of anthropology of the American Museum, jointly with the Carnegie Institution, carried on explorations in Cañon del Muerto, Arizona, during July and August. The field work was in charge of Earl H. Morris of the Carnegie Institution, but formerly connected with the Museum. The camp of the field party was located near the famous ruin known as Antelope House, and the excavations were in the adjacent parts of the Cañon. The major portion of the work was the excavation of a burial cave opposite Antelope House in which were unmolested remains of the Basket-Maker period in the pre-history of the Southwest.

From these excavations were secured a fine series of specimens representing the Basket-Maker culture as it flourished in the Cañon. Further, the information provided by this site gives a clear picture of the part the Basket-Maker culture played in the development of the later cultures occupying the Cañon.

The find of special interest, however, was a unique burial. In this case the body of the deceased, together with his belongings, were placed in a stone crypt, carefully sealed. As a result, the clothing and other grave objects were perfectly preserved. The body seems to be that of an old man wrapped in two cotton blankets, covered with a robe of feather cloth. Attached to the grave bundle were many hanks

of cotton yarn, the strands of which have a total length of more than two miles. Accompanying the burial were five baskets, five pottery vessels, a bowl, and a planting stick. The stone crypt containing the body was roofed over with timber overlaid with matting, cedar bark, and earth. The ceiling was so complete that no dust had worked its way into the cavity, nor had the contents been disturbed by rodents or insects. Another interesting feature is that the pottery found with the body is of the well-known Mesa Verde type, and the nearest ruin in the Cañon accompanied by such pottery is more than half a mile distant. This find not only yields unique specimens for our collection but also gives us for the first time a complete costume for the Basket-Maker period.

These explorations were made possible by the generosity of Mr. Ogden Mills.

THE first detailed geographical study of Cañon del Muerto, Arizona, was made this summer by Edward M. Weyer, Jr., special field assistant in the department of anthropology. In addition to this work he carried on geographical investigations to determine the extent of possible agricultural lands used by the prehistoric inhabitants of that Cañon. Mr. Weyer's map and geographical notes will be an important contribution to the Museum's knowledge of the ancient civilizations of the Southwest.

DURING the past summer Barnum Brown investigated caves in southern Nevada for prehistoric mammals, collected Pliocene mammals in northern Utah, and found two Jurassic dinosaur skeletons in eastern Utah.

IN THE FIELD OF NATURAL HISTORY

Education — Scientific Research — Conservation
Books — Meetings of Societies

PERCY R. PYNE

ON August 22, Percy R. Pyne, for twenty-nine years a Trustee of the American Museum and its Secretary for the past eight, died at his summer home, Upton Pyne. An account of Mr. Pyne's association with the Museum will appear in a later issue of NATURAL HISTORY.

ASTRONOMY

“THE Big Telescopes and What They Do” was the subject of the address at the first fall meeting of the Amateur Astronomers Association on September 18. Mr. James Stokley,

astronomical editor of *Science Service*, came from Washington, D. C. to deliver the address, which described his rambles among the leading American, Canadian, and European observatories.

“Our Friendly Stars of the Polar Night” will be discussed October 2 by Anthony Fiala, commanding officer of the Baldwin-Ziegler Polar Expedition of 1903-1905.

FREE classes in astronomy will again be open only to members of the Association this fall. Information concerning these may be obtained from the secretary, Miss M. Louise Rieker.

EDUCATION

THE American Museum, in expanding and developing its educational activities, will take a further step this year by initiating "Cultural Courses for Teachers" of both elementary schools, and high schools and colleges. The Board of Education in New York City requires of its teachers thirty hours of cultural courses, and these courses at the Museum are designed to give the thirty hours' credit. They are free to teachers in the public schools of New York City. At the end of the course a paper of not less than 5000 words may be submitted in place of an examination.

For the teachers of elementary schools "A Cultural Course in Geography" is offered on Tuesday afternoons beginning September 24 and continuing until May 27, 1930, under the direction of Mrs. Grace Fisher Ramsey. This series will be opened by Dr. George H. Sherwood, director of the Museum, with a talk on the "Plans and Aims of the Course." This will be followed, beginning on October 1, with a series of six lectures on astronomical geography; and in November and December by six lectures on the "Earth-crust and Its Changes"; then will come a series on "Life in the Zones," and the "Races of Mankind"; and on May 27, 1930, a summary of the lectures will be given in a talk on classroom application by Mrs. Ramsey. Each session will last one hour and will consist of discussion in the classroom followed by study and examination in the exhibition halls of material relating to the subject under consideration. The topics for this course are based on the new syllabus in geography and will be of great value to teachers for current classroom use. The sources of the lecture material are, largely, the various expeditions of the Museum in all parts of the world, and will embody the results of researches and investigations by members of the scientific staff as well as other scientists.

The course for high school and college teachers will open on September 25 with a lecture by Doctor Sherwood on the "Plans and Aims of the Course." This will be followed during October and part of November by six lectures on astronomy by Dr. G. Clyde Fisher, curator of astronomy. Section II, "The Early History of the World," will consist of six lectures: two on geology by Dr. Chester A. Reeds, curator of geology; two on mineralogy by Dr. Herbert P. Whitlock, curator of mineralogy; and two on fossils by Mr. Barnum Brown, curator of fossil reptiles.

Section III will be devoted to five lectures on anthropology by Dr. Clark Wissler, curator of anthropology. Section IV includes five lectures

on birds, to be given by Dr. Frank M. Chapman, curator of ornithology, and Dr. Robert Cushman Murphy, curator of oceanic birds. Section V will include a course of six lectures on "The Nature of the Living World," by Dr. G. Kingsley Noble, curator of experimental biology. The course will be closed on June 4, 1930, by a summary lecture on "Classroom Applications of the Course," by Mr. Paul B. Mann, associate in the department of education.

These courses will be open to those who may desire them and are not teaching in public schools upon payment of a registration fee of \$15. Checks may be drawn to the order of the American Museum of Natural History and sent to the Museum at 77th Street and Central Park West. Registration should be made before Sept. 25 either by letter or in person at Room 306 of the School Service Building in the Museum.

DURING the fall of 1929 several activities will be carried on for the children in the blind and sight conservation (partially blind) classes of the public schools and for the blind children in private institutions. Members of the department of education will give, as formerly, a program of ten lessons in geography, history, and nature study, fully illustrated by museum material. Groups of boys and girls from Manhattan, Bronx, Brooklyn, and Queens will visit the Museum, some of them only once but others as many as ten times. In the classroom of the School Service Building, where these lessons will be given, each child will be allowed to examine and handle the objects used as illustrative material. Under the guidance of a Museum instructor, some groups of partially blind children will visit exhibition halls related to the lesson given in the classroom.

In addition to the class work, the Museum plans to send study collections to the blind and sight conservation classes in the public and private schools. Of particular value to the teachers are the relief globes which are so modelled with raised land formations, sanded coast lines, etc., that totally and partially blind children can easily learn their geography lesson by "seeing" with their fingers. The department of preparation has just completed ten new globes which will be distributed this fall as permanent loans to the public schools. These, together with those already distributed, will supply geographical aids to every school where there is a blind or sight conservation class.

THE success of the June session of the Nature Training School which is held each year under the direction of the Coördinating Council

on Nature Activities, has led the Council, at the solicitation of numerous camp directors and nature counselors, to offer for them two parallel courses in Nature Training and Camping for the eight weekends of October and November at Cold Spring Harbor, Long Island.

The Cold Spring Harbor region, well known as a center of scientific research, offers exceptional advantages for nature study, as it includes sea water, both pure and brackish, with fresh water adjoining, with the consequent "transition zones." It provides in the sea water, muddy, sandy, and rocky bottoms, all within the action of the tides, as well as at greater depths. The region is protected, thereby assuring a very wide range of ecologic conditions with abundant flora and fauna. It is also interesting geologically.

The locality presents excellent opportunities for camp demonstrations, with its heavily wooded slopes and hills and sand dunes, as well as the famous Hempstead Plains. The Eugenics Record office and the Carnegie Station for Experimental Evolution and the New York State Fish Hatchery adjoin the premises.

The Biological Laboratory has placed Blackford Hall, with its dining room, sleeping apartments, and club room at the disposal of the Council for these week-end groups.

The programs in Nature Training and Camping are so arranged that a member may take either course and receive a certificate at the end of eight weeks. Students unable to attend the eight consecutive sessions may register for a minimum of four week ends or may attend a single session by special arrangement. The staff will include directors and specialists in various fields of natural science and camping.

Dr. Bertha Chapman Cady, executive secretary of the Coordinating Council on Nature Activities, with headquarters at the American Museum of Natural History, and Mr. Ben Solomon, Editor of *Camp Life Magazine*, 93 Remsen Street, Brooklyn, New York, are directing the courses, and will be glad to furnish full information regarding them.

FISHES

THE model of a rare and highly specialized deep-sea fish, *Regalecus argenteus*, the oar-fish or herring king, constructed by C. Marguglio, has been placed on exhibit in the Hall of Fishes at the American Museum.

The specimen on which the model is based was cast ashore at Moeraki, New Zealand, in 1883. Its skeleton was mounted for the Otago University Museum.

This fish is remarkable for its extreme fragility and flatness in proportion to its great length, and

for its peculiar skull structure. It is particularly vivid in coloring, frosty silver with blue head parts and light crimson fins. The anterior dorsal fin rays are produced into a high crimson crest, and the ventral fins reduced to long filaments. *Regalecus* as seldom been captured and is probably responsible for some sea serpent stories.

FOSSIL VERTEBRATES

ERRATUM.—In the caption of the full page drawing that appears on page 507 of this number, illustrating Doctor Simpson's article on "Hunting Extinct Animals in Florida," one of the two animals pictured is called, by mistake, a capybara. This animal is a ground sloth.

UPON his return from Peking to the Museum, Curator Walter Granger, will immediately take up the preparation, arrangement, cataloguing and illustration of the valuable collection of fossil mammals made by the Central Asiatic Expedition during its season of 1928.

After a long delay, the collection is reaching the American Museum in two consignments; the first, of ten boxes despatched from Peking in April, is now being prepared, and the remaining shipment of twenty-seven boxes was sent from Tientsin in June.

All the materials in these boxes have been carefully worked over in the laboratory of the American Museum headquarters in Peking by our own staff of Chinese preparators under the direction of Mr. Granger and our chief preparator, Albert Thomson. After this careful preparation they were recovered with wrappings of burlap and splints fitting tightly to the sides of the bones but readily removable in the New York laboratory by the free application of water which dissolves the adhesive material applied in Peking. The results of this method of preparing in Peking and subsequent finishing in the American Museum are very gratifying, first, in the great economy of expense; and second, because of the utilization of our entire Peking force in the winter season who otherwise would be idle; and third, because of the relief in pressure on the overcrowded laboratory of the department of vertebrate palæontology in New York. As rapidly as these specimens are being finished they are being placed on exhibition in the Central Asiatic Hall on the fourth floor, east pavilion, so that the public may see them within a relatively short time after their shipment from China. The first of these new 1928 arrivals has already been described by Curator Osborn under the name *Embolotherium*, signifying the "battering-ram" titanothere. The second and third descriptions will appear shortly of the "shovel-tusker"

mastodont or *Ambelodon*. Owing to the delay in the shipment of these specimens from China, the American Museum was anticipated by the Leningrad Museum in the description of a "shovel-tusker" mastodont discovered in Chinese Turkestan and described by Dr. A. Borissiak of the Palæontological Museum of Leningrad.

WHEN Dr. William Diller Matthew, F. R. S., was called from the head of our department of vertebrate palæontology to a full professorship of the same subject in the University of California, it was agreed that he should return to the American Museum during his vacation periods of the summer months to continue his researches on the oldest fossil mammals of Tertiary time, chiefly from the famous deposits known as the Puerco-Torrejon of northern New Mexico. Through the Cope Collection purchased in the year 1894, the Museum acquired the large and unique series of fossil mammals of this region, amplified by the explorations of Wortman and

us a much better idea of the real character of the four tæniodont genera. I was even able to make a restoration of the skeleton of *Psittacotherium*."

WALDRON DE WITT MILLER

ON August 7 Mr. Waldron Miller, associate curator of ornithology at the American Museum of Natural History, died at New Brunswick, New Jersey, from injuries received a few days previous, when the motor cycle on which he was riding collided with a motor bus.

For twenty-six years Mr. Miller had been a member of the scientific staff of the Museum, giving to the institution and to numberless bird-lovers who have called upon him, the benefit of his unequaled knowledge of birds and of fauna and flora, particularly within a radius of fifty miles of Plainfield, New Jersey, his old home.

Since boyhood Mr. Miller had been a close student of birds. In his early twenties he attracted the attention of William Dutcher and



Photograph by James P. Chapin

WALDRON DE WITT MILLER
1879-1929

A member of of the scientific staff of the American Museum since 1903

Granger. It is a bizarre world of life totally unlike the present. Through years of research Doctor Matthew has become a master of this subject and on the invitation of the Trustees he is preparing a memoir entitled "Revision of the Puerco-Torrejon Fauna of New Mexico" of which Part I was finished during the summer of 1928, the plates made up and the illustrations completed. During the present summer Doctor Matthew has completed the second part including twelve plates, about thirty-five text figures and between three and four hundred pages of manuscript. The chief feature of this year's work is the re-study of the strange large-clawed mammals known as 'tæniodonts' (from the Greek signifying 'banded-toothed'). He writes: The drawings "took most of Mr. Prentice's (the artist) time. I pieced the skulls and feet together more completely, and restored them in plaster so far as justified by exact knowledge. They give

later of Dr. Frank M. Chapman, through whom he came to the American Museum. During all the succeeding years he continued his field studies with unflagging enthusiasm, spending every spare moment out of doors, studying the local birds in varying phases during the cycle of the seasons. He made himself familiar not only with the botany of the region where he worked, but also with the small mammals and reptiles.

Mr. Miller was a member of the committee appointed to draw up the classification for the new check-list for the American Ornithological Union, which was published by Wetmore and Miller in 1926 in *The Auk*. He was undoubtedly one of the best bird anatomists in America. During his studies and field trips he had gathered an enormous amount of information on the anatomy and pterylosis of birds, and his notebooks bear witness to his keen observations of the specimens that passed under his eyes for record

and preparation. He made a special study of woodpeckers and their allies, world-wide in its scope, as well as of the characters of parrots and numerous other families.

To Mr. Miller's colleagues at the Museum to whose requests for information and assistance in their work he never failed to respond by placing at their disposal his rich stores of knowledge, and to his many friends and admirers, the tragedy which has robbed ornithology of one of its leading students, is cause for profoundest sorrow and regret.

HISTORY OF THE EARTH

AN extended vacation during the past summer permitted Dr. Chester A. Reeds, of the American Museum, to observe the geological features at many interesting places in Austria and Germany. A month in the Austrian Alps afforded an opportunity to examine the Höhe Tauern Range, the Gastein, Nassfeld and Seebach valleys near Badgastein and Mallnitz, and the beautiful glacial lakes Zeller See in the Saalach Valley, Mond See, Wolfgang See and Königs See near Salzburg. At Zell am See the recently completed funicular railway, which carries passengers up 2000 meters, provided a convenient ascent to the top of the Schmittenhöhe, where an excellent panorama of the eastern Alps with their snow-capped peaks and glaciated valleys was to be had. Here the barren Steinernes Meer range, with reddish hue and turreted battlements, was more picturesque than the snow-capped peaks of the Höhe Tauern. The descent into the salt mine at Berchtesgaden revealed extensive beds of rock salt of variegated colors, which has been mined since prehistoric times and afforded a revenue for various governments for centuries.

In Germany special studies were made:

(1) of the loess, sand and gravel deposits at Mauer near Heidelberg, where *Homo heidelbergensis* was found in 1907;

(2) of the Sächsische Schweiz or Saxon Switzerland where thick sandstone deposits with marked erosional features are exposed along the Elbe between Dresden, Germany, and Tetschen, Czechoslovakia;

(3) of the varved clay deposits in the valley of the Havel River at Zehdenick, 60 kilometers north of Berlin. Numerous photographs were taken at the points visited while at Gastein, Mauer, Dresden and Zehdenick. Samples of the material were collected for the American Museum series.

INSECTS

RESEARCH work at the Mt. Desert Biological Laboratory, Salisbury Cove, Maine, has engaged the attention of Curator Frank E. Lutz, of the American Museum's department of insect life, most of the summer. His studies were chiefly

concerned with the flexibility of the case-building instinct of caddis-fly larvæ, those interesting aquatic creatures that make "houses" of sticks or stones, or of both, according to their species. His results will probably be published in a subsequent issue of NATURAL HISTORY. Through the kindness of Mr. Pratt, chairman of the department's Trustee committee, Doctor Lutz had with him a motion-picture camera with which he filmed the activities of various insects for the Museum's department of public education.

EXPERIMENTAL BIOLOGY

IN continuing the investigations on the cause of blindness in cave salamanders, the department of experimental biology of the American Museum extended its activities to a study of species which do not ordinarily become blind. Mr. Maurice K. Brady has been studying the rare Coastal Plain salamander, *Stereochilus*, a close relative of the blind species, *Typhlotriton*. The work was carried on in Winton, N. C., where Mr. Brady found the species dwelling in certain magnolia bog conditions peculiar to the white cedar and cypress swamp area of the southern Coastal Plain. He obtained a series of both adults and larvæ for the department.

Mr. Brady, who has made a special study of salamanders of the eastern United States and is a graduate of George Washington University, has recently joined the staff of the American Museum as assistant in experimental biology.

REPTILES AND AMPHIBIANS

A NEW appointment at the Museum is Mr. Charles E. Burt who has joined the staff as assistant curator of reptiles and amphibians. He is a graduate of the Kansas State Agricultural College, and during the past two years has been carrying on graduate work in the University of Michigan. Mr. Burt has made special study of the American lizards, and at the present time has ready for publication a revision of the race runners, *Cnemidophorus*, one of the largest and most difficult groups of lizards.

DURING June and July Mr. and Mrs. Charles E. Burt made an extensive collection of reptiles and amphibians in the Mississippi Valley, which included 784 amphibians and 209 reptiles, obtained in thirteen states and in a wide range of habitats. The most important material was obtained in the region of the badlands and the Black Hills of South Dakota, in the sandhills of northern and central Nebraska, and in the swamps of southwestern Louisiana. The American Museum has very few collections of reptiles and amphibians from the Middle West and this material adds important species to the collections.

NATURAL HISTORY AUTHORS

Gilbert C. Klingel is a field naturalist of Baltimore who has for a long time been interested in photographing reptiles and amphibians. The expedition which he describes in "Lizard Hunting in the Black Republic" was sent out under the auspices of the department of herpetology and experimental biology of the American Museum, and was financed by Mr. Klingel.

Although **Vilhjalmur Stefansson** has spent a considerable portion of his life in exploration in the Arctic and sub-Arctic, his wide interest in all polar exploration is evidenced in his former contribution to the September-October, 1928, issue of *NATURAL HISTORY* entitled "By Air to the Ends of the Earth."

"The Theoretical Continent," gives the reader a most interesting account of the gradual shrinkage of the Antarctic Continent under the steady advance of exploration.

To **S. Harmsted Chubb**, who tells "How Animals Run," is due the credit of having had the first inspiration to mount skeletons artistically and scientifically accurate at the same time. As a boy he spent most of his spare time in cleaning and articulating the bones of stray mammal specimens. This early interest developed with the years, despite the fact that he had to go into commercial work. His love of the art urged him continually to seek some connection which would enable him to devote his entire time to it, and he was led to show several of his mounted specimens to President Henry Fairfield Osborn who presently gave him an opportunity to do some work for the Museum. That was eighteen years ago. Today Mr. Chubb is known as the foremost authority and exponent of artistic expression in skeletal museum exhibits.

The story of "The Birds of Little Diomed" is told by **Francis L. Jaques**, one of the artists on the staff of the American Museum's department of preparation. Mr. Jaques painted the exquisite sky background for the bird dome of the Bird Hall on the second floor of the Museum,

and the background for the dramatic shark group in the new Fish Hall, as well as that of the Panama bird group.

Mr. Jaques' remarkable artistic ability, self-trained, and his particular interest in birds, fit him especially to interpret an artist's reaction to the problems of museum group construction.

Myron Ackland since February of this year has been an assistant in the Museum's department of mammals. As is evident from his article, "Animals in Orchestration," he is not a firm believer in the ancient admonition that "A cobbler should stick to his last"; and it so happens that music is his avocation.

Mr. Ackland was formerly a student of chemistry at Ithaca, N. Y. During his studies in 1923 and 1924, he had the rare opportunity of making frequent visits to the studio of the late Louis Agassiz Fuertes, who engendered and fostered in him the interest in natural history which was ultimately to take first place in his choice of activities.

There appears on the *Natural History Cover* for this issue a reproduction in color of a painting by Mr. Arthur A. Jansson, of the rhinoceros iguana, *Cyclura cornuta*, the largest of the iguanid lizards. It is exceeded in length by the iguanas of South and Central America, but these never reach the weight of the rhinoceros iguana. The Iguanidae include the horned toads and the chameleons, as well as the greater number of American lizards.

After several years of work on the earliest mammals, in the Yale Peabody Museum, British Museum, and other American and European institutions, **George Gaylord Simpson** joined the staff of the American Museum in 1927. Since then he has devoted much time to the study of the extinct mammals of Florida. "Hunting Extinct Animals in Florida" is an outgrowth of these studies and of field work early in 1929 in coöperation with the Florida State Geological Survey and with Mr. Walter W. Holmes, Field Associate of the American Museum.

Facts concerning other contributors have been given in former issues.

NEW MEMBERS

SINCE the last issue of *NATURAL HISTORY*, the following persons have been elected members of the American Museum, making the total number 11,200.

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For the enrichment of its collections, for the support of its explorations and scientific research, and for the maintenance of its publications, the American Museum of Natural History is dependent wholly upon membership fees and the generosity of friends. More than 11,000 members are now enrolled who are thus supporting the work of the Museum. The various classes of membership are:

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

AUTUMN AND SPRING COURSES OF POPULAR LECTURES

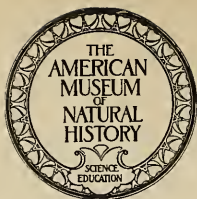
Series of illustrated lectures, held in the Auditorium of the Museum on alternate Thursday evenings in the fall and spring of the year, are open only to members and to those holding tickets given them by members.

Illustrated stories for the children of members are presented on alternate Saturday mornings in the fall and in the spring.

MEMBERS' CLUB ROOM AND GUIDE SERVICE

A room on the third floor of the Museum, equipped with every convenience for rest, reading, and correspondence, is set apart during Museum hours for the exclusive use of members. When visiting the Museum, members are also privileged to avail themselves of the services of an instructor for guidance.

SCIENCE
EDUCATION



RESEARCH
EXPLORATION



FIFTY-NINE years of public and scientific service have won for the American Museum of Natural History a position of recognized importance in the educational and scientific life of the nation and in the progress of civilization throughout the world. With every passing year the influence of the Museum widens, as is witnessed by the increasing number of visitors who daily enter its halls without the payment of any admission fee whatever.

THE NEW SCHOOL SERVICE BUILDING, with the increased facilities it offers, makes it possible to augment greatly the Museum's work not only in New York City schools but also throughout the country. Fourteen million contacts were made during 1928 with boys and girls in the public schools of New York and the vicinity alone. Inquiries from all over the United States, and even from many foreign countries, are constantly coming to the School Service Department. Information is supplied to, and thousands of lantern slides are prepared at cost for distant educational institutions, and the American Museum, because of this and other phases of its work, can properly be considered not a local, but a national—even an international—institution. Through its loan collections, or "traveling museums," which are circulated locally, 557 schools were reached last year, and 2,282,192 direct contacts were made with the pupils. More than a million lantern slides were lent to the New York City schools, and 4,851 reels of the Museum's motion pictures were shown in 223 public schools and other educational institutions in Greater New York, reaching 1,576,249 children.

COLLEGE AND UNIVERSITY SERVICE. The President and the Curator of Public Education have extended and intensified the courses of college and university instruction. Among the institutions with which the Museum is coöperating are Columbia University, New York University, College of City of New York, Hunter College, Rutgers College, University of Vermont, Lafayette College, and Yale University.

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

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MANY POPULAR PUBLICATIONS, as well as scientific ones, come from the Museum Press, which is housed within the Museum itself. In addition to *NATURAL HISTORY*, the journal of the Museum, the popular publications include many handbooks, which deal with subjects illustrated by the collections, and guide leaflets, which describe individual exhibits or series of exhibits that are of especial interest or importance. These are all available at purely nominal cost to anyone who cares for them.

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From these adventuring scientists, as well as from other members of the Museum staff and from observers and scientists connected with other institutions, *NATURAL HISTORY MAGAZINE* obtains the articles that it publishes. Thus it is able to present to the constantly enlarging membership of the American Museum the most fascinating and dramatic of the facts that are being added to the Museum's knowledge, or are deposited in this great institution.

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BIRDS OF PARADISE

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The Journal of The American Museum of Natural History

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BAKER'S BOWER BIRD
(*Xanthomelus bakeri*)

Adult male and young male of one of the new species discovered by Mr. Rollo H. Beck near Madang on the northern coast of New Guinea. The female is still unknown

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A COLLECTOR IN THE LAND OF THE BIRDS OF PARADISE

Collecting Brilliantly Colored Birds Among the Mountains of New Guinea—The Problems and Difficulties of an Ornithologist in the Savage Interior of One of the Greatest of Islands

By ROLLO H. BECK

Leader of the Whitney South Sea Expedition

WITH FIVE DRAWINGS BY FRANCIS L. JAKUES

After sixteen years of arduous adventure in the service of the American Museum of Natural History, Mr. Rollo H. Beck and Mrs. Beck had started homeward from the Solomon Islands in June, 1928. They looked forward to retirement and a well-earned rest in their California home. The heat, and danger, and swelter of nearly a decade among the far-flung islands of the South Seas, during the period of Mr. Beck's leadership of the Whitney South Sea Expedition, was soon to become only a memory in which happy episodes would crowd out any less pleasant to remember.

Mr. and Mrs. Beck had not even reached Sydney, Australia, on their homeward way, however, before a wireless message overtook them, proposing an additional year's work on the mainland of New Guinea. A study of the birds of paradise was among the naturalist's temptations mentioned in the message and, despite their homesickness, Mr. and Mrs. Beck turned northward again as soon as they had outfitted in Australia. Some of their experiences during the subsequent year are related in the following account, in which Mr. Beck tells of the discovery of a bird of paradise new to science, all the more remarkable because it was obtained in territory supposedly exhausted of such ornithological surprises.—ROBERT CUSHMAN MURPHY.

A bird of paradise called far across the cañon from our hut in Meganum, a little native village, twenty miles inland from Madang, the principal mainland port of New Guinea Territory. From far up the cañon another answered, and many times a day during the next six weeks we heard the strident calls of the yellow-plumed bird of paradise (*Paradisæa minor finschi*). Shortly after our arrival, Manube, our first shootboy, strolled out for a couple of

hours, and brought in the first three specimens of this species, all of them fine males, with the flowing plumes so beloved by the milliners of twenty years ago. The absence of these three individuals from the vicinity of our camp could not be detected by any decrease in the volume of paradisiacal sound that was audible daily, so we classed the species as common.

From several sources in the Territory I was told that most of the former German owners of plantations along the coast had



A SIX-PLUMED BIRD OF PARADISE]
(*Parotia wahnesi*)

The beautiful jet-black body-feathers of this bird are topped by six plumes, also jet black. A tuft of bronze feathers grows directly over the bill, and the throat has an iridescent sheen of green and purple. One of these birds is here pictured in partial display



PRINCE RUDOLF'S BLUE BIRD OF PARADISE
(*Paradisornis rudolphi*)

Wholly unlike the usual attitude of display is the performance of the blue paradise bird. He hangs from the perch by his feet, spreading the feathers of breast and flanks into a living fan. Across this blue fan run bands of black and rufous. (See also the article by Lee S. Crandall, page 579.)



"MAIN STREET" IN MEGANUM

A village in the mountains inland from the town of Madang which is the principal port of eastern New Guinea. In the near-by forests, Mr. Beck collected some of his birds of paradise

paid for the clearing and planting of their properties by selling bird of paradise skins. At one port in the Territory several dozen old commercial skins were offered to me, but the law against killing and exporting this family of birds appears to be well obeyed at present, for within five miles from where these skins were offered I saw several and heard many of the same species.

That at least one New Guinea resident hopes for a repeal of the present drastic prohibitory law was evidenced by a communication sent recently to a Sydney (Australia) paper, wherein damage to cultivated crops in one section of the Territory was laid at the door of marauding birds of paradise. During my stay in the Territory I heard literally hundreds, dozens of these close to native gardens, but not one did I see feeding on cultivated plants. The usual food of several species, determined by stomach examina-

tions, was apparently wild berries of various kinds.

From the point of view of an experienced bird collector, Meganum is not an ideal collecting point. Nowhere on the various trails round about can one find a level stretch of ground fifty yards long. It is either steeply up or down, and birds of paradise as well as other species prefer the larger and highest tree tops to those within reasonable shooting distance. My first bird of paradise was a lucky fluke. While I was walking along a trail through high forest trees, a bird called ahead of me and I answered with a crude imitation. A small brown appearing bird lit over my head and a moment later dropped at my feet. Not till I stooped to pick it up did I see the long, gray, curled tail feathers, and it was much more surprising to see the same curling feathers change to dark metallic blue when their upper surface was viewed. But the multi-

tudinous colors of the bird when held in hand made one wonder where one's eyesight could have been when only a dull brownish bird had been the apparent target. Rich green were the underparts, while brown, yellows, and grays in various shades and patches marked the upper parts. A page would be needed to describe the color combinations of the back alone. This beautiful creature has been burdened with a name which is spelled *Cicinnurus regius similis*.

Later in the day a loud call and swishing wings drew my attention to a dark-colored bird that lit close to me. This proved to be another species of paradise bird, the rifle bird. Its shiny blue throat color changed to purplish green on the breast, while the velvet black back merged into a metallic blue crown on the head. When feeding, this species

often works down to the smaller trees of the heavy forest, but ordinarily it keeps to the higher parts of the largest trees. One bird that I kept hearing every half hour or so for several hours, changed his perch a dozen times during that period, but did not fly out of a half-mile radius from the original perch. Each male of this species seemed to me to have a definite area in which he moved, for, on several of my visits to a given locality, I would hear the same bird calling. Although I frequently tried to see certain individuals that I could hear calling in trees near by or mayhap directly overhead, only on rare occasions could the bird be observed. Sometimes the loud swish of the wings would give me notice of their passing in the forest, and on those sounds I based most of my attempts to get within reach of the elusive quarry. An interesting



AUGUSTA VICTORIA'S BIRD OF PARADISE
(*Paradisæa apoda augustæ-victoriæ*)

This bird, shown also on the cover of NATURAL HISTORY in full color, is among the most gorgeous of all the birds of paradise. In display the male stands on the perch with wings raised and long flank-feathers greatly expanded



MEETING THE STEAMER NEAR AITAPE

At certain ports along the New Guinea coast, fleets of canoes hover about the monthly mail steamer during its stay



CROSSING THE GOM RIVER

The Government pays a monthly stipend to a native to ferry in his canoe all persons wishing to cross the river



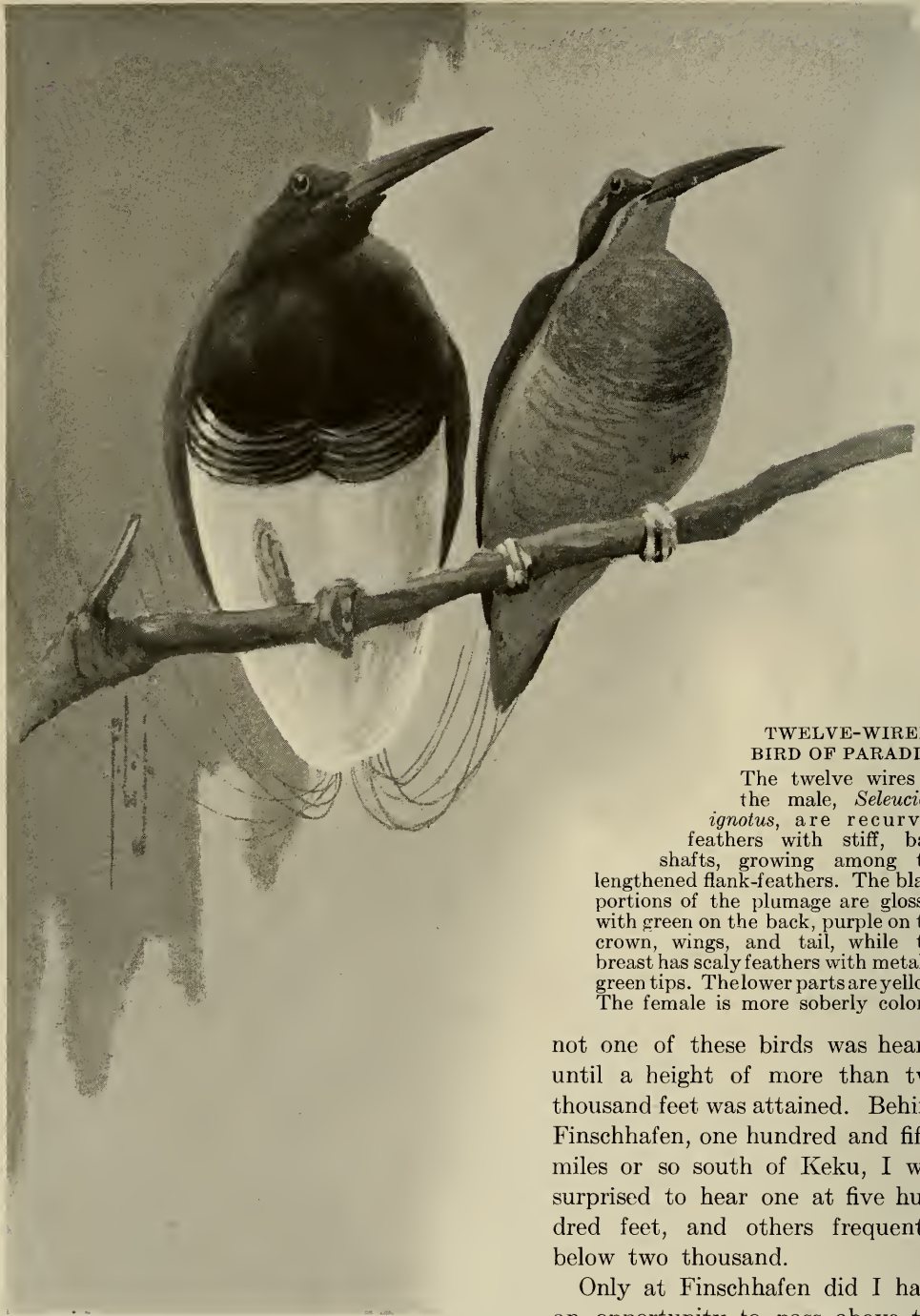
CARRYING TOBACCO TO MARKET

This group of natives is starting from its mountain village with a load of home-grown tobacco to be sold to plantation owners on the coast



EARLY TRAINING IN NEW GUINEA

Children of the mountain villages early begin their training with bows and arrows, which are highly important in securing various species of birds as well as opossums and kangaroos



TWELVE-WIRED
BIRD OF PARADISE

The twelve wires of the male, *Seleucides ignotus*, are recurved feathers with stiff, bare shafts, growing among the lengthened flank-feathers. The black portions of the plumage are glossed with green on the back, purple on the crown, wings, and tail, while the breast has scaly feathers with metallic green tips. The lower parts are yellow. The female is more soberly colored

not one of these birds was heard, until a height of more than two thousand feet was attained. Behind Finschhafen, one hundred and fifty miles or so south of Keku, I was surprised to hear one at five hundred feet, and others frequently below two thousand.

point, to me, about this species was the altitude at which it ranged at different stations. At Meganum, and at Keku, a station forty miles south of Meganum,

Only at Finschhafen did I have an opportunity to pass above the range of this species, the mountains about the first two camps exceeding little more than three thousand feet. This height was the extreme limit beyond which no birds

were heard when I worked inland from the port of Finschhafen. How closely birds keep to certain bounds was illustrated by the vociferous calls of another bird of paradise (*Paradisæa guilielmi*). This species begins to make itself heard plentifully at about twenty-two hundred feet, where it replaces a related species that inhabits the forest in the lower zone. From twenty-two it is heard regularly up to four thousand, where it abruptly stops. We spent some time at Zegaheme, which is four thousand feet and, though we heard and saw the birds often about the village and below it, when I climbed up a few hundred feet on the ridge

behind the settlement, the bird was missing, even though I could hear it calling a thousand feet below my trail.

At Zegaheme three birds of paradise new to me appeared. My acquaintance with one of them began when I crossed trails with my shootboy about noon the

A SUPERB BIRD OF PARADISE (*Lophorina superba latipennis*) is here beginning to display his iridescent shield. His plumage is jet black with a bronze luster on the cape, and crown and breast-shield metallic green



first day. He was accompanied by a small boy carefully carrying (by a thread run through the nostrils) a long-tailed black bird which had a collar of burnished gold, separating the black of the throat from the bright green of the breast.

Another black-bodied bird had three long feather vanes tipped with tiny black feathers extending to the base of the tail, the vanes coming from just back of the eyes. A metallic patch of light green or dark blue feathers (depending on the angle at which the light struck them) covered the lower throat.

The third bird of the list was also blackish. Its throat was blue and had long points sticking out somewhat after the fashion of the present-day collars that I find New Yorkers wearing.

In addition to the pointed collar, this bird sports a beautiful ruff of soft, velvety feathers, which it raises or lowers as occasion demands. Whether these three species live much above six thousand feet I did not determine, my trips to seven thousand and above being too few to form an opinion. It was disappointing to me to find no specimens of the blue bird of paradise, its range beginning about five thousand above sea level. Apparently it does not range so far to the north, as none of the natives seemed to be acquainted with it.

Contrary to the habits of most species

of birds, the females were the more curious when investigations were to be made. Often a female would drop down quite close to me to have a good look, while the brightly colored male, if seen at all, would be flitting about high above. In addition

to the birds of paradise, pittas, small-sized ground birds, were on my list of extra desirable specimens. Although they were not rare, they proved to be very adroit in their movements.

Had it not been for some small boys at Keku whom I interested in trapping for me, the series would have been very meager. These youngsters built miniature duplicates of their fathers' pig traps in the forest, and by baiting with big grasshoppers or other convenient bird food, succeeded in capturing several



MRS. BECK EXAMINES A SPECIMEN
The bird, which is a hornbill, has just been brought in from the mountains near Madang by the expedition's "shootboy"

specimens of two species of pittas. They surprised me by bringing in also a number of kingfishers, caught in the same manner. In fact they brought me more long-tailed kingfishers (*Tanysiptera hydrocharis meyeri*) than I captured with the shotgun, although later I found it much easier to locate the kingfishers sitting in the forest. Often the slowly waving tail would be my first intimation that one of these beautiful birds was right in front of me. One evening after dark one of the boys working at a mission station brought in to me a freshly killed specimen of the blue-bibbed pitta. I



A NEST OF A BLUE-BIBBED PITTA

(*Pitta macklotii macklotii*)

The nest was discovered tucked away under a decaying log in a heavily forested cañon. No eggs were readily visible, so one was placed at the entrance while the nest was being photographed



THE NEST OF A RED-CAPPED DOVE

(*Ptilinopus pulchellus decorus*)

A few twigs, carelessly laid on top of some dead leaves, answers for the home of this beautiful dove. Although it is not uncommon in New Guinea, it is not often seen, due to its habit of frequenting the thick forest trees



A NATIVE "SINGSING" AT MADANG

When the Resident Commissioner makes his yearly visit to Madang, the mainland seaport of the Territory of New Guinea, the natives gather by the hundred, and, decorating themselves in gala attire, dance their oldtime dances for his pleasure



BEDECKED PARTICIPANTS OF THE "SINGSING"

This pair is awaiting the signal to begin dancing. The head of the drum is covered with a tightly stretched piece of iguana skin, this being the usual material for drum heads in that region



FIELD LABOR IN NEW GUINEA

These two women, who live in the New Guinea mountains, are preparing ground for the planting of taro, a crop upon which the natives are widely dependent. It is rather unusual for a mother to carry her child on her back while working in the fields



NEW GUINEA WOMEN PERFORM MOST OF THE LABORIOUS DUTIES

The women are planting sugar cane in a taro garden at Keku, New Guinea. Other plants introduced by the missionaries are also interspersed among the taro



CIVILIZATION ENTERS NEW GUINEA

With a plane obtained from the white men, this schoolboy planes a board for the schoolhouse in the background

asked him where he got it and how. He explained as follows:

"Bello, now me go drink water. Mama belong keow run away. Me lookim, now me come back. Long night time me go ketch im. Me come me giv im you."

Translated to plain English all this means:

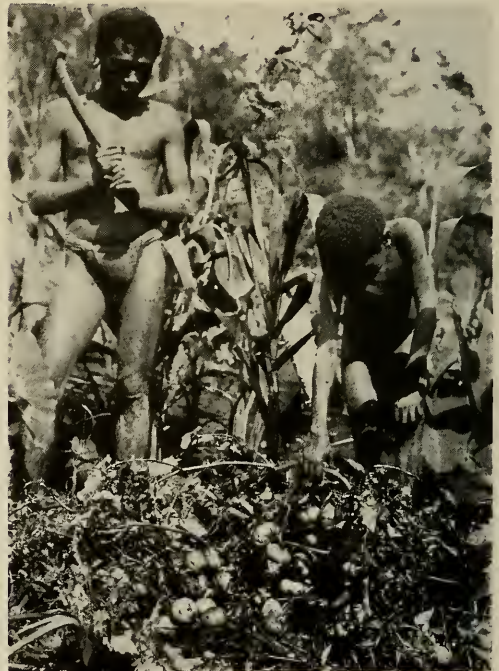
"When the noon horn sounded I went down to the brook for a cool drink and saw a bird run away from its nest. I saw eggs in the nest, so at night time I went to it and caught the parent, bringing it to you."

This meritorious act earned for the boy a stick of tobacco and enabled me to get a photograph of the nest and an egg of the bird, one of the two the nest contained being broken when the bird was caught.

Glancing casually at the nest in situ, nine out of ten persons would see merely a jumble of dead leaves and the usual litter

which had fallen about the rotting log, while an oölogist looking for nests would likely note the structure and give it the second confirmatory glance. It was tucked away under a large decaying branch, in a shallow hole in the bank, and had at the sides and bottom long dead leaf stems as if they had fallen naturally. The roofing was cunningly composed of fresh green fern leaves and intermingling dry leaves in the usual forest proportions. Inside there was a thick lining of fine black rootlets on which the creamy spotted eggs showed plainly.

While sitting before the nest writing this description in my notebook, a tiny kingfisher *cheeing* through the forest lit over my head for the time it took to turn my eyes toward it, and then darted on its invisible flight to another perch. A larger



TOMATOES IN A TARO GARDEN

Missionaries have introduced many plants new to the natives. Corn, potatoes, pumpkins, cucumbers, tomatoes, and other vegetables are now occasionally to be found grown by natives who have come in contact with white men



AT WORK IN THE INTERIOR

In the mountains of New Guinea Mr. Beck usually had several natives waiting for the flesh of the birds whose skins he was preparing



MAKING A NEW GUINEA "RAINCOAT"

These garments, which are made of pandanus leaves, are suprisingly light and shed water well. In the higher mountains practically all the natives carry these, for heavy showers lasting from twenty minutes to several hours may occur at any time

kingfisher (*Alcyon azurea lessonii*) similarly colored, which flies up and down the mountain streams, reminded me often of the flight of dippers in California mountains, but the tiny one has its counterpart only in straight-flying humming birds, for by the time its call reaches the ear, the bird itself is yards away, *chee cheeing* as it goes.

One of the little birds that I always listened for was the pygmy parrot, two species of which I took in New Guinea. Its note is a most elusive *scree scree*, and frequently, although hearing the note regularly, I could not focus my eyes on the spot on the near-by tree trunk where the bird was. From the hotel porch in Rabaul the capital of the Mandated Territory, I watched several times the feeding actions

of the green species, while they worked up and down and under the limbs of the trees within twenty feet of me.

They repeatedly pulled off small bits of the dry bark, but just what they found underneath I could not determine. Like some species of kingfishers these little parrots use an occupied termite nest for their home. A cavity in one side of the nest appears to keep dry, even in heavy rain squalls. Just how they keep clear of the thousands of termites has never been explained to me satisfactorily.

This was just one of the many interesting, incidental questions that puzzled me on the New Guinea trip. There were many others, and still more await future collectors to the unknown mountains in the interior of that great island.



ON A DESERTED RUBBER PLANTATION NEAR MADANG, NEW GUINEA, THE NEST OF A COMMON KINGFISHER WAS FOUND HOLLOWED OUT IN THE CENTER OF A POPULOUS WHITE ANTS' NEST



A Visiting Motumotu Sailing Canoe on Hall Sound

TO NEW GUINEA FOR LIVING BIRDS OF PARADISE

An Account of an Expedition Sent to New Guinea by the New York Zoological
Society for the Purpose of Collecting the Strange and Beautifully
Feathered Birds of the Island's Forests

By LEE S. CRANDALL
Curator of Birds, New York Zoological Park

TWO skins of the greater bird of paradise, brought by the adventurers of Magellan's voyage around the world, in 1522, are believed to have been the first of these beautiful birds to have reached Europe. Like most native skins, even to this day, these specimens were without wings or feet. The unexplained lack of extremities, coupled with the ethereal beauty of the birds' plumage, gave rise to a great variety of conjectures of rashly romantic nature. For years it was believed that they "live in the air, always turning toward the sun, and never lighting on the earth until they die, for they have neither feet nor wings." Even as late as 1758, perfect skins were still unknown, and the great naturalist Linnaeus, quite possibly with his tongue in his cheek, designated the species as *Paradisæa apoda*, the name it bears today.

In spite of the occasional visits of naturalists and explorers, this halo of romance still hangs over New Guinea and its near-by islands. Various professional collectors have gained fame through their labors and sacrifices in this forbidding country and more than one thousand species of birds have been described. Yet the supply of new bird species appears to be inexhaustible, and we know next to nothing of the life histories of this tremendous avian population.

There are several excellent reasons why zoological exploration in New Guinea has done little more than scratch the surface. The mainland of this great island contains a surface area of well over 300,000 square miles of almost impenetrable jungles and towering, inaccessible mountains, that offer every obstacle to the uncovering of their many treasures. A few great rivers,



LESSER SUPERB BIRD OF PARADISE
(*Lophorina superba minor*)

The southern race of a species collected also by Mr. Beck. (See p. 571.) Many of the shorter feathers of the metallic breast-shield of this bird have velvety black centers

such as the Fly and the Sepik, which are navigable by small craft for considerable distances, provide comparatively easy ingress to sections of the interior. But the huge mass of country, lying between the larger waterways, can be traversed only on foot. Food and equipment must be cut to less than necessities, for every ounce means an added burden for the reluctant native carriers, who never can be secured in sufficient numbers. This need of economy is increased by the extreme difficulty of the terrain. In some sections coastal swamps or plains must be traversed before the foothills of the great mountain ranges are reached. In others,

the mountains rise almost directly from the sea. Here the going is of the roughest, up and down sharp, razor-backed ridges, or along their narrow crests, ever climbing higher and higher. If there is a government or mission track to follow, the way is fairly clear, if not easy. When these are not available, native tracks usually can be found. A day spent in climbing an almost perpendicular mountain-side, on a native path, should convince the most rabid anti-evolutionist.

Tremendous areas have never been trod by foot of white man. Other great stretches have been "explored" by small parties of government officers, who have threaded their way through the wilderness, glad to return safely to civilization and report new mountains, lakes, or

rivers. Many years must pass before the last elusive "new species" of the New Guinea fauna is taken and described, and many more before the last life history is finally worked out.

Since the primary purpose of all public zoölogical institutions is to attract the greatest possible number of people, and to attempt to arouse in them an interest in natural history, no birds can equal in value the birds of paradise. The brilliance of their plumage and the bizarre nature of their decorations set them apart as the world's most beautiful group of birds. Nearly one hundred forms are known, including several that are doubtfully

placed among the bower birds. Living specimens have always been uncommon in captivity—in fact, when three greater birds of paradise arrived at the New York Zoological Park in November, 1910, they probably were the first of any species ever to reach America alive.

The need of a fine collection of living birds of paradise has long been felt by the officers of the New York Zoological Society. In consequence, I found myself, early in October, 1928, established in a tiny, rickety "rest house" in a native New Guinea village. I was accompanied by Mr. J. E. Ward, of Sydney, Australia, and we had come in an attempt to secure for the New York Zoological Park the beautiful birds we had been unable to obtain by other means. I ought to say here that our final success was due chiefly to the knowledge, grit, and determination of Mr. Ward, whose previous experience

in New Guinea proved to be invaluable.

Our particular village was Inawaia, in the Mekeo District of the Central Division of the Territory of Papua, once known as British New Guinea. Mekeo is a plain of considerable area that extends northward from Hall Sound, about sixty-five miles west of Port Moresby. The natives here are of the Papuo-Melanesian group—that is, they appear to be the descendants of Melanesian immigrants, more or less intermixed with the true Papuans. They are mostly light brown in color, though occasionally very dark or very pale individuals are seen. The hair is of the "mop" type, long and bushy, and usually not tightly curled. It is seen to the best advantage in the men, who regard their coiffures with pride and give them constant attention. The women, on the other hand, are accustomed to wear their heads closely clipped, apparently for the excel-



LONG-TAILED BIRD OF PARADISE

(*Epimachus fastosus meyeri*)

This specimen is an immature male. The adult is chiefly metallic black and in length measures more than forty inches



PORT MORESBY FROM THE HARBOR

The seat of colonial government, Port Moresby is the first town of the Territory. It boasts of a number of substantial, well constructed buildings



A SEA-GOING CANOE

This clumsy craft, composed of two large canoes, decked over, was sailed to Yule Island from Motu-motu, a native village, about fifty miles to the west



A TRADING STATION ON YULE ISLAND

The headquarters of the Angabunga Company, known as Arure. The manager's house is seen at the right, with the store and boys' quarters at center and left



STREET SCENE IN SAMARAI

Situated on a tiny island at the extreme southeastern end of Papua, Samarai is the second town of the Territory. It is a green and lovely spot, in sharp contrast with dusty Port Moresby

lent reason that they are too busy in the gardens to devote much time to their personal appearance.

Clothing is confined to a perineal band for men and a grass skirt for women. The men, however, particularly those who are as yet unmarried, decorate themselves elaborately. The body is smeared with a heavy coat of cocoanut oil and red ochre, or some other reddish dye. Intricate and beautiful designs, in red, black, and yellow, are painted on the face, sometimes covering its entire surface. These patterns would repay study, for not only are they carefully done, but I never saw two alike. The designs are not the property of individuals, for each boy changed the pattern when redecoration was necessary. Pale green, scented *Colius* and *Croton* leaves are inserted in woven armlets and sometimes in leg bands as well. A deep cream or scarlet *Hibiscus* blossom, inserted

in the hair, completes a really striking effect.

In common with most of the New Guinea tribes, the Mekeo people make use of the "dubu" or boys' house. Here the unmarried boys of the village live together, in theoretical isolation from their families. Actually, however, they continue to receive most of their food from the family pot. It is brought to them, usually in the evening, by mother or sister, who must retire immediately on leaving the offering on the platform of the dubu, for no woman may enter the sacred precincts. It is bad form, also, for a dubu boy to eat food before a woman, and none will willingly do so. This custom appears to have its origin in the desire of the unmarried boy to impress the women with the idea that he is a light feeder and that his wife would have an easy time in her garden. He wears a broad belt, drawn to really alarming tightness, to prove it.



PRINCE RUDOLPH'S BLUE BIRD OF PARADISE

(*Paradisornis rudolfi*)

Among the rarest and most beautiful of the birds of paradise, this species was one the expedition was most anxious to obtain. Seven specimens were brought alive to the New York Zoological Park



COUNT RAGGI'S BIRD
OF PARADISE

(*Paradisæa apoda raggiana*)

Of the group of typical birds of paradise, with long, filamentous side plumes, this is the only member found in southeastern New Guinea. The plumes are crimson, paling to brownish at the tips

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FAWN-BREASTED
BOWER-BIRD

(*Alphachlamydera cerviniventris recondita*)

A characteristic bird of the lowlands. The beautiful bowers, or play grounds, are usually found close to native tracks. They are easily located because of the noisy chattering of the bird as one passes near



BOYS' HOUSE OR "DUBU" IN THE MEKEO DISTRICT OF PAPUA

In most parts of New Guinea it is customary for the unmarried boys to leave the family circle and enter the dubu



OUR LANDING IN MEKEO

Just as the expedition finished unloading, the two boys in the foreground came along, on their way down river to a dance. The photograph shows the splendid physique of the Mekeo native

The Mekeo people undoubtedly have been cannibals, but under the influence of government and mission, have long since given up the practice. In fact, they express horror at the suggestion of such a thought. But this apparent abhorrence carries little weight, for even in remote districts, where contact with white people has been of the slightest, known cannibals will often vehemently deny that they have ever heard of a habit so disgusting.

The language of Mekeo is of Melanesian origin and apparently very difficult for a white man to master. However, many of the men are able to speak Motu, another Melanesian tongue spoken by the Port Moresby natives. This is a comparatively simple language and with a vocabulary of fifty or sixty words, which are easily acquired, one is able to get on very well. Extended conversations, of course, had to be carried on through an interpreter and in this capacity, the services of Koi, our cooky-boy, were constantly in demand. Koi was a Mekeo boy, but he spoke understandable pidgin-English, as well as several native dialects. The Mekeo country is quite flat and only a few feet higher than sea level. In a few scattered localities, high primitive forest still remains, but for the most part, the bush is low and intermingled with large patches of saw grass, which frequently is ten or twelve feet tall. Travel

through this grass country is ordinarily both difficult and unpleasant. However, it is occasionally burnt off during pig and wallaby hunts, and when the grass begins to grow anew, a very beautiful parklike effect results.

There are many birds here, of course—swarms of parrakeets and lories, flycatchers and honey-eaters—but only one bird of paradise is common. This is the green manucode (*Manucodia ater alter*), a black, crowlike bird which is very abundant from Yule Island to the foothills. The twelve-wired bird of paradise (*Seleucides ignotus*) probably occurs in Mekeo, where the sago palm grows, and Koi



MOUNT IOLA

This isolated peak rises from the floor of the Aya Valley, northeast of Deva-deva. The top is saddle-shaped, and on each point is a village. The two are known, collectively, as Iola



THE CHIEF OF JESUBAIBOA

In Papua a chief has practically no control over the individual actions of his people, except as they may affect the general good of the community

PARTICIPANTS IN THE DANCE

Adornment for such social occasions is carried out with elaborate attention to detail. The ornaments are handed down from generation to generation





MOTUMOTU NATIVES

These people come from near the mouth of the Lakekamu River, about fifty miles west of Yule Island. They probably represent the purely Papuan type



BAGGING COPRA

The dried coconut meat is being packed for shipment on the launch which took the expedition to Jesubaiboa. The skirted man at the left is a boat boy

assured me that the magnificent bird of paradise (*Dyphylodes magnificus hunsteini*) is sometimes found there also. At the northwestern edge of the district, just

than two hundred feet, we heard the raucous calls of the magnificent rifle bird (*Craspedophora magnifica*), a beautiful black bird of paradise, which inhabits the



MEKEO WOMEN AT THE DANCE

Women are invariably reluctant to pose for photographs and pictures are difficult to get. The elaborate decorations are well shown, particularly in the figure at the left. The woman at the right is not participating

before the foothills are reached, I saw the only king bird of paradise (*Cicinnurus regius claudii*) that was recorded during the expedition.

After some difficulty in organizing a staff of carriers, we set out on the long march to the mountains, which lay to the northeast. During the second day we reached the first of the foothills, and here, at an elevation of less than one hundred feet, we heard the first call of Count Raggi's bird of paradise (*Paradisæa apodaraggiana*). Thereafter, even at elevations of six thousand feet, the piercing notes of this splendid species were constantly in our ears.

At Kubuna, where the elevation is less

mountains up to about two thousand five hundred feet. From Kubuna, the elevation rises abruptly so that traveling became very strenuous indeed. After three days of hard marching we finally came to a point known as Deva-deva, at an elevation of about four thousand feet, in the western extension of the Owen Stanley range. The place takes its name from a native village that once existed there and on which we had relied for food. Unfortunately, the former inmates had scattered up and down the lovely valley of the Aiya River, so that there was no food to be had. Most of our boys immediately deserted, leaving us in an alarming fix. The reduced size of our party, however,



A VILLAGE DANCE IN MEKEO

These dances are purely social affairs, given by one village, to repay similar courtesies of their neighbors. On this occasion, ten Mekeo villages were the guests of Eboa



A PHASE OF THE DANCE

The steps are graceful and dignified, in perfect time with beats of the drums carried by the men. The women in the foreground are waiting to join in at the proper time



AYA, THE EXPEDITION'S BIRD BOY

Aya finds it difficult to control his expression, because the other boys are making fun of him

undoubtedly increased the confidence of the local natives, who eventually came in and made friends.

The Deva-deva people belong to the Kuni tribe, whose boundaries extend northwestward to the Mafulu country. In appearance, the Kuni people are quite different from those of Mekeo. They are noticeably shorter in stature, averaging hardly more than five feet one inch. They are much darker in color and oblique eyes are common. I noted several people with strikingly Mongolian features, including oblique eyes. The hair is not worn in the bush formation of Mekeo, and usually is covered with a headdress of bark cloth. It seemed to me that climatic conditions have made this custom necessary, for in the mountains rain falls heavily nearly every day. The mountain native goes about indifferently, his hair safely protected. The Mekeo boy, on the other hand, is very reluctant to have his mop

dampened and will always seek shelter if he can.

The Kuni language, while apparently fundamentally Melanesian, is quite different from that of Mekeo, and of all our boys, only Koi was able to make himself understood. Under his benign influence, the people quickly overcame their natural shyness of white men. They soon began to bring us small supplies of sweet potatoes, and after further persuasion and the display of trade knives and axes, they began to bring us the birds we had come so far to get.

The magnificent bird of paradise (*Dyphylodes magnificus hunsteini*) is very abundant here and in spite of our assurance to the natives that we did not want this bird, they brought us more than we could take. Lawes' six-plumed bird of paradise (*Parotia lawesi*) and the lesser superb (*Lophorina superba minor*) were



OPU KAKI, VILLAGE CONSTABLE
OF JESUBAIBOA

Opu is a splendid specimen of the Mekeo native, excelling in physique and intelligence. He is well known throughout the district

almost as numerous. Mt. Kebea, which lies between Dilava and Deva-deva, and rises to a height of about six thousand feet, seems to represent the limit of the southwestward range of Prince Rudolph's blue bird of paradise (*Paradisornis rudolfi*). This beautiful species is very local in distribution and only a very few living specimens have been taken. Consequently, our efforts were concentrated on securing it, but it was only when we had begun to refuse others that our constant persuasion began to have its effect and our first blue bird was brought in. Whether because the blue bird lives very high up the precipitous slopes, or from some superstitious dread, the natives are reluctant to take it. However, a nice, shiny, seventy-five-cent trade ax is a powerful argument against superstition, in the eyes of people who use axes of stone to clear the forest for their gardens. Seven lovely blue



A DUBU BOY FROM EBOA

This boy came frequently to visit the expedition at Inawaia, but would pose for his photograph only when he considered his toilet perfect



A BOY FROM THE VILLAGE OF WAIACKA

A typical dubu boy, in his everyday finery. Unfortunately, the camera failed to pick up the intricate pattern painted on his face

birds of paradise, landed safely in New York, witness this fact.

At the last moment, a pair of young long-tailed birds of paradise (*Epimachus fastosus meyeri*) were brought in. This is the largest species of the group, the adult male reaching a length of more than forty inches. It is found in the high mountains northeast of Deva-deva, and we had hardly hoped that even the promise of an ax would cause the hunters to go so far afield.

After many difficulties, caused chiefly by lack of carriers and scarcity of food, we succeeded in getting our precious collection down to Mekeo, where no one who can live on sweet potatoes and excellent bananas is likely to starve. We stopped again in Inawaia, for some weeks, to make further collections, and just as we were about to leave, I had the great good fortune to be able to witness a native

dance, a thrilling experience. This event took place at Eboa, a village about two miles to the north of Inawaia.

This dance was of purely social character, given by Eboa, to repay the inhabitants of ten neighboring villages for similar entertainments previously enjoyed. Such an affair cannot be arranged until the host village has accumulated a great store of surplus food, which requires months of planning and hard work. We heard excited talk of this dance almost as soon as we reached Inawaia on our first arrival, but it failed to materialize, and I thought I should miss it entirely. However, it actually began the day before we were to leave, and I had full opportunity to make observations, photographs, and moving pictures.

The actual dancing is of a graceful and dignified character, performed by both men and women, to the beat of drums, carried by the men participants only. The costumes are both weird and

beautiful, many of the men wearing magnificent headdresses composed largely of the plumes of Count Raggi's bird of paradise. As individuals tire, their places are taken by others, the performance going on continuously, day and night, for three or four days, without pause longer than a few seconds. At the end of this period, when everyone is thoroughly exhausted, there is a great feast, at which the village pigs are killed for the guests. It is a curious fact that no one ever dreams of eating his own pig.

We left New Guinea on December 10, 1928, but it was not until March 21, 1929, that our forty birds of paradise, in company with some two hundred other specimens, finally reached New York. Soon after their arrival, a number were presented to the zoological gardens of other American cities. Those that remain at the New York Zoological Park are now in perfect condition, displaying their handsome plumage daily to the delight of our visitors.



MOTUMOTU CANOE IN THE LITTLE HARBOR AT ARURE, YULE ISLAND
These coastal people are skilled seamen. Their double canoes are propelled by both oars and sail, and can hold their own in heavy seas



A view on the coast of Dominica

THE MOUNTAINS OF DOMINICA

The Two Highest Mountains in the Lesser Antilles, Diablotin and Trois Pitons, on Which Plant Life Is Still in the Process of Ascent and Increase

BY PAUL GRISWOLD HOWES

Curator of Natural History, The Bruce Museum, Greenwich, Connecticut

PHOTOGRAPHS BY THE AUTHOR AND DICKENSON S. CUMMINGS

THE highest and most beautifully forested of the Lesser Antilles is Dominica, which lies about midway between Guadeloupe and Martinique.

In Roseau, the capital, we heard strange stories regarding the mountains we had come to investigate. Few people have climbed Trois Pitons and Diablotin, and no accurate observations have ever been recorded so far as Dickenson Cummings and I could ascertain. Even more confusing and vague were the accounts of some who claimed to have reached the summits, and many of their statements were too absurd to record.

We were assured that the time we had selected to climb Diablotin (between March 2 and 14), was not the proper time at all, but no one realized that we were basing our plans upon actual meteorological records carefully prepared for this very purpose upon a former expedition. As it finally turned out, we were correct. We encountered ten days of

perfect weather, but during the remainder of our stay in the island we saw the top of the mountain emerge only once from the clouds.

There is no place in the world where it rains harder or longer, once it sets in, than in Dominica, and I do not hesitate to say that it can be the windiest and most disagreeable, or the sunniest and most delightful country of all. One must know actual conditions in order to succeed in mountain work there, for, though the mountains are not high, they are difficult to ascend and explore.

We were told that the Diablotin region abounded in huge boa constrictors that "hung from every tree," and various other good-natured little dangers were rumored about for our special benefit, but we took these warnings philosophically.

In addition to all this, our search for data before leaving the United States had resulted in the following interesting information—the mountain Diablotin might



CLOUDS COVERING THE SUMMIT OF TROIS PITONS

The round leaves in the foreground are those of the "Ka-klanh" tree that here, near the summit, has dwindled into bushes. This tree exudes a disagreeable sticky slime whenever bruised or cut

be any height from 4747 feet, by authority of the maps, up to say 5313 feet as the *Encyclopædia Britannica* has it, a mere difference of 563 feet!

And so, after despairing of finding out anything of particular value in advance, we decided to ascend Trois Pitons first. It was close to our headquarters on the estate of Captain Struan Robertson, 1800 feet above sea level, and would supply us with the desired information as regards the zones to be encountered, the best methods of working, and the equipment necessary, so that we might know just what conditions we would have to face in the ascent of Diablotin in March.

Having waited many days for the weather to settle and in the interval having missed one or two clear afternoons when the clouds had lifted entirely from the mountains, we finally decided rather unexpectedly to make the ascent on the morning of February 16.

Our guide, Son Esprit, had sent a message that was never delivered, but upon his arrival with two porters for the trip, we soon were off, leaving Sylvania about nine-thirty o'clock.

The clouds hung leaden and heavy over Trois Pitons, curling down from the summit over the cloud-forest below and then evaporating as the warmer air met this vapor from above.

Leaving the trail, we crossed two rivers almost at once and found ourselves in a magnificent forest of great trees which even at this low altitude were already coated with a delicate blanket of feathery mosses, for, as we found later, this mountain is the highest in the island and therefore catches the maximum of moisture from the clouds above.

The zones on Trois Pitons and upon all of these Dominican mountains are startlingly abrupt. At 2500 feet on Trois Pitons, one runs into that strange area

where the big forest of the sub-tropical zone merges with the cloud-forest; a few feet above this, the big forest disappears altogether, leaving one in a gloomy, dripping place, inhabited by spindly trees, shaggy with dark-colored mosses. Again, at 2650 feet, a change is noted, the trees becoming stunted and fantastically gnarled, and covered with calumet vines; and at 3300 feet comes the true central cloud-forest with its dwarfed, twisted, and otherwise deformed trees, weighted and staggering under countless parasitic and epiphytic plants and dripping mosses that gush forth their water at the slightest touch.

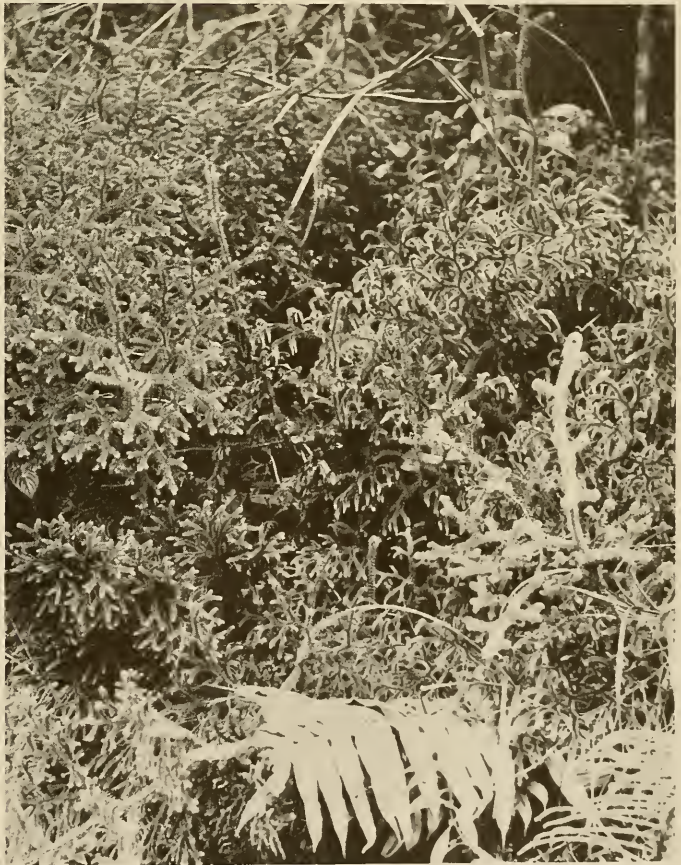
Under foot there is deep, sticky mud, and as the mountain-sides grow steeper and steeper, and the vegetation more stunted and tangled, progress without a previously marked route ends in exhaustion and total loss of direction.

To make matters worse, we were making the climb during the endless rainy weather of the spring season, and because of the peculiar manner in which the trees grow out from the mountain instead of up in the usual fashion, it was necessary to walk and climb and pull the body hand over hand through the slippery limbs for hundreds of feet at a stretch.

We forced our way ahead to 3500 feet and here for a brief period we encountered more open country because of the hurricane that

during the previous September had ravaged these mountains. We were now above the clouds, and far below on the Caribbean a tiny steamer could be seen headed toward the north.

The hurricane which hit Dominica was the same one that ruined Porto Rico. From our lofty observation point we could see the strange tricks that such a storm can play. Some of the mountains were untouched, but others were covered with heavy jungle on one side only, while the other side was swept almost free of vegetation. Viewing them from a distance, I could not help but liken them to a man with a heavy growth of beard who had shaved only one side of his face.



BESIDE THE TRAIL

The vegetation at an elevation of 1850 feet on Trois Pitons includes a plant known locally as "staghorn"



A BROMELIAD AT THE BASE OF A GOMMIER TREE

The bromeliads are parasites, the leaves of which hold water harboring all kinds of life from amœbæ to amphibians. This plant was 6 feet 8 inches high

We made photographs and records from this point and then continued our laborious way through trees that grew smaller and more stunted as we ascended. We passed through masses of lava from ancient upheavals, explored dingy, dripping caves in the clouds, and fell a dozen times into watery holes and crevasses, fortunately without serious results; then, as suddenly as we had encountered the cloud-forest, we left it and found ourselves in another world.

A tree, called by the natives "Kaklanh" or "Figi" had been encountered almost from the start of the trip. We were conscious of it continually because of a disagreeable, heavy slime which it exuded whenever bruised or cut. This sap was extremely sticky, and our clothes and hands were smeared with patches of black. It never came out of our clothes, and it was some days before we were able to remove the last of it from our skins.

At the base of the mountain these trees were twenty-five feet in height, but as we ascended they became smaller and smaller until finally they dwindled into bushes and became the dominant vegetation up to an actual *tree line* fifty feet from the summit.

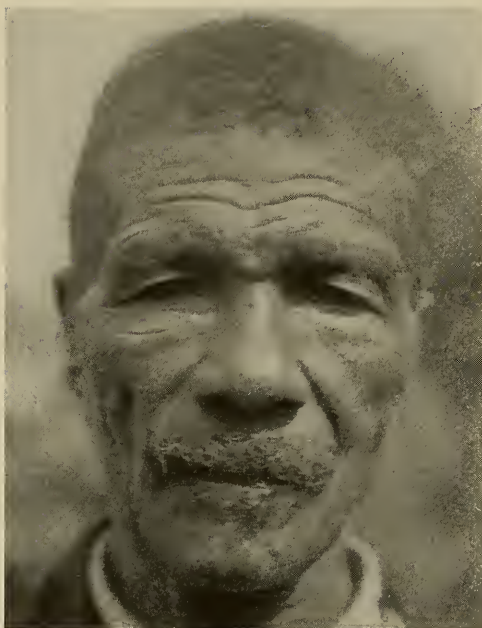
We had been told that the top was all rock, but such was not the case. No more beautiful or fantastic spot could be imagined, for the whole ground was covered with countless small bromeliads that looked something like the leafy parts of pine-apples. There were bromeliad bushes also, if one might call them such, consisting of fifty or a hundred small plants all stemmed together and growing as a living whole. White, gray, red, salmon, and emerald green mosses, were here also, and two or three varieties of low bushes, one in orange flower, constituted the summit vegetation for the most part. There were absolutely no trees, but a rock stuck



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THE FALLS IN SALTOUN GORGE

This picture graphically illustrates the difficulties of exploration in the mountains and gorges of Dominica. Note the fall at the lower right issuing from an invisible source



SON ESPRIT—GUIDE

This native, who knows more about the mountains of Dominica than most white people, having spent his 76 years among them, told the author at the outset that Trois Pitons was higher than Diablotin

up here and there, and upon the highest one our aneroid registered 4600 feet.

It was cold and very windy, and we had to hold the tripod to keep it from blowing off the mountain. The men, used to the heat of the lower levels of a tropical island, crouched in the bushes shivering, despite the rum that had been served liberally to all hands. Clouds made seeing difficult at times, and the moisture condensed upon the glass and metal of the camera and fell from the instrument as rain.

Two things that seemed of importance stood out in my mind after we had returned to our headquarters. One was the fact that an actual tree line had been encountered, and that we had found a treeless summit. The other was that our chief man, Son Esprit, had stated that the top was all rock and that he had not made the ascent in some time. He also ex-

pressed surprise at certain forms of vegetation which we had found when nearing the top. The significance of these things I will speak of later.

On March 2 we left Roseau for the ascent of Diablotin. We traveled by launch to the little village of DuBlanc, where Mr. Shillingford, a native of Dominica, gave us every possible assistance. From here we proceeded with eleven porters up the hills to the plateau at Milton, where we pitched our base camp near the great lava gorge of the DuBlanc River. From here we directed the cutting of a passable trail to 3400 feet on Diablotin, where a second camp was established and made ready. This camp was a typical native hut of boughs and palm leaves, called an *adjoupa*. Another one was constructed by our men for themselves, less elaborate than ours, and then the trail was continued to the summit.

On March 9 we moved up from the base



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A PRIMITIVE DOMINICAN

All types were met during the expedition, but this was the most primitive mental type found—a man who was bewildered and frightened by the camera's shining eye



MEMBERS OF THE EXPEDITION

Paul Griswold Howes, the author of this article, stands at the right. The other white man is Dickenson S. Cummings. The negroes are local natives

to the *adjoupas* with our equipment. With us were five men: Babtiste, our own man; John Joseph, who spoke English and assumed a slightly superior air; Casimer, lean, with tremendous lips, and muscles like iron; Toulon, loud, talkative, and gay, a huge fellow, who staggered up the cliffs and through the labyrinth of the forest with a seventy-pound load; and Sicite Ploui, woodsman, hunter, and the proud possessor of mustachios and an ancient shotgun. As mascot we took a dog, whom Cummings appropriately christened "Bromeliad."

We had not gone far before Sicite spied a ramier, or wild dove. It flew from the forest floor to a limb, perched for a moment of observation, and then made off through the trees. We saw it plainly, but our hunter, wishing to impress us, placed his gun to his shoulder, cocked the hammer with much difficulty with the aid of his cutlass, and then pulled the trigger.

He had fired at the spot where the dove had been fully a minute before, and now the whole forest vibrated with a deafening roar. Flame belched from the gun, and a huge cloud of smoke enveloped everything, while a shower of newspaper wads and glowing sparks fell all about us. The charge blasted away leaves and branches, and was truly a remarkable spectacle, and then to make the whole procedure more ridiculous, Sicite insisted upon searching the ground minutely for his bird!

This part of the forest of Diablotin is much like that on Trois Pitons, but the trees are of greater diameter and very beautiful. We climbed up slowly and were nearing our second camp when we heard a strange squeaking and twittering in the ferns and begonias near by. Upon investigating, we witnessed a furious battle between two tiny plumbeous warblers. They rolled about in a gray,



A DISTANT VIEW OF DIABLOTIN

The long ridge leading to the summit of Diablotin is plainly visible in this view, which shows the mountain fifteen miles distant



© Paul Griswold Howes

SUBTROPICAL GROWTH ON DIABLOTIN

This beautiful forest lies at an altitude of 1700 feet. It was through such growth that the expedition was forced to travel in order to reach the summit of the mountain



© Paul Griswold Howes

THE FIRST PHOTOGRAPH EVER TAKEN FROM THE SUMMIT OF DIABLOTIN

The Y-shaped mark in the middle distance is the result of a huge landslide that removed a great strip of forest from the other mountain



Photograph by Dickenson S. Cummings

MR. HOWES HIGH ON MT. DIABLOTIN

Here the leader is shown in the expedition's native camp at 3400 feet elevation. The hut is made of palm leaves



© Paul Griswold Howes

THE CARIBBEAN SEA

From 3400 feet up the side of Mt. Diablotin. This picture was taken from one of the expedition's camps. In the center distance is the bay and the town of Portsmouth

squeaking ball of feathers and dirt. Never have I seen such a display of fury in such tiny bodies. Still more remarkable is the fact that all about them sat a gallery of their own species, cheering on the combatants and apparently enjoying the spectacle enormously.

It was late when we reached camp and found a wet howling wind blowing through our hut. The roof was dry, but the floor consisted of heavy mud. Besides this, we were badly infested with fleas which had overrun everything at our base camp, and things were not too comfortable. A huge roaring fire was successfully kindled only because we had remembered to collect a good quantity of Gommier gum from the trees below. Everything is saturated with water and soaking moss covers all the branches up in these mountains. Soon we were making ready a pot of steaming erbswurst, and we were just settling down to a

little comfort, when a delegation of shivering men came grumbling to our *adjoupa*.

With the exception of Babtiste, they had all decided to try to intimidate us. Dissatisfaction with their rations, which were all too good, was the excuse for the trouble, and they demanded more food.

In the growing darkness of the abrupt Dominican night, these disgruntled black men, each armed with a long gleaming cutlass, looked rather unpleasant by the light of the fire. We stood our ground and refused point-blank to add to their rations, although actually we had been cooking an extra large batch of erbswurst in an old kerosene tin, as a special treat for them. If they wanted more food they could go back down the mountain and get it, and that ended it. They looked at one another, and their cutlasses flashed in the light of the flames, but we held our gun, which was a good gun, and we had demonstrated it



© Paul Griswold Howes

A HAZY VIEW FROM DIABLOTIN

Looking toward the Atlantic side of Dominica. A faint white line may be seen at the upper left-hand corner which is the surf on the Atlantic coast



© Paul Griswold Howes

A STRANGE VEGETABLE WORLD

At the top of Diablotin and of Trois Pitons the expedition found such growth as this. In the water gathered by the leaves of these weird plants strange life forms were found. Insects, worms, and tiny frogs of the *Eleutherodactylus* group lived among the vivid mosses. The ground vegetation was very similar on the summits of Diablotin and Trois Pitons



© Paul Griswold Howes

THE TREMBLEUR

Cinclocerthia ruficauda ruficauda

Found only in Dominica is the trembleur, a strange brown bird of the mountain forests that droops and trembles its wings and holds its long tail above its body. It feeds upon everything from hard nuts to tree frogs. Here it is shown one-third life size

not without reason earlier in the day, just for good luck.

They backed off to their hut, but Sicite, the gloomiest of the lot, went down the mountain again. Before morning he returned but, as far as we could find out, he brought no extra food. All the other men were cheerful and happy.

The last part of the climb on Diablotin is more exhausting than that on Trois Pitons, but conditions are very similar as regards the vegetation, until the top is reached.

After coming out into the open, we proceeded along a gradual ridge which may be seen plainly miles away from the mountain. We walked along this ridge on the edge of a great cañon and looked down on smaller mountains that had been ripped and scarred by the hurricane. The view is superb over endless great valleys

and mountains, and the surf may be seen breaking all along the northeastern and eastern shores, while great masses of cloud drift by or about one, changing the scene every minute. Our photographs had to be shot through the holes in the clouds. The dense masses to the south and southwest prevented pictures being made in those directions, but as the ones we did secure toward other points of the compass were the first ever taken from the summit of this mountain, we felt well satisfied.

Diablotin was supposed to be the highest mountain in Dominica, but to our great surprise our instrument registered 4550 feet, or fifty feet lower than Trois Pitons. At the top we found one other record left by Mr. Tavernier of Roseau, some years before, and at 4450 feet another bottle contained the date and the names of a party headed by Mr. Aird and



© Paul Griswold Howes

A PARROT FOUND ONLY IN DOMINICA

Amazona bouqueti

While common in Dominica and encountered frequently by the members of the Howes-Cummings expedition, this bird occurs no place else in the world. Shown slightly over one-third life size



ANOLIS LIZARDS

These lizards possess yellow throat fans which they extend when excited, and after eating

Mr. Archer, that did not reach the summit.

Undoubtedly our readings are correct, especially in view of the conditions which we found on the two mountains. The summit of Trois Pitons is treeless and the tree line lies about fifty feet from the top. On Diablotin there are trees fifteen feet high, almost at the very peak, and one of my photographs shows palms growing along one of the highest ridges.

It is very interesting that the vegetation appears still be to creeping up these mountains. They are not high enough to allow of permanent tree lines as in greater ranges, and I firmly believe that in the future trees will reach the top of Trois Pitons and that they will become more numerous on Diablotin.

As to the readings of Diablotin which ascribe to the mountain an altitude of 5000 feet or more, let it be said that 5000 feet would be 450 feet higher than we recorded it, which would also make the plateau at Milton 450 feet higher, or 1850 feet. This would be absurd, for the reason that the plateau is a grassy, un-forested area, with underbrush and clumps or lines of medium-sized trees, with many life forms living upon it that are charac-

teristic. Anyone who knows Dominica, or who has paid the slightest attention to conditions as they actually exist, knows that an altitude of 1850 feet or even less, anywhere on the Caribbean side, would carry one into the heavy subtropical forest zone with its attendant living forms.

Recalling what Son Esprit had said about the top of Trois Pitons, it appears that noticeable changes have taken place even between the time he went up with us, and with a former party. I should like to climb these two mountains fifteen years from now.

The zoölogy of the mountains is of much interest also, but I shall have to mention it briefly. At the top of Trois Pitons we heard frogs calling, and at all levels on Diablotin, from base camp to summit, we collected specimens of the remarkable little frog called *Eleutherodactylus antillensis*. They become paler as the altitude increases, and it is interesting that they have reached the top of this island world.

These frogs have no tadpole stage at all that is free-swimming. The entire process



A COMMON BUTTERFLY

Colanis julia Fabr.

A butterfly characteristic of the Milton Plateau at 1400 feet elevation. It extrudes a strange gland which smells strongly of banana oil and which has the power of attracting the opposite sex



AN ANTILLEAN BROAD-WINGED HAWK

Buteo platypterus antillarum

This bird, which was captured alive by the expedition is of a common species. Stomachs examined contained giant centipedes and spiders, and the birds were frequently seen eating or carrying the black and white snake, *Leimadophis juliae*. The species is shown about one quarter life size

takes place within the unusually large eggs, which are deposited upon the ground. The young frogs step out of the eggs perfect in every detail and are about the size of a black-headed pin!

There is plenty of life up on these mountains, for the stomachs of these frogs contained flies, two kinds of beetles, and many ticks and mites. In the water caught by the leaves of bromeliads, black worms and other semi-aquatic creatures were thriving.

Molluscs in the form of land snails have reached the summit of the mountains also. A variety of *Bulimulus guadeloupensis* inhabited the plateau at Milton (1400 feet) and also a small, flat-shelled species of *Amphibulima*. The beautiful snail, *Pleurodonte josephinae*, occurred up to 3400 feet, where a number of the shells

were found beside a rock where they had doubtless been cracked open by the thrush, *Chichlherminia dominicensis*.

Species of *Neocyclotus* were also found well up on the slopes of Diablotin; this may possibly be a new species. At the summit of Diablotin I found a beautiful horn-colored *Amphibulima*, its shell streaked with delicate, waving lines of brown, and another as yet unidentified snail with a high spiral shell.

Land crabs were not uncommon in the subtropical zone of both mountains, and the streams on the lower slopes were inhabited by hundreds of shrimps and many of those strange gobies, fitted with suction discs for clinging to stones in the roaring mountain streams. The species which we found was *Sicydium punctatum*. The fishes were feeding upon algæ.

Insects were numerous, but space prohibits a discussion of them in this article. I must mention, however, a large green mantis from 1500 feet on Diablotin that was quite different from any other species I have taken in Dominica.

Bats were encountered, but not at the higher levels, while bird life was much in evidence. The Imperial parrot, *Amazona imperialis*, and the smaller *Amazona bouqueti* both inhabit Diablotin, and the latter was seen several times on Trois Pitons. *Imperialis* is scarce, but *bouqueti* was seen many times every day during our Diablotin expedition, and on one day we saw seventeen.

On the grassy plateau at Milton and in the rows of trees and the thickets which grew here, twenty-seven species of birds were found including anis, cuckoos, four flycatchers, two warblers, two finches, and

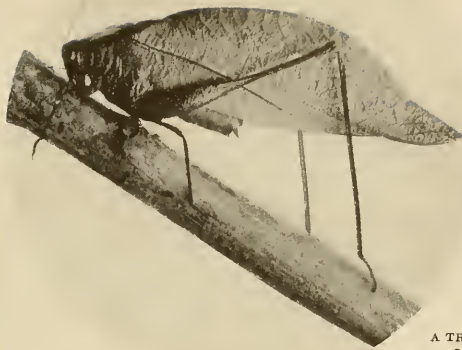
a grossbeak, a wren and a honey-creeper, three thrushes, and a solitaire called the mountain whistler (*Myiadestes dominicanus*), which is peculiar to the island. There was also a comical bird, the trembleur, *Cinclocerthia ruficauda ruficauda*, with the habit of continually drooping and trembling its wings, a swift, and four humming birds, the Antillean broad-winged hawk, *Buteo platypterus antillarum*, and a wild pigeon and a dove.

All of these except the Imperial parrot were found also between our headquarters at 1800 feet and the top of Trois Pitons, but birds were scarcer on the higher parts than on Diablotin, although the Dominican sparrow, *Pyrhulagra noctis dominicana*, flew over the very top of it while we sat making our notes! Near by, but not actually on Trois Pitons, at 1850 feet, Cummings and I secured a specimen of the very rare *Euphonia flavifrons* three days before the end of our trip. The only other record of this we know of is that of Ober made in 1887.

Our time, was far too short for our purpose, and there is doubtless a great deal more of interest and value to be found out about these rugged mountains. I hope sometime in the future to climb them again, in order to check up on my predictions.



WHITE PIERID BUTTERFLY newly emerged from its chrysalis. This species sometimes appears in great broods, both at sea level and high in the mountains. About four times life size



A TROPICAL RELATIVE
OF THE KATYDID

SOME INSECTS FROM BARRO COLORADO

A Region of the Panama Canal Zone Where Insects of Peculiar Shapes and Habits
Carry on the Never-ending Struggle for Existence—How They Kill and in
Turn Fall Prey to Enemies

BY C. H. CURRAN

Assistant Curator, Department of Insect Life, American Museum

Mr. Curran, assistant curator of insect life at the American Museum, spent several months early in 1929 studying the insect fauna of the Canal Zone, particularly Barro Colorado.

Barro Colorado was originally a headland on the shores of the Chagres River. When the Gatun Dam was closed, the surrounding lowlands were flooded and the water level rose 85 feet, making of the headland an island that stands 452 feet above the lake.

The 3500 acres comprising the island are heavily forested, and support an essentially primeval fauna of the greatest interest to scientists and naturalists. Through the efforts of Mr. James Zetek, specialist in tropical insects, U. S. Department of Agriculture at Washington, D. C., the United States Government has set aside Barro Colorado as a laboratory for students of tropical animals and plants, and has placed it under the care of the Institute for Research in Tropical America.

Mr. Zetek, as resident custodian, has earned the gratitude and esteem of all visiting scientists by his unflagging interest and assistance in their scientific investigations. Another resident of the Zone whose influence is felt is Mr. J. B. Shropshire of the Army Sanitary Division. In work carried on in the Zone Mr. Shropshire was always at Mr. Curran's service and much of the success of the entomological studies in the Zone is due to his coöperation. Dr. William H. Weston, professor of botany at Harvard University, also gave much of his time to the preparation of the insect photographs in the following article.

THE EDITORS

IN no part of the world is the eternal struggle for existence so obvious as in the tropical regions. There animals and plants are engaged in continual warfare, and even the casual observer in the wooded region, or "jungle," cannot fail to be impressed by the rapidity with which death swoops down upon the ever watchful inhabitants of the "underworld." No animal is safe; no plant is secure. In the case of all living things, enemies are awaiting the opportunity to destroy that

they themselves may live. The mighty giants of the forest are brought to earth by the ravages of insects, fungi, and wind; the larger animals succumb to others of greater or less skill, which possess the advantage of being able to make surprise attacks.

Among animals, the insects very greatly exceed in point of numbers of individuals as well as species, all the other animals found in any given portion of the world. Not only do insects make war upon all



ON THE BEACH AT BRUJA POINT

The swamp land to the right provided a breeding place for countless *Anopheles* mosquitoes, and the ravages of malaria once made the region almost uninhabitable. Drainage by the Army Sanitary Division eliminated the conditions favorable to the mosquitoes, and malaria is now practically unknown hereabouts

the animals and plants in their neighborhood, but they war upon one another. If any analysis were made, therefore, it would be found that they have, in reality, many more enemies than any other one group of the animal kingdom.

Since they are so preyed upon and their lives are so precarious, it is not surprising to learn that insects secure protection in many ways. As a rule they are unable to defend themselves, and once fairly in the grasp of an enemy, they are doomed to destruction. Since they are weak defensively, how do they escape their enemies? Is it by speed or by concealment?

Speed seemingly plays but a small part in the safety of insects. One evening a bat-hawk, having set himself up in the top of a dead tree near our laboratory on Barro Colorado Island, made numerous sorties after large moths. He never

missed. On one occasion a moth escaped the first plunge, but with the speed of lightning the bird wheeled, and before the moth had gone a dozen feet in its mad flight to escape, the bird had grasped it in its claws and was carrying it to the treetop, there to devour the tasty morsel, the torn wings drifting slowly to the ground a hundred feet below. So speed is no real measure of safety.

Concealment in the direct sense is the safeguard of many insects, but its limitations are evident. Yet, if we include under concealment such terms as protective coloration, deceptive form, and so-called mimicry, it may be said that insects find concealment to be their greatest protection. To the observer of insects it soon becomes obvious that under certain conditions some insects are almost invisible even when in full view

and but a few feet distant. If their presence is betrayed, it is usually because of some movement on the part of the insect. It may seem a strange anomaly to assert that it is motion which warns an insect of the presence of an enemy, and at the same time it is usually some motion on the part of an insect which acquaints an enemy of its presence.

INSECTS OF PECULIAR SHAPE

One finds, as a rule, that insects which have developed in such a way that they are bizarre in appearance have formed the basis of a great many papers dealing with tropical forms. As a result of this, the opinion prevails that the tropics are full of weird six-legged creatures which may be secured in almost countless numbers. Yet the visitor to the tropics would be exceptionally well repaid could he find three or four creatures so bizarre as to attract more than usual attention.

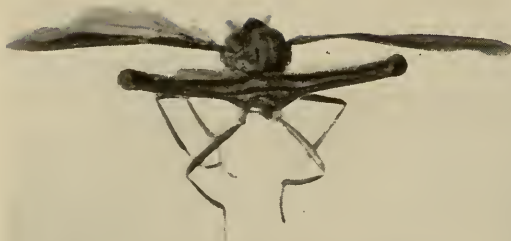
It will be gathered from this that bizarre forms are rare, and this is indeed the case. Many insects of strange structures are quite small, and it is only when they have been examined under a powerful microscope that their peculiarities become strikingly apparent.

One day while walking along the trail at a point where the growth was no higher than ten or twelve feet, I saw what appeared to be a brown, twisted stem of a leaf, or a dried portion of a leaf, wafted downward from an overhanging bush. But it did not reach the ground. Instead it made an upward sweep and came to rest on the slender stem of a plant. It was one of the little tree hoppers, or brownie-bugs, as they are sometimes called, and as it rested upon the stem, its peculiar shape might well have deceived any observer into the belief that it was merely a piece of dried leaf stuck to the plant. On Barro Colorado there



THE AIRPLANE BUG

This assassin bug lives fairly close to the ground, although its name and structure would seem to indicate that this was not the case



A STALK-EYED FLY

The wierdest fly occurring on the American continent and known only in the tropics. In life it is even more grotesque than it appears here

are at least two more tree hoppers of striking form. One of these is said by James Zetek to be the original pawnbroker's sign, as it bears upon its back three swellings which do remind one of the pendent spheres. This little "brownie" is quite common. Whether its unique armor is of much service as a means of protection is open to question.

Occasionally the bushes on the side of the trail will harbor two or three ferocious looking bugs belonging to the family of which our common squash bug is a member. In the several instances that these were observed, almost always two male bugs were found on the same bush, rarely three, never a single individual. Had they been in pairs, one might have concluded that here was marital fidelity among the bugs, the two sexes going happily about the business of enjoying life together. Evidently the opposite was true, and they could not get along peacefully, because the males seemed to enjoy each other's company and to travel in pairs. Why? It is a problem still to be solved and one which promises to be of interest.

Many flies are found resting beneath the leaves of the Panama hat palm (it is not a true palm), especially if the plants grow

in close proximity to a stream. Some of these creatures are of unusual structure and one of them has its eyes situated on the ends of long stalks. This is one of the two really "stalk-eyed" flies known from America, yet they are not closely related to the true stalk-eyed flies of the Old World tropics. So far as could be observed, the development of the head serves no useful function. Perhaps it has grown in this way in order to please the eye of the female, which is an ordinary looking individual with a normal head.

Possibly the males look quite dangerous to other insects; certainly the outline, as the fly rests on a leaf, always on the under surface, is scarcely fly-like.



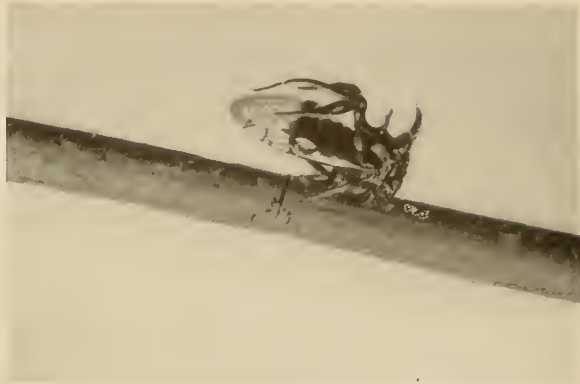
AN ASSASSIN OF THE TRAILS

An assassin fly, crouched in waiting attitude ready to spring forth and inflict death upon any unwary insect which may come within range of its clutching legs

SOME INSECT ASSASSINS

Assassins are numerous in the insect world. Many entire families of insects prey upon others, pouncing upon them suddenly during flight, lying in wait for the unwary individual that comes within their domain, or pouncing upon their victims after a stealthy approach.

On many of the very low shrubs which spring up on the trails, there rests an assassin ever alert, turning its head this way and that in search of some flying insect which would furnish a much-needed meal. These assassin flies, or robber flies as they are usually called, though they never rob anything but life, are extremely strong, and an insect, unless it be of much larger size



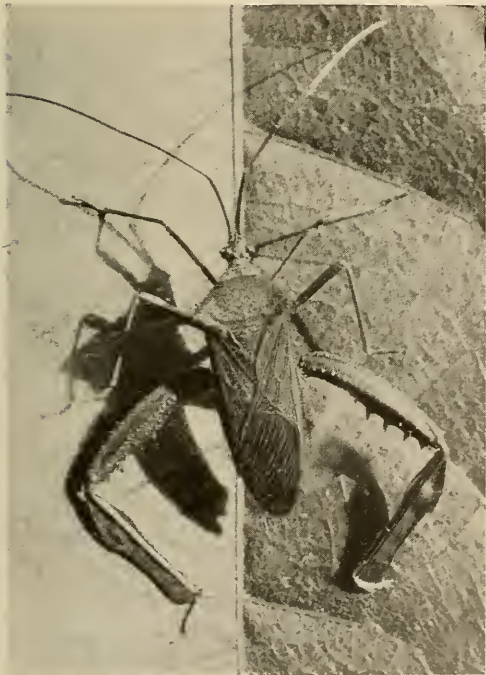
THE PAWNBROKER'S SIGN

The common and wierd treehopper enlarged several times, carries three globular swellings above its back

than the would-be murderer, has little chance of escaping from the clutching legs of the aggressor. Some of them live almost entirely upon bees, in some unaccountable manner escaping the searching sting as the bee fights for its life.

The stink bugs are evil smelling creatures. A very large, green kind with orange stripes is very often met along the trails. It takes to the air very readily upon the approach of danger, and for this reason often escapes recognition. It enjoys a meal of caterpillars, although other insects also seem palatable to it.

Among the assassin bugs is a peculiar creature in whose hind legs the tibiae have become expanded into an orange and yellowish mottled leaflike structure. To this bug Zetek has aptly applied the name of "airplane bug." It is not difficult to imagine it soaring high above the treetops, skimming along with little alar effort. However, it lives fairly close to the ground and may be found resting upon leaves, eager to locate some other insect to furnish it a meal. One afternoon I observed a relative of the airplane bug sitting on a leaf enjoying a repast of stingless bee. On the same leaf, evidently attracted by the dead insect but careful to keep out of reach of the living one, were two tiny flies.



A VICIOUS LOOKING BUG

Related to the squash bug, this creature looks dangerous, but it is not. It lives on the juices of plants. Perhaps the huge hind legs cause it to appear ferocious to its enemies



A SANITARY DIVISION BUILDING IN SCENIC SURROUNDINGS

A view from France Field, Army Air Station, on the Atlantic side of the Isthmus. The building is used primarily for the storage of tools needed for the digging of drains for the elimination of mosquito breeding places



A TREE HOPPER

The droll facial expression of this insect has suggested the name "brownie bug," by which it is sometimes called

They seemed to be anxious to secure some of the meal. Perhaps they intended to await the end of the assassin's dinner, and then themselves feast upon what remained.

"LANTERN" FLIES

On the side of a cliff-like slope leading up from a small stream, stood a tree with quite a smooth bark and patches of lichens scattered sparsely on its surface. To the human eye, it was apparently not at all different from others of its kind scattered through the forest. But to one species of lantern fly (Fulgorid) it must have had some special attraction for there seemed to be quite a large colony permanently residing on its trunk. They sat there, some thirty or more, usually one above the other, in rows of four or five, scattered on the shady side of the tree. The formation was not unlike that of soldiers engaged in an attack, each keeping

the proper distance from the other. But the Fulgorids are no soldiers, and their green, gray, yellowish, and white waxy bodies stood out conspicuously on the tree trunk. When frightened off, they flew a short distance and found temporary quarters on some other tree, but they always came back. Why was this tree selected above all others? This is another question still to be answered.

Many Fulgorids resemble moths. The resemblance can scarcely be any protection, but nevertheless it is very great, especially when the insect takes wing or rests upon the underside of leaves. The family contains many examples of remarkable structure and beautiful coloration, as well as numerous dull colored forms.

GRASSHOPPERS AND ALLIES

Most people will agree that the katydids are graceful creatures, and that their cheery song is not unwelcome music



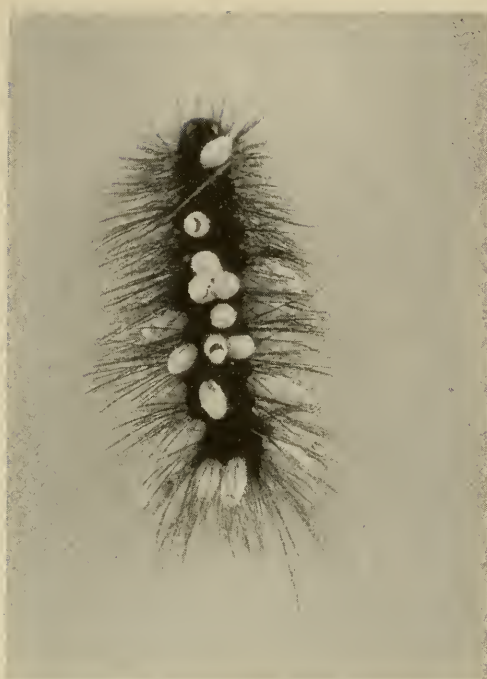
AN INSECT CONVEYANCE

This walking stick served as a unique chariot for a pair of biting midges. The larger wingless female has a yellow body and is shown to the right of the male



LIKE SENTRIES ON GUARD

Together with many others of their kind these two Fulgorids sat for days on the same tree trunk. "Lantern flies" are not luminous, as the name implies, and are not flies. They are bugs



DEATH

The parasites formed their white cocoons and departed before this caterpillar succumbed

during the night in northern regions. Many of their relatives occur in the tropics, some of them quite conspicuous. One common species closely resembles in color the dead leaves among which it spends much of its time, flying, when disturbed, to some neighboring low bush or tree trunk. Another has antennæ or feelers about three times as long as its body, and the female possesses a very strong ovipositor. The so-called "ears" of the grasshopper, located on the front tibiæ, show up very strongly in the picture on page 619.

Occasionally a large cockroach found its way into the laboratory. These did not make themselves disagreeable, and they were really "strays," preferring the free life of the open spaces to the confines of the building. They were not beautifully colored as many of their kind are, and were therefore conspicuous only because of their great size, their length

averaging a little more than three inches.

Walking sticks are familiar friends, and many species occur in Panama. They do not always walk. Many of them fly, and their flights, in which their colored under-wings are conspicuous, might well lead to confusion as to their identity. One of them appeared to assume the rôle of an insect passenger plane.

It had been commandeered as a means of transportation by a pair of tiny biting midges. Such an association is truly remarkable, and it also happens to be rather necessary as far as the travels of the flies are concerned. The male fly is furnished with wings, but not so his meek but fat little wife. She knows not what it is to soar through the air by her own volition, so to overcome the defect in her transportation equipment and in order that she might enjoy the



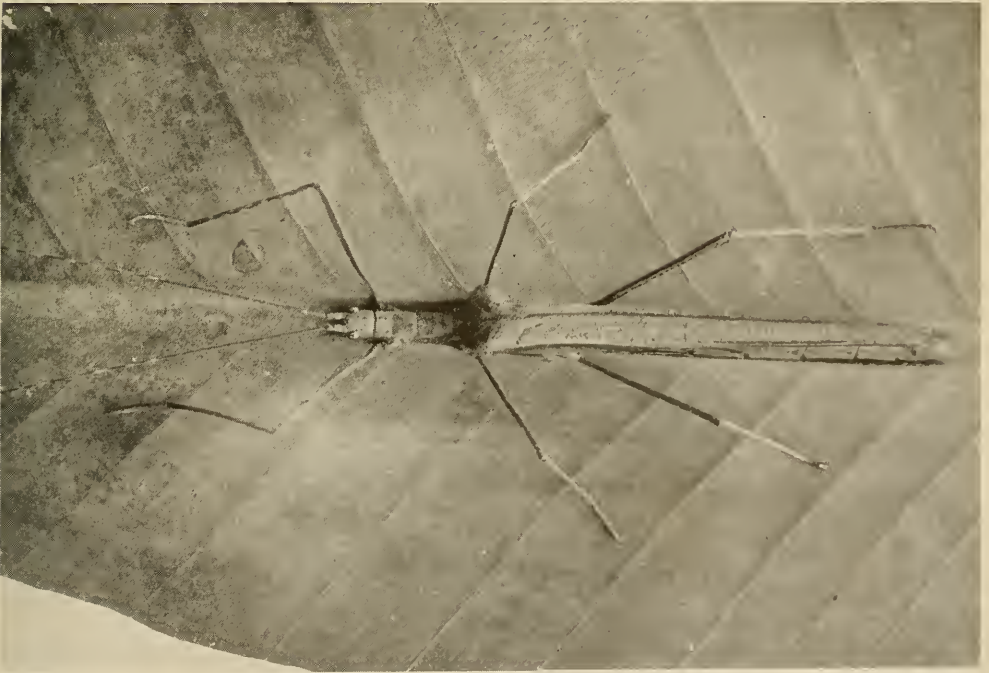
COCKROACHES MAY BE LARGE

This one is reproduced natural size and, like most of its relatives, lives out-of-doors, occurring rarely in dwellings



A "LONG-HORN" GRASSHOPPER

She carries her "ears" on her front legs and has antennæ several times longer than her body. The "ear" on the right leg appears as a whitish spot on the inner surface of the front tibiæ near the base



A "WALKING STICK"

It is always a matter of surprise to see what appears to be a part of the branch of a tree walking away. These insects feed upon foliage, and many of the adults are winged and quite good fliers

thrills of aerial travel, she has chartered a walking stick for her flight.

Probably the female midge takes only one flight. It seems likely that this occurs when she feels the need of reaching new ground where her numerous family can develop undisturbed by overpopulation and escape possible famine. In order to travel, she sinks her proboscis or mouth into the short wing covers of the walking stick. In this particular case (it may be only an exception) her mate (he was presumed to be such) had also fastened himself in the same manner. It is really a very interesting relationship. Of course the walking stick is an unwilling carrier of the family, but he is not inconvenienced in any way.

WHEN DEATH COMES

Death, in insect terms, lurks everywhere. Insects are born by the million, and it is safe to presume that they die in equal numbers. It is difficult to picture an insect dying from old age. If such a death is natural, it is at least rather unusual. If an insect escapes its predaceous enemies, there is still a possibility that disease will carry it off. There are

several fungus diseases peculiar to insects, and these are responsible for a goodly percentage of the insect death rate. At times the diseases reach the epidemic stage and then certain species may be all but wiped out.

Parasites attack almost all of the larger insects, and perhaps also most of the small ones. Caterpillars are occasionally observed struggling along on their dying legs, too weak, almost, to move, bearing on their backs several white cocoons of a hymenopterous parasite. As a rule the parasite does not reach maturity and emerge until the caterpillar is dead, but some of them do emerge before and leave the host free to continue feeding, although no adult butterfly or moth will later develop from the caterpillar. Parasitism is a study full of interest and teeming with remarkable relationships between host and parasite. Very little is known of this phase of entomology.

It is possible to discuss in one article but a very few of the great numbers of species of insects observed during two months spent on Barro Colorado Island in the Panama Canal Zone.



A MOTHLIKE FULGORID

"Lantern flies" display a great diversity of form. This type is found on the under side of leaves, from which it sucks the juices



A BIT OF JAPAN IN MINIATURE

The Building of a Museum Group Showing a Japanese Country Home of the Middle Class—How Such Models Are Constructed

By V. ROXOR SHORT

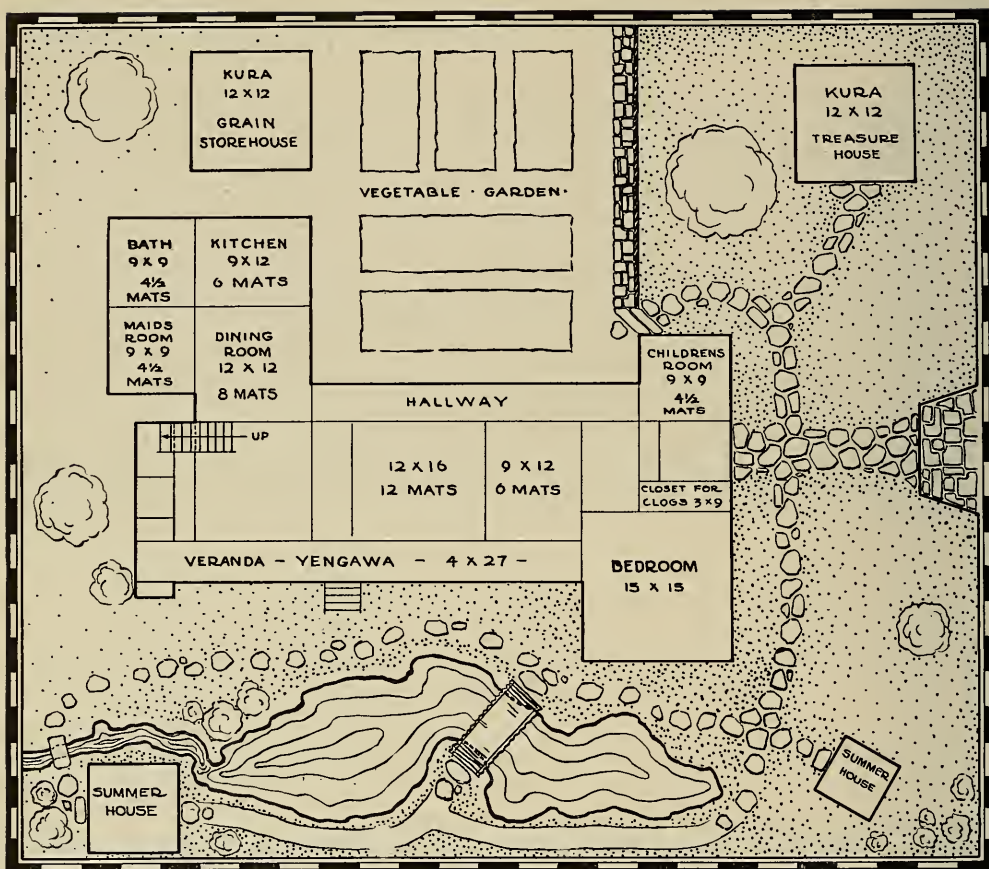
Department of Preparation, American Museum

IT is hardly practicable to present, in the halls of our museums, actual full scale exhibits of many of the objects that it is desirable to show, for large though the exhibition halls are, temples, tombs, and houses are often equally large, with the result that they must be shown in model form or not at all. Thus it is that almost every museum presents models of many objects, and remarkably accurate presentations can be made. With these visual aids, the visitor can re-create, almost perfectly, the original that is represented.

It has long been recognized as desirable by the department of ethnology of the American Museum that a model be constructed of a Japanese country home, for only by such means could the department readily explain the details of construction, and the plan and appearance of one of these thoroughly charming residences. The decision to build the model

having been made, I was fortunate enough to be assigned to the task of erecting it, and for more than six months have been engaged in building the house, laying out the garden, creating a tiny artificial pool, setting up trees, bushes, rock gardens, pergolas, fences, and all the other delicate features that go to make up this elfin home—all of which is built on the scale of one-half inch to the foot, with the result that the house and garden complete cover an area measuring only 48×53 inches.

As I have been working on the model I have been impressed by the number of people who have told me that they had imagined that Japanese houses were built of bamboo and paper. Paper, of course, is used only in screens, and takes the place of our glass in order that light may be admitted; and bamboo, while often used in making furniture, is extensively used



THE PRELIMINARY SKETCH

With this sketch as a beginning, and with innumerable sources of information upon which to rely, the group was begun

as lathing and under-surface structure.

Naturally, when confronted with the task of erecting this model, my first activities had to do with gathering all the available information concerning the attitude of individual Japanese toward their homes. Thus armed with a point of view which among Japanese is fairly constant, I began to study very carefully the details of construction. Sound reasons underlie all the structural intricacies of Japanese architecture, and many formulæ enter into their designs and plans.

After studying several Japanese architectural drawings, I started out with a preliminary sketch for our model, and almost before a plan was decided upon, I

found a minor difficulty in the measurements we had to use.

In Japan the *shaki* is a unit of linear measurement, and fortunately it is equivalent to our foot. It is, however, divided into tenths instead of twelfths, so all of our figures had to be converted into *shakis* and parts of *shakis* called *suns*.

The frame of the house is constructed of cedar, with each individual board and timber cut accurately to scale. By these careful means construction was pushed forward slowly and accurately, measuring and verifying until the siding was in place and the delicate joists of the roof were erected, ready to support the thick layer of grass thatch.



THE MAIN ENTRYWAY

It is difficult to believe, from the picture, that the house shown here measures only 6 inches from the ground to the eaves. Even the shrubbery has been so chosen as to suggest the same proportions as the house



FROM THE WISTARIA ARBOR

Showing the garden pool and the house. In the pool, over which the bridge passes, very tiny real fish, infiltrated with paraffin, give the impression of life



A GUEST VIEWS THE GARDEN

The little lady on the bridge, made of wax and standing only two and a half inches high, may be intent on the arrested activities of a real, paraffin-infiltrated frog, which sits on a wax lily pad on the glass of the garden pool



THE GARDEN FRONT OF THE HOUSE

Looking across the pool, one sees into the guest room, which has been opened to the garden by sliding the wall screens aside. Within, tea is being served to the guests of the house



THE WISTARIA ARBOR AND THE GATE

In the background is the *kura* or fireproof storehouse for the treasures of the family. The boy standing near the gate has unfortunately entangled his kite among the branches of a tree from which he is never likely to recover it



AN "AIRPLANE" VIEW

Looking down on the house and the garden, one sees two square yards of miniature Japanese countryside, representing about one quarter of an acre. The incompleted portion of the roof has been left to show the construction of the house

Boards, of course, could be cut and trimmed to scale, but the problem of obtaining something to imitate the thatch used in Japan, and of having it, too, to scale, was less easy. Furthermore, it was during the month of May that this thatch was required, and for a time it seemed as if Nature had nothing to offer us. Finally, however, on a collecting trip that led us fifty miles out on Long Island, we found a bed of dried pine needles in the midst of a delightful pine forest. Carefully selected, these dried pine needles served our purpose admirably, and seem an almost perfect thatch for a house built on the scale of one-half inch to the foot.

Another task lay in the selection of stones for rock gardens, walls, and walks. The result was that we spent hours along the Long Island shore picking pebbles

with the utmost care in order to choose only those that seemed to have, on a small scale, the characteristics that one would find in such rocks in a full-size garden. Endless hours were spent collecting odd stones, twigs, tiny bushes, and unusual plants, which would lend themselves to the scheme of things on that ever-present scale of one-half inch to a foot.

After laying and trimming the thatch, we turned our attention to the construction of tiny tiles for those portions of the roof on which thatch was not used. The roof of the *yen-gawa*, or verandah, alone required more than 600 individual tiles, each less than half an inch square.

For the *shoji*, or screens, we had the good fortune to obtain some real Japanese *shoji* paper, and the screens themselves are so constructed as to slide on tracks as

they do in a real Japanese house. The wooden storm doors, too, and the gates, are swung so as to be movable.

The house had progressed considerably before much detail work was done on the garden, and the *kura*, or fireproof warehouses, were constructed. Sometimes, in the more decorative *kura*, the art treasures of the establishment are kept, for Japanese houses are readily destroyed by fire. In other simpler *kura* rice and other grains are stored. The walls of these structures are heavily built of mud and plaster, and the vaultlike doors were reproduced in the lightest of wood—balsa.

One of the difficult problems in the garden was the construction of an elm tree, which was finally made of wax, for there are no shrubs that take a shape that is satisfactorily elm-like. The leaves of the elm tree were made of oatmeal carefully colored green.

About the most difficult illusion to

develop on a small scale—or a large one either, for that matter—is the illusion of water. It is generally either stiff or badly colored, and the methods that are adaptable to a large scale do not lend themselves to manipulation to the scale on which this Japanese garden is built. Consequently, a piece of fine plate glass was flowed with a layer of liquid cellulose and delicately colored to give the soft variation of hue that is found in a quiet pond or pool. Careful scrutiny will divulge several *real* fish, not alive, it is true, but preserved, in the pond; and comfortably established on a neighboring lotus pad is a frog—also an actual preserved specimen.

If one were able to dwindle in size, as did Alice in Wonderland, and were then introduced to this Japanese garden, one would have attained the ideal viewpoint necessary to a model builder. One might then follow the stone-flagged path and tell



"MOONLIGHT" IN JAPAN

The completed group will be shown in its case as if in broad daylight. The photographer, however, was able, with the careful use of electric lights, to get this moonlight effect

in an instant if the wax vegetables and the berry bushes were ever so slightly out of scale.

In order to add to the illusion, and to show more clearly the relative size of the house and its occupants, several figures appear in the garden. A Japanese lady with a parasol stands on the tiny bridge over the garden pool, her costume showing, by its symbols, her station in life and the family of which she is a member. Japanese kimonos usually carry the insignia or coat of arms of the family on the sleeves or in the middle of the back, and this wee garment is no exception to the rule. The lady's method of doing her hair explains her position in matrimony and there are many other such symbols woven into the model. A boy is trying to extricate his kite from among the oatmeal leaves of the waxen elm tree where I

entangled it in an effort to create a bit of "human interest," and the preserved fish in the pool, after the manner of live fish, pay no attention to what is going on in the airy garden about them.

It is by such methods that the department of preparation of the American Museum attempts to depict those distant objects that cannot be brought bodily into the Museum, and even if, as in this case, the "thatch" is of pine needles, the figures are of wax, the water is made of glass, the leaves are made of oatmeal, and the grass is represented by finely clipped silk, the illusion is convincing.

The accompanying illustrations were made by Irving Dutcher of the American Museum photographic department, and present a series of pictures that tell with great accuracy the story of a home in the Land of the Rising Sun.



MR. SHORT COMPLETING THE MODEL

The scale on which this bit of Japan has been built is here shown plainly

HOW ATOMS BUILD

A Proof that Simplicity and Not Complexity Lies at the Base of Crystal Structure

By HERBERT P. WHITLOCK

Curator of Minerals and Gems, American Museum of Natural History

IT has been said that the deeper we penetrate into the knowledge of natural processes the wider is the vista of the unknown that opens up before us. The theory that fifty years ago was hailed as a veritable outpost of scientific achievement, has today become a part of a larger, fuller, more far-reaching theory. And as we travel this road of knowledge we are beginning vaguely to grasp the rhythm, order, and continuity of these processes of nature. Gradually there emerges from what formerly seemed unrelated facts and phenomena, basic principles of great and supremely beautiful simplicity. We become fundamentalists in science searching always for the key note of simplicity, the deep basic tone that makes for harmony in the scheme of material things.

Such a fundamentalist in science was Rene Just Haüy, who, amid the appalling circumstances of the French Revolution, sat calmly in his Paris prison, surrounded by his little collection of mineral specimens, and evolved the great law of symmetry that is the basis of the science of crystallography.

Such fundamentalists, no less, were the little group of workers, Laue, Debye, Scherrer, and the Braggs, father and son, who, a century later, used the short waves characteristic of the X ray to demonstrate how the atoms composing crystalline bodies are grouped in symmetrical three-dimensional patterns, thus giving us a far-reaching and definite reason for the outward harmony of symmetry that was Haüy's contribution to our store of knowledge. Today the physicist and the crystallographer, working with

these tools of modern science, can map the relative position of the atoms in crystalline substances with as much certainty as the physical astronomer can name the elements that compose a distant star.

This relatively new field of investigation is known as crystal structure. Its units are almost immeasurably small; so small, in fact, as to be far beyond the limit of vision of our most powerful microscopes; and in dealing with them we do not attempt to assign to them the attributes of size and shape. What we do know, thanks to the special properties of the X ray, is the relative distances between them. Even these distances are exceedingly small, and we are obliged to resort to minus exponents of high value and to somewhat fantastic comparisons to convey an adequate idea of the minuteness of these atomic distances.

For instance, let us assume a fragment of crystallized common salt no larger than the head of a pin. In order to represent the spacing between the sodium and chlorine atoms of this tiny chip of crystallized matter, in such a manner as we have used in the model shown in Fig. 6, we would have to magnify it to a mighty mountain of salt whose base would extend about twenty-five miles and whose summit would tower far above the highest clouds. Is it then at all remarkable that crystals in the perfection of their development should present to our eye the brilliant smooth surfaces that are the bounding planes of their countless myriads of atomic units?

Let us consider the plan upon which some of these atomic edifices are reared, atom next to atom, like bricks in a tre-



Drawing by Mrs. E. R. Fulda

A GRAIN OF SALT

Fig. 1.—A grain of rock salt so small that even an ant can carry it, contains many millions of atoms

mendous wall which by some transcendent magic has become small enough to be encased in a nut shell.

No doubt many of us have noticed that when we attempt to crowd together a number of objects of similar size, such as peas, golf balls, or oranges, they inevitably form groups of three, and that these groups of three are linked together until the layer of objects makes a pattern, like that pictured in Fig. 3. If we were to add to the first layer of balls such as we have used in Fig. 3, another layer piled upon it and still another piled upon that, the assemblage of balls would look like Fig. 4. This arrangement of particles of matter, no matter what their size, has been called "close packing" because by this method the greatest number of particles are made to occupy a given space. It is therefore the simplest and the most obvious of particle grouping.

Research with the X ray has shown us that the atoms of many of the metals such as gold, silver, copper, lead, nickel, aluminum, calcium, iron, and platinum are grouped in this way, so that we are

confronted with the very significant fact that a number of simple substances (the above metallic elements) form in crystals, the atomic structure of which consists of the simplest particle grouping.

Let us study the close-packed grouping of Fig. 4. If we were to consider the uppermost ball of the pyramid as the corner of a cube and complete the cube by the addition of four more balls as in Fig. 5, we would find that the added balls (representing atoms) have only extended the close-packed grouping, and that Fig. 5 is only another expression of close packing. It is in some ways more convenient and illuminating to consider the aspect of close packing shown in Fig. 5 (which is called a face-centered cube) as our starting point, although we should by no means lose sight of the very significant triangular aspect of Fig. 4, because it emphasizes the group of four atoms arranged at the angles of a tetrahedron (compare the four topmost balls of Fig. 4).

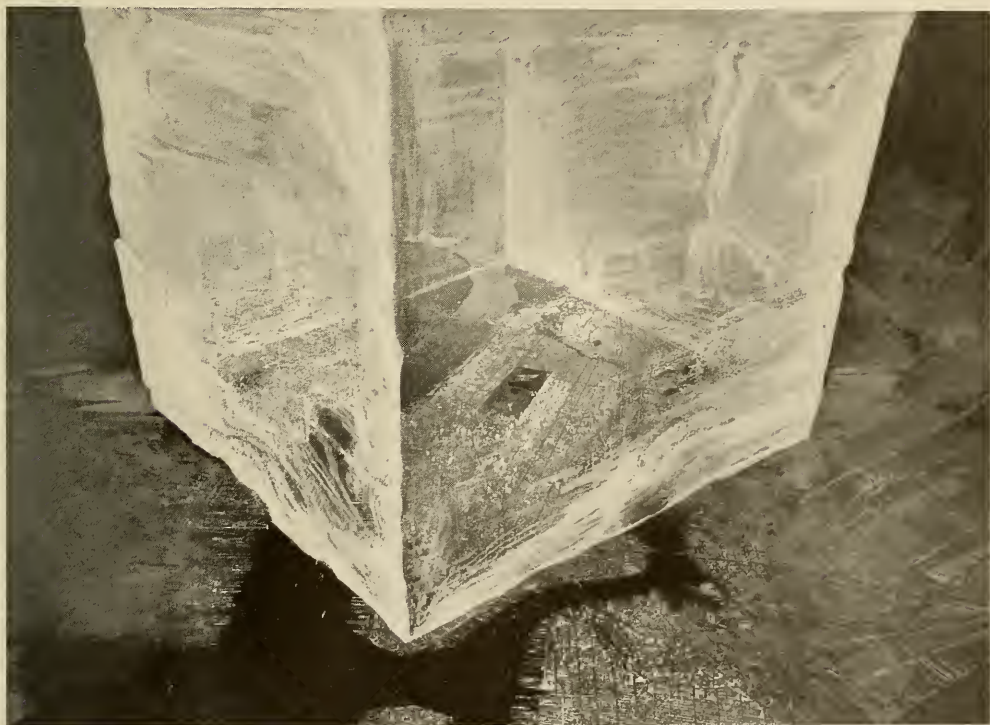
If we were to suppose the close-packed grouping to consist of alternate layers of *two different kinds of atoms* as in Fig. 6,

and if we were to suppose the atoms represented in the model to be those of sodium and chlorine, the resulting grouping would show the atomic structure which the X ray has revealed to be that of sodium chloride or common salt. Notice how the smaller balls representing the chlorine atoms, which have a smaller *atomic domain* than those of sodium, fit into the open spaces between the larger balls representing the larger atomic domain of sodium atoms. Both sodium and chlorine atoms as represented in the model (Fig. 6) are in face-centered cubic arrangement, and in an extension of the grouping there would be as many of the one kind of atoms as of the other.

Also note that the planes of atomic crowding are parallel to the face-centered cubes of both aggregates of atoms, ex-

plaining why sodium chloride crystals show a marked tendency to break parallel to cube planes. And finally note that the relation between the two face-centered groupings of sodium and chlorine atoms is that of two tetrahedrons, one reversed on the other, as shown in Fig. 8. Among the crystallized substances whose atomic structures are at present known, a considerable proportion have structures of the sodium chloride type.

Let us now suppose that two kinds of atoms are separately spaced in close-packed (or face-centered cubic) grouping, and that these two groupings or sets of atoms are so interlocked that the corner atom of the tetrahedral cell of the one grouping falls in the *center* of the tetrahedral cell of the other grouping. The relation of the tetrahedral cells in such an



A COMPARISON

Fig. 2.—If we were to try to magnify the fragment of common salt that the ant is carrying in the preceding picture until we could distinguish the atoms that compose it, we would have to enlarge it until its huge size would completely cover Greater New York and tower up above the clouds



CORK BALLS IN CLOSE-PACKED ARRANGEMENT

Fig. 3.—Whenever a number of objects of similar size are crowded together, they inevitably form groups of three, which when linked together, form a pattern such as is pictured here

atomic structure is pictured in the model shown in Fig. 7, in which the positions of the atoms at the angles of the tetrahedra

are not shown. Such a structure composed of zinc and sulphur atoms has been found to be characteristic of the mineral sphalerite, a zinc sulphide, in which every zinc atom lies at the center of a tetrahedral group of the sulphur atoms, and every sulphur atom at the center of a similar cell formed of zinc atoms. The model shown in Fig. 9 will help to make clear the intricate relations of a crystal structure of this type. In this model the larger balls represent the zinc atoms with the larger atomic domain, and the smaller ones represent the sulphur atoms.



A CLOSE-PACKED PYRAMID

Fig. 4.—When the units are fastened together, the pyramid will appear the same, no matter on which one of its four sides it may rest

Although not so frequently met with among those crystals which have been studied, as the atomic structure of the sodium chloride type, groupings of the zinc sulphide type are nevertheless characteristic of a number of substances. The carbon atoms in a diamond crystal are spaced in this manner, except that in this instance all of the atoms are of one

element, and a single tetrahedral cell would appear as the model shown in Fig. 10A, or assembling several such cells in the atomic grouping of diamond, we have the model shown in Fig. 10B. It is very obvious from this aspect of the diamond atomic structure that the carbon atoms are firmly linked together in a pattern that is highly resistant to physical deformation. We would therefore expect such a crystal structure to be very hard. It does, in fact, belong to the hardest substance known.

There is, as we all know, another kind of crystallized carbon, the mineral graphite. Now investigation has shown that the crystal structure of graphite differs from that of diamond in a relatively slight particular from a mechanical point of view. Observing Fig. 10 closely,



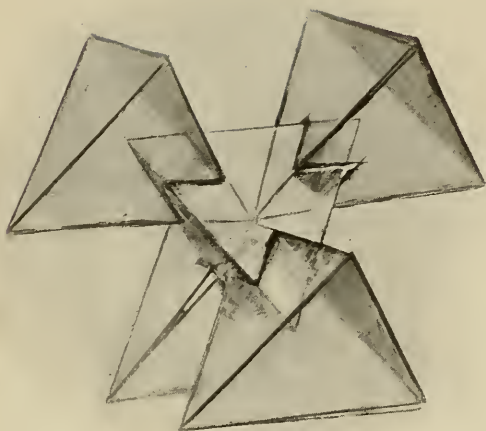
A "FACE-CENTERED CUBE"

Fig. 5.—The close-packed arrangement of cork balls in this model is the same as that of Figure 4. If the lowest ball, the upper right one, and the upper left one were removed, we would see the arrangement of Figure 4



ATOMS IN A CRYSTAL OF SALT

Fig. 6.—The arrangement of the atoms in a crystal of common salt is represented in this model. It is a close-packed grouping like Figure 4, spread apart so as to show the relative position of the atoms. The large balls represent sodium atoms, the smaller ones chlorine atoms

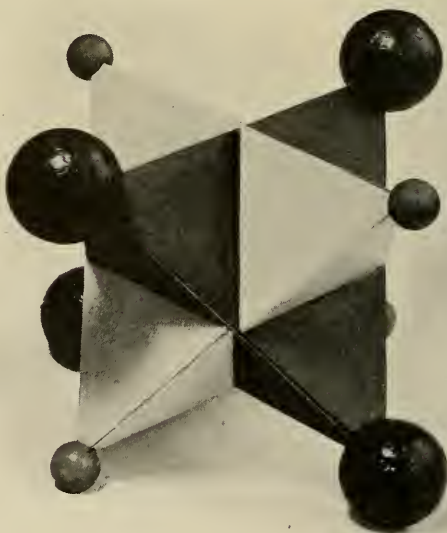


INTERLOCKED CELLS OF ZINC SULPHIDE

Fig. 7.—The balls representing the atoms in this model of the interlocked cells of zinc sulphide have been omitted. There should be one ball at the four points of every tetrahedron, placing an atom of zinc in the center of every group of four sulphur atoms and an atom of sulphur at the center of every such group of zinc atoms

we find that we may consider the atoms as lying in layers, upon one of which the model rests, as shown in the illustration. Imagine the second layer of atoms from the bottom to be slightly shifted (one sixth of a circle) until it "clicked" into place, and at the same time was drawn away slightly from the lower layer. The result of this slight mechanical shift will be seen in the model shown in Fig. 11, which represents the position of the carbon atoms in graphite. This crystal structure has not the symmetry of the diamond pattern; the close bond that tied together the atoms of that remarkable substance is gone, and in its place we find open spaces between successive layers of atoms, suggesting the possibility of the layers slipping one upon the other. Graphite is soft and greasy or slippery to the sense of touch.

Hitherto we have been considering the crystal structure of such minerals as common salt, sphalerite, and diamond, all of which crystallize in the isometric system, and the atomic groupings involved have consequently all presented the perfect symmetry of that system; they have all (with the exception of graphite) shown us a three-fold arrangement of atoms when viewed from the direction of the corners of a face-centered cube. Let us now turn back to the consideration of Fig. 4 and assume that the close-piled aggregate of material particles are pressed together along *one* three-fold axis, or drawn apart in the same direction. Such conditions produce atomic structures that no longer show isometric symmetry, but which present the symmetry of rhombohedral crystals, that is *one* axis of three-fold symmetry. If we were to assume the sodium chloride grouping of Fig. 6 to be



THE ATOMS OF A SINGLE "CELL"

Fig. 8.—The eight balls forming the top corner of Figure 6 are arranged as in this model, which by separating them from the others and linking them in fours shows how the atoms of a "cell" of a crystal of common salt are related

so compressed, say in a vertical direction, our model would bear a close resemblance to the structure of a common rhombohedral mineral, calcite.

Calcite is composed of the atoms of three elements, calcium, carbon, and oxygen. There are in its composition as many atoms of carbon as there are of calcium, and three times as many oxygen atoms as there are of either calcium or carbon. X ray research has shown us that the oxygen atoms are grouped in clusters of three around every carbon atom, and that the atoms of calcium and of carbon are grouped as those of sodium and chlorine are in rock salt, except that the entire atomic aggregate has been slightly compressed in one trigonal direc-

tion. The model shown in Fig. 12 represents the arrangements of atoms in a crystal of calcite. The largest balls represent calcium atoms; the black ones spaced alternately with them represent the carbon atoms; and the smallest balls grouped in threes about the carbon atoms are those of oxygen. Just as the cleavage of rock salt is cubic, the cleavage of calcite for a similar reason is rhombohedral.

The few examples with which we have dealt in the foregoing pages constitute only an introduction into the bewilderingly fascinating field that has been opened up by this "new crystallography." For instance, no attempt has been made to show how the structure of crystals in systems other than the isometric and the



ATOMS IN A CRYSTAL OF ZINC SULPHIDE

Fig. 9.—A model showing the arrangement of atoms in a crystal of zinc sulphide. The face-centered cube grouping of the larger units (representing zinc atoms) is quite obvious. The smaller units (representing sulphur atoms) are also on a face-centered cubic pattern

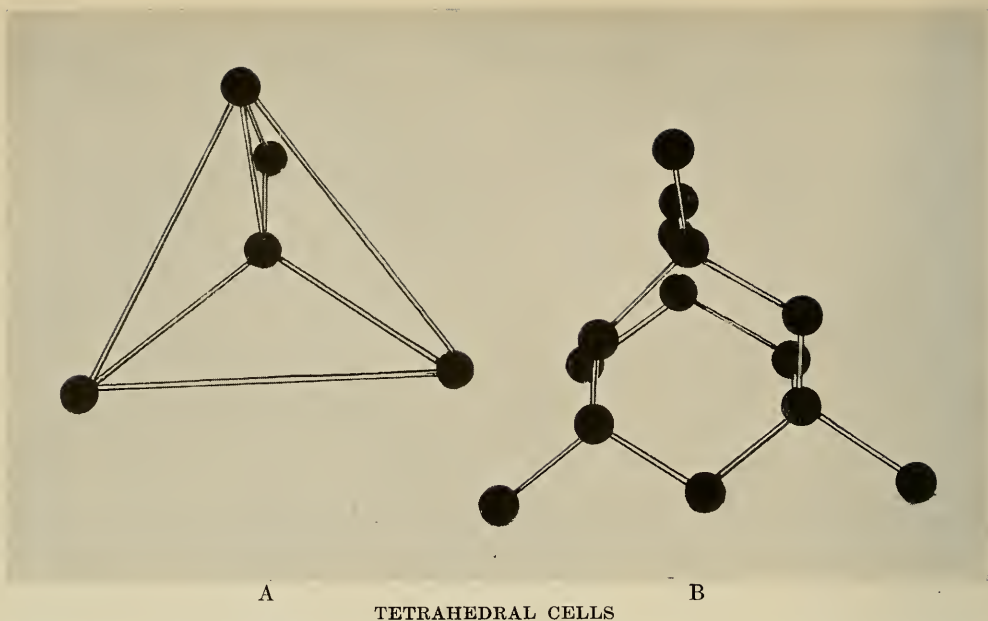
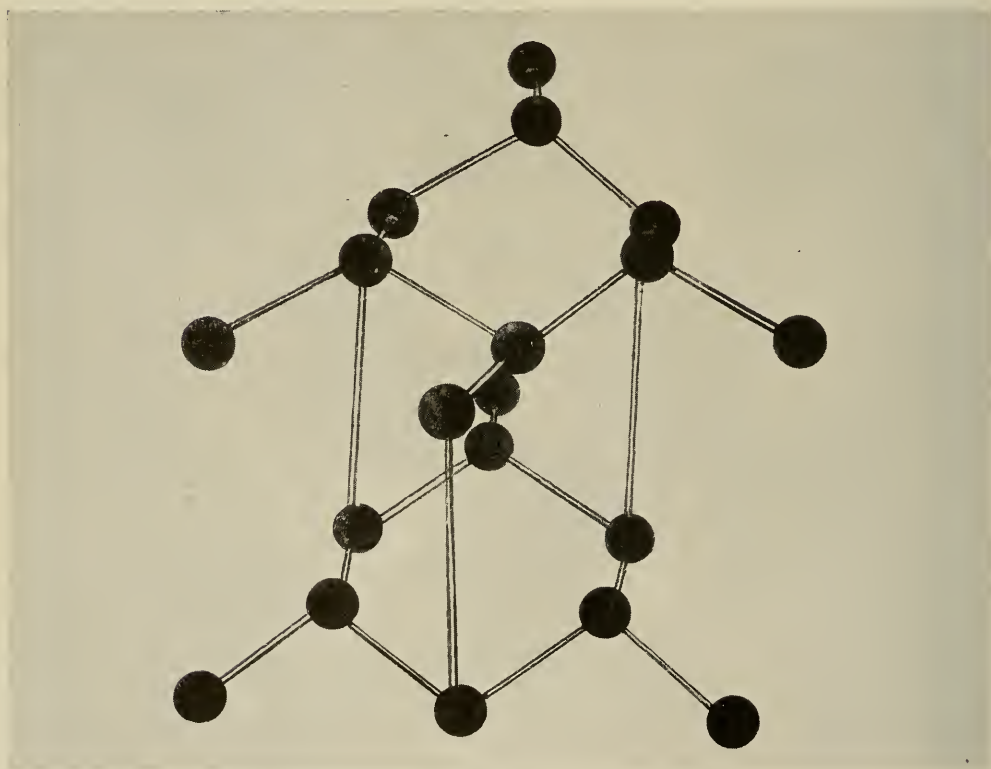


Fig. 10.—“A” shows a single tetrahedral cell formed by the carbon atoms of a diamond crystal, and “B” shows a number of such cells linked together as in the atomic structure of diamond



ATOMS IN A CRYSTAL OF GRAPHITE

Fig. 11.—A model showing carbon atoms arranged as in a crystal of graphite. The six balls upon which this model rests are in the same position as the six upon which that shown in Fig. 10B rests

rhombohedral are derived from the close-piling principle, although such a demonstration would have been quite simple and along the theoretical lines made classical by Bravais and others.

The new demonstration of crystal structure has been responsible for the elimination of some of the time-honored concepts of mathematical crystallography. We have found, for instance, that rhombohedral crystals, like calcite and quartz, that have heretofore been classed with the hexagonal system, are structurally more nearly allied to isometric atomic groupings, and should therefore belong to a distinctly separate system. Also the old concept of hemihedrism in crystals becomes structurally unfounded, however

much it may add to convenience in treating them mathematically, and when we consider the atomic structure of sphalerite.

In general, the work that is now being energetically pursued in countless laboratories throughout the world by investigators who are using the X ray to determine crystal structure, has shown that simplicity and not complexity lies at the base of this great problem.

The examples we have taken to show how directly in very many instances crystal structure has at its foundation the close-piling principle, are not exceptions but standard types. It would then seem that here we have another comprehensive law reaching down to the very roots of material things.



ATOMS COMPOSING CALCITE

Fig. 12.—The atoms composing calcite, represented in relative position by the cork balls of this model, are of three kinds. The large balls represent the atoms of calcium, the black balls those of carbon, and the white balls, grouped in threes about the black ones, atoms of oxygen



Mount Karisimbi in fresh snow

Photograph by Mary L. Jobe Akeley

AFRICA'S GREAT NATIONAL PARK

Carl Akeley's Gorilla Sanctuary and Biological Survey Station
Becomes a Reality—The Formal Inauguration of
the Parc National Albert at Brussels

By MARY L. JOBE AKELEY

On October 19, 1929, the Belgian Government officially opened the Parc National Albert, in the Belgian Congo, the plan for which originated with Carl Akeley of the American Museum. The following article, by the wife of this explorer and naturalist, tells in detail of the development of this important step in the conservation of African wild life.—THE EDITORS.

IN January, 1922, while homeward bound on the Red Sea, from his gorilla expedition in the Belgian Congo, Mr. Akeley's idea of a gorilla sanctuary took definite shape. He wrote to Judge Paul Salkin, Elisabethville, Katanga, Belgian Congo, that he had found the gorilla "a wholly acceptable citizen and not the wicked villain of popular belief"; that he is "a splendid animal in every sense, in no sense aggressive or inclined to look for trouble."

He also said that the largest male, a magnificent creature weighing 380 pounds, like all the others secured by the expedition, showed only a disposition to get out of danger. He stated that he was

communicating with the authorities at Brussels in regard to establishing a sanctuary for the gorillas of the Kivu country where they may have protection for all time. He then added: "If this is not done very soon, they are in positive danger of being exterminated. I do not think it is fair to future generations to exterminate an animal of such intense human interest as the gorilla. He is harmless; the natives of the region have no fear of him and he in no way interferes with them. He occupies a region that will never be available for agriculture or other human uses more than to supply forest products such as bamboo and fire wood, and the native privileges need not be curtailed by con-

verting a great tract of primitive country into a gorilla reserve. I not only want to establish a sanctuary, but also a biological survey station, where students of animal psychology and kindred subjects may carry on their research work under most advantageous conditions."

On January 18, 1923, Mr. Akeley compiled various suggestions regarding the establishing of a sanctuary for the gorillas, and submitted these to his esteemed friend, Dr. John C. Merriam, of the Carnegie Institution, Washington, dean of ardent conservationists and promoter of scientific research. He called attention to the fact that the number of gorillas in the Kivu region is small, which seems strange since, so far as we know, they have no enemy but man and the natives do not molest them; that they are healthy; that they are not wild, as was shown when three of them ran onto a leaning tree 150 feet away to get a better look at

him and were apparently unconcerned, though he was in full view operating a motion-picture camera. He recalled the fact that even with one of their number shot, they moved away only a short distance where they were easily approached again, and he stated that obviously it would be a very easy matter to exterminate this colony.

He suggested setting aside as an absolute sanctuary an area approximately ten miles square, where, when undisturbed, the gorillas would soon have complete confidence in man and would doubtless afford opportunity for observation and study at close range; and also that the area should be bounded by a native-police-patrolled roadway, a "dead line," within which the "gorillas would soon learn that they were safe, and beyond it in danger" and that there would be "no difficulty in keeping them within the sanctuary unless it became over-populated."



Photograph by Mary L. Jobs Akeley

THE PRIMITIVE FORESTS OF THE PARC NATIONAL ALBERT

This shows a section of the Rugeshi or Cold Forest on the slope of Mount Karisimbi



Photograph by Carl Akeley

A GROUP OF KIVU PYGMIES

The pygmy, doubtless the earliest of primitive peoples in the Kivu forest, dwells in the lower reaches of the volcanoes. The mature pygmy is approximately four and a half feet in height, and looks like a ten-year old child in contrast with the native Wahutu, who is only average height

the Belgian Consul-General at Baltimore, Mr. James Gustavus Whiteley, whose helpful interest for more than twenty years had furthered the scientific expeditions sent to the Congo by the American Museum of Natural History.

Among American organizations interested in the project were the Camp Fire Club of Michigan and the New York Zoological Society, both of whom in resolutions to Baron de Cartier expressed keen interest in the undertaking. The Department of the Interior of the United States also voiced its interest in a memorandum to the press.

On March 2, 1925, His Majesty, Albert, King of the Belgians, created by Royal Decree the Parc National Albert, Kivu District, Belgian Congo. A letter from His Excellency, Baron de Cartier, to Doctor Merriam, president of Carnegie Institution and vice-president of the National Academy of Sciences, supplies

the historical development of the Park at this point:

The advance of civilization into Central Africa has brought with it its inevitably attendant menace to primitive forms of wild life. This National Park has therefore been laid off, under the auspices of His Majesty King Albert, as a sanctuary where both animals and plants and natural scenery may be preserved and where scientists from all over the world may eventually come to study the flora and fauna of Africa in their original and natural surroundings.

During the past few years there has been an ever-increasing influx of big game hunters and natural scientists into the Belgian Colony which is the last refuge of many rare species of African fauna. The Belgian Government has recognized the necessity of permitting a certain number of such rare animals to be taken for scientific purposes, but has consistently endeavored to preserve these rare species and also to prevent the wanton destruction of other less rare, but harmless, animals, whose slaughter serves no useful purpose.

In these circumstances the Belgian Colonial Authorities have found it necessary to restrict not only private hunting expeditions but also similar expeditions contemplated by many of the



THE HEART OF THE PARC NATIONAL ALBERT-

This painting, by W. R. Leigh, was made under the direction of Carl Akeley, and is, in Mr. Akeley's own words, of "the most beautiful spot in the world"

most distinguished museums of natural history and other scientific bodies.

Among the rare animals which are in danger of extinction is the Gorilla—an animal of extreme interest to scientists. The Belgian Government has, in the past, felt it its duty to permit a few specimens to be killed or captured for strictly scientific purposes, but the time has come when, in the interests of humanity, as well as in the interests of Science itself, steps must be taken to preserve the remaining gorillas from extermination.

The reservation embraces the three volcanoes, Mt. Mikeno, Mt. Karisimbi and Mt. Bishoke.

In this Parc National Albert it is planned to erect a laboratory for biological studies where scientists from all parts of the world may eventually come and study the flora and fauna of the Belgian Congo as well as the geological and meteorological conditions.

In inaugurating this new experiment—the first of its kind in Central Africa—the King and his officials have studied the great American reservations and national parks and have sought the advice of eminent American scientists.

In order that the best results may be achieved it is hoped that this humanitarian and scientific

project may receive the sympathetic coöperation of the members of the National Academy of Sciences, and the benefit of their experience and wise counsel.

This letter was presented at the meeting of the National Academy of Sciences, in Washington on April 29, and a resolution was passed expressing the Academy's gratification at the establishment of the Albert National Park, and assuring His Majesty of its disposition to coöperate in the realization of the benefits to science and mankind arising from this wise and generous action.

Mr. Akeley's enthusiasm for the consummation of his dream and his appreciation of the action of His Majesty, the King, and the efforts of Baron de Cartier, are voiced in the following letter to the Belgian Ambassador:

May I offer to you hearty congratulations on the successful result of your work in connection with the campaign for the protection of the



THE SADDLE BETWEEN MOUNTS MIKENO AND KARISIMBI

In the distance, across the lava plains shown in these two pictures, may be seen the two active volcanoes, Nyiragongo and Nyamulagira. Lake Kivu lies at the extreme left

gorillas of the Kivu? May the Parc National Albert continue indefinitely to the honor of His Majesty, King Albert, and his Ministers, who have been instrumental in establishing this splendid wild life sanctuary.

Of course the killing of a reasonable number of specimens for scientific institutions is legitimate and necessary, but the indiscriminate killing by sportsmen and others is unpardonable. Killing gorillas cannot possibly be considered sport; the animals are easily located with the help of native guides in the regions they inhabit, easily approached, and easily killed. They are not wild in the sense that most hunted animals are wild.

They are not great wanderers. They are reluctant to leave the region in which they live, so it is possible, by following a band or a single animal, to come within shooting distance a number of times in one day.

Unfortunately there is a large class of men who for one reason or another, are constantly seeking excuses for killing. The gorilla, because of his unjust reputation for vicious ferocity, makes a strong appeal to the would-be hero type of sportsman, and the gorilla is menaced by the "white hunter" who would exploit him in catering to these "sportsmen" and for his own financial benefit.

It is possible that we "alarmists" who are interested in preventing the destruction of the gorilla have overstated our case and that there are more than one hundred gorillas in the forests of the three mountains now included in the Parc National Albert. *I hope there are more than one hundred*, but I doubt it. The point of paramount importance is that we "play safe," and that is the thing that is accomplished through the establishment of the Parc National Albert. If in the future it is found that there are, for any reason, too many gorillas, it will be very simple to reduce their numbers; while, on the other hand, if we were some day suddenly brought face to face with the fact that the last gorilla had been killed, it would be a very different story.

In reply to Baron de Cartier's request for Mr. Akeley's suggestions in relation to the enlargement of the Parc National Albert, he wrote the Ambassador "that there is much of this region that might well be included—the southern end of Lake Edward with its wonderful herds of hippopotami; the Ruindi plains with their lions and their great herds of

antelope of several species; the forests of the Ruindi valley—the haunt of elephant and buffalo—not much more than a graveyard now, but the game would come back if given sanctuary there; the slopes of the volcanoes Nyamlagira and Nyiragongo, of little use except as a reserve for game and for its scenic interest; Lake Bulera, to the east of the Parc—one of the most beautiful of all the small lakes of the region. All these are worthy of being included in the Parc National Albert.”

To Baron de Cartier on the same day he also wrote asking for permission to return to the Belgian Congo to obtain the accessories and painted background for his Gorilla Group, and stating that he had delayed asking permission to do this work pending the establishment of the Gorilla Sanctuary. On this expedition he wished to take with him two scientists, one of whom should be a Belgian, to carry on preliminary studies of the live gorilla.

“I have definite, and I trust good, reasons for wishing to be of the party making the *initial studies* of the gorilla when first approached by man as a friend instead of as an enemy,” he wrote. “It is of great importance that these first observations be carefully made and recorded; that the process of ‘taming’ and making the acquaintance of them be done intelligently, taking every precaution against accidents such as might result in injury to one of the party or unnecessary shooting of a gorilla because of injudicious approach.”

It may be stated here that back in 1921 the officials of the Belgian Government kindly gave Mr. Akeley permission to obtain ten gorillas. He took only five, feeling that this number of specimens was ample for a group that would tell a true story of the gorilla.

In February, 1926, in Brussels, while en route to Africa, we were entrusted with the Mission to the Kivu, which empow-

ered us to execute a general survey of the National Park; to fix on the map native villages, position of forests, bare rocky country, grass lands, cultivated land and pasture, and areas inhabited by gorillas and chimpanzees; to estimate the number of these animals; to study methods of preservation of the fauna, especially the gorillas; and to select suitable sites favorably located and naturally endowed for laboratories and residences for park conservators and visiting scientists.

Later Dr. J. M. Derscheid, of Brussels, research zoölogist, conservationist, and cartographer, joined our 1926 expedition to the Kivu to assist in this survey. After Mr. Akeley's death, Doctor Derscheid's presence made it possible for the expedition to fulfill the mission of the Belgian Government.

In April, 1927, President Henry Fairfield Osborn, who from the beginning was in warm sympathy with the idea of gorilla protection and deeply interested in this rare spot so rich in its possibilities for scientific investigation, received from the Belgian Government a letter inviting the American Museum of Natural History to participate in plans for scientific development and research in the Kivu region. To this he replied that the “American Museum is keenly interested in this great movement.”

In further response, a unanimous resolution of the trustees of the American Museum of Natural History expressed their appreciation of the action of His Majesty and their willingness to coöperate in carrying out plans for scientific development of research in this area.

It was in June, 1927, that Derscheid returned to Belgium, and during a year of military service, prepared an initial report on his gorilla findings and also did yeoman service in the correcting and amplifying of the maps of the region between Lake Kivu and Lake Edward. In September and October, 1928, I spent four



Photograph by Carl Akeley

A VIEW IN THE PARC NATIONAL ALBERT

Here, following Carl Akeley's death, his widow, Mary L. Jobe Akeley, obtained the background and accessories for his Gorilla Group. The horizontal branch in the foreground bears a great platform or cushion of green and golden moss. Frequently giant lobelias and orchids, flowering in tall red and pink racemes, are rooted in these mossy platforms

weeks in the home of Doctor Derscheid collaborating on the preparation of the First Memorandum for the Belgian Government concerning the Parc National Albert.

Our memorandum proposed that the limits of the Park be extended to include the arid active volcanoes of Nyamlagira and Nyiragongo, which are of geologic, volcanologic, meteorologic, and seismologic importance, and also the swamp and sandy lands along the south shore of Lake Edward and the Rutshuru River, in and about which are large herds of hippo and a fair number of antelope. It was further proposed that certain outlying regions of the park be contracted in order to exclude native villages and arable land. Such arrangement would increase the area from 24,000 hectares (the original area set aside) to 200,000 hectares (500,000 acres).

An important section from our plan follows:

We consider the Parc National Albert a Royal Institution, remembering that His Majesty has shown the deepest interest from its creation to the present time. The first words of the Royal Decree give us the essential character and the true meaning of such an undertaking: '*Le Parc est créé dans un but scientifique.*' Since the promotion of science is the definite and final goal, not only for today, but also for the benefit of future generations, we wish to emphasize most strongly the necessity of preserving in the park all wild and natural conditions as they now exist.

The richness and exceptional variety of flora and fauna of this region, its extraordinary geological and geographic interest, as well as an almost unique opportunity of saving some of the primitive African pygmies, a race now threatened by extinction, are the chief reasons for demanding that this area should remain inviolate.

Furthermore, on account of the different altitudes—ranging from 2,500 feet to more than 14,000 feet—nearly all kinds of vegetation, from the palm-fringed equatorial rivers to the flower-filled alpine meadows under the snow-



"THE CASTLE"

Photograph by Mary L. Jobe Akceley

The culminating peak of Mount Mikenno, viewed from south of the Saddle Camp at Kabara

capped peaks, are to be found, with a corresponding variety of animal life, thus affording a wonderful opportunity for endless scientific investigation in a rather small area of comparatively easy access.¹ In the proposed area half is mountainous, the other half consists of the sand and swamp lands of Lake Edward.

It is believed also that the region is of practically no economic value, which eliminates conflict between the material development of the country and the interests of science. Furthermore, except for the pygmies who should be left undisturbed in their ancestral way of living because they are few and of slight menace to any living species, the areas are uninhabited.

The memorandum further includes questions of ownership, native rights, jurisdiction, etc.

As a final matter, the question of scientific research is dealt with. It provides for a central station at Rutshuru for the administration of the park and to serve as a permanent base for scientific research; for the use of certain vacant

colonial buildings as a warden's office and domicile, and for the construction of others for the essential use of scientists and desirable visitors. Well equipped laboratories, an adequate scientific library, a small local study museum of geological, botanical, and zoological collections should be established in order to facilitate research.

It suggests also that "small ranger stations be located in places of strategic importance and rich in opportunity for accomplishing a serious survey of the Park, the first being located on the middle slopes of the north side of Mount Kari-simbi on the shore of the small Lake Rukumi, discovered by Derscheid in 1926 near tree line. This pond is above the region of heavy cloud and abounds in the most interesting animal species—gorilla, buffalo, elephant, leopard, hyrax, ante-lope, squirrel, sunbirds, plaitain eaters, et cetera."

¹The main motor highway from Redjaf to Kisenyi, which is now nearing completion, will run through the Parc National Albert.

In conclusion, the memorandum states that "in view of the determination of the Belgian Government to support the park, which is a region of international scientific importance, and because it seems wise to secure competent direction by men perfectly aware of the needs of scientific research and nature conservation and who have had experience in such matters, it appears wholly desirable to place the management of the park in the hands of a Belgian scientific institution which is so favorably situated as to obtain financial and scientific help both in Belgium and in foreign countries."

This memorandum approved by His Highness, Prince Albert de Ligne, and His Excellency, Baron de Cartier, was submitted to His Majesty, Albert, King of the Belgians, on October 8, 1928, by Prince Albert de Ligne. The following evening His Majesty and Their Royal Highnesses, the Duke and Duchess of Brabant, received in the Palace at Brussels the Belgian Ambassador to the United States and Princess de Ligne, the American Ambassador to Belgium, and Mrs. Hugh Gibson, the Prime Minister and Minister of the Colonies, M. Henri Jaspar and Mme. Jaspar, M. and Mme. Franqui, and other friends of science, as well as Doctor and Mme. Derscheid, and myself. There, throughout a long and intensely interesting evening, the project of the park was discussed.

Derscheid gave an ac-

count of the findings of the Akeley-Derscheid Expedition and projected photographs of the Kivu. I had taken with me to Brussels the gorilla film which Mr. Akeley had made in the Kivu, and this we showed to His Majesty and Their Highnesses.

A few days after our evening at the Palace in Brussels, Derscheid and I described the gorilla country, the plans for conservation, and also our scheme for scientific research therein before the Society for the Preservation of the Fauna of the Empire at the Zoölogical Society in London. At the December meeting of this society Baron de Cartier introduced



Photograph by Mary L. Jobe Akeley

M'GURU, GORILLA GUIDE

He is perched in a moss-covered tree, which was brought to America by Mrs. Akeley as an accessory for the Gorilla Group for the Akeley African Hall

Mr. Akeley's gorilla film and Derscheid again spoke, both expressing the earnest hope that the British Government may make absolute sanctuary of the Uganda side of the gorilla volcanoes.

Inasmuch as the boundary between the Belgian and British volcanoes is not an impassable natural barrier, it is easy for gorillas to range from one side to the other as they undoubtedly do. To have complete protection on the British side would be an unquestionable guarantee that the Belgian gorillas would have absolute sanctuary. Mr. C. W. Hobley, acting as Secretary of the Society for the Preservation of the Fauna of the Empire, wrote me on June 20, 1929, that the society had this matter in hand, and that the Zoölogical Society of London was supporting the proposal and had taken the matter up independently with the Government.

Throughout the fall and winter months of 1928-29 Prince Albert de Ligne has been untiring in his efforts to push to completion the satisfactory organization of the Park to the end that scientific work be begun and also that the always necessary financial support be secured. Likewise Dr. John C. Merriam, in a letter to me on March 30, 1929, expressed his continued interest:

The Parc National Albert project is to me one of the most interesting and important plans of this nature being studied in the world at the present time and I am extremely desirous of seeing it reach the very high level of effectiveness which I know is desired by all concerned.

As an outgrowth of this keen interest, in the late spring of 1929 a joint expedition to the Parc National Albert was proposed by the Carnegie Institution and Yale University. Permission for the undertaking was received from the Belgian Government through Prince de Ligne. The expedition started for Africa in June, under the direction of Dr. Harold C. Bingham, associate of Dr. Robert M. Yerkes in the Institute of Psychology at

Yale, to conduct a psychological investigation of the habits and behavior of the mountain gorilla in the Kivu sanctuary.

Another expedition, sent out jointly by Columbia University and the American Museum of Natural History for scientific investigation in both the Belgian and French Congo, entered Africa in July, 1929. It is in charge of Henry C. Raven, associate curator of the department of comparative anatomy in the American Museum. The other members are Dr. William K. Gregory, curator of the department of anatomy in the American Museum, professor of vertebrate paleontology at Columbia University, and author of works bearing on the evolution of man; Dr. J. H. McGregor, professor of zoölogy at Columbia University, and an authority on the anatomy of the anthropoid apes and man; and Dr. E. T. Engle of the department of anatomy at the College of Physicians and Surgeons, Columbia University, and a specialist in endocrinology and physiology. Their object is to trace the source of functional disorders common to both gorilla and man, with a view to alleviating the sufferings of man. These scientists also expect to visit the Parc National Albert to observe the gorilla in his wild state and to study the gorilla's relationship to man. That the findings of both expeditions will be of rare significance is without question.

The crowning achievement in the history of the organization of the Parc National Albert is The Royal Decree signed May 6, 1929, which was confirmed by the Colonial Council and re-confirmed by King Albert in June, 1929. *King Albert has by this act created a corporate body in the Belgian Congo and in the mandated territory of Ruanda-Urundi for preservation of fauna and for strictly scientific purposes.*

The park has been greatly enlarged by this act and now consists of 500,000 acres



THE HOME OF THE GORILLA

Photograph by Mary L. Jobe Akeley

Looking across the jungle-clad lower slopes of Mt. Mikeno to the lava plains below

and comprises four Reserves, or Sectors, lying in the Kivu District, in proximity to one another. Within these Reserves it is forbidden, under penalty of penal servitude or fine, or both, (1) *to pursue, capture, kill, or molest in any way, any kind of wild animal, including animals which are reputed dangerous or harmful*, (2) to take or destroy the eggs or nests of wild birds, (3) to cut down, destroy, or remove any uncultivated plant, or (4) to make any excavation, embankment, boring, or any operation of a nature to change the aspect of the ground or of the vegetation.

Unless provided with a special permit, no one (except officials and others properly qualified) may enter the Parc National Albert, or circulate, camp or sojourn therein, or introduce dogs, traps, or firearms, or possess or transport or export skins or other parts of wild animals or uncultivated vegetable products.

As the four Reserves, or Sectors, of the Parc National Albert include certain tracts of land now occupied by natives or previously granted to private persons or companies, provision is made for the expropriation of these tracts, if found proper and desirable. and it is further provided that even on these tracts under private or native occupation, *the destruction, capture or pursuit of the gorilla, as well as all forms of hunting this animal, are absolutely forbidden.*

To the four Reserves, or Sectors, of the park proper, there are added certain adjacent territories, under less severe restrictions, to serve as protecting zones to the Reserves. These protecting zones are sparsely inhabited by natives. In these zones, hunting, fishing, and, cutting down trees are prohibited, except that the few natives now living there will be permitted to exercise their customary rights which

they now enjoy but only with the primitive weapons which they still use.

The Belgian Colonial Government undertakes to create and maintain, at its own expense, a corps of conservators and a corps of native police, and to pay the strictly administrative expenses of the park. The Parc National Albert is to be administered by a Commission ("*Commission du Parc National Albert*") and by a Committee of Direction.

The *Commission du Parc National Albert* will consist of not less than eighteen members; one-third, including the President, to be appointed by the King; another third to be selected by the King from nominations made by Belgian scientific institutions; and another third to be chosen from among members of foreign scientific institutions.

In addition to its administrative functions, the Commission is authorized, subject to the approval of the King, to accept gifts, legacies, and other donations which may be contributed to further the scientific purposes of the Parc National Albert.

King Albert has already appointed Dr. John C. Merriam and Dr. Henry Fairfield Osborn as members of this commission. This act of the Belgian Government stands as an epochal opportunity for science. Both broad-mindedness and liberality are shown in their willingness to have foreign scientists share in the administering board. It points to that long-hoped-for internationalism in conservation and in science and to a widening interest in protection throughout all Africa.



A NATIVE IN
A GORILLA NEST

Photograph by Mary L. Jobe Akeley



A saw-belly has become firmly lodged in the widely distended jaws of a lake trout

VORACITY IN FISHES

How Fishes, in Their Search for Food, Occasionally Choke on Finny Prey
Too Large to Be Engulfed

By E. W. GUDGER

Bibliographer and Associate in Ichthyology, American Museum of Natural History

WE are all acquainted with the semi-classical allusion to the engineer who was "hoist by his own petard," and with the very unclassical allusion to the boy who "bit off more than he could chew," but that such a fate could happen to a fish is at least unusual. So unusual is this in the experience of even those who have to do with fishes that it seems well worth while to set forth the facts about the fishes pictured above, and also to bring together as a background the few scattered instances and figures of like occurrences known to the writer.

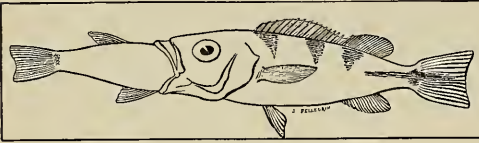
Carnivorous fishes, while not averse to other animal food, find their chief alimentation in their finny fellows. It is interesting to note what large specimens are swallowed, compared with the size of the aggressor and the capacity of its stomach. At Tortugas, Florida, I once dissected a

22-inch red grouper (*Epinephelus morio*), which had in its 8-inch stomach an 11½-inch snapper, 3½ inches of whose tail protruded from the oesophagus into the mouth of the grouper.

The fishes pictured in the headpiece of this article are a lake trout (*Cristivomer namaycush*) which attempted to swallow a saw-belly (*Pomolobus pseudoharengus*) with dire results to both. These fishes were picked up on the shore of Lake Keuka, in New York State, about 10 A.M. on August 2, 1929, by Arthur A. Jansson, Jr. and by him presented to the department of ichthyology of the American Museum. Both fishes were dead when found, but were still limp. Possibly their mutual decease had occurred that morning, certainly not earlier than the night before.

There is nothing unusual in the attempt of the trout to swallow the saw-belly,

since small specimens of the latter are the favorite bait used by trout anglers on this lake. The unusual thing is that the trout (8¼ inches long over all) attempted to swallow a saw-belly (5 inches long and 1 inch deep) which was too large for his capacity. The trout could not work his



AN UNTIMELY FATE

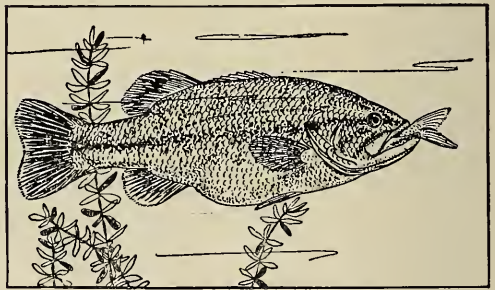
This greedy young Cichlid attempted to swallow a fish almost its own size. After Pellegrin, 1903

(relatively) large prey down into a stomach too small to contain it, nor could he disgorge his capture. The head and foreparts of the saw-belly (measuring 1¾ inches) fitted very accurately into the mouth and pharynx of the trout and distended its jaws so widely that the teeth caught in the dorsal and ventral surfaces of the body of its prey and held it fast. However, another factor in retention is found in the peculiar structure of the body of the saw-belly which gives it its name. The body of this fish is shaped like a capital V, the two sides of the abdomen coming together in a sharp angle on the midventral line with the scales so set as to give this line the appearance and feel of a saw with the teeth pointing backward. These teeth catching inside the anterior angle or "point of the jaw" of the trout made it impossible for it to disgorge its prey. With a glass one may note in the drawing the sawlike edge of the ventral surface of the fish.

Since the fishes were bent to get them into the container in which they were brought to the Museum and since they have become hardened in the preservative, it is impossible to photograph them in lateral view. The spirited sketch at the head of this article was made by Arthur A. Jansson, Sr.

Undoubtedly there are to be found, especially in sporting journals and in books on angling, accounts of such happenings. Few, however, have come to hand, but these will be of interest as a background to the accident described above. The first is by the distinguished French ichthyologist, Jacques Pellegrin, who has figured such an incident on page 130 of his memoir on the Cichlidæ (fresh-water perch-like fishes found mainly in Africa and South America (*Memoires Société Zoologique de France*, 1903, tome XVI). This figure, which is reproduced on this page, shows a young Cichlid only 45 mm. (1¾ inches) long, attempting to swallow a fish but little smaller than itself.

Among our North American carnivorous fishes, the black bass (especially the large-mouthed form, *Micropterus salmoides*) is particularly voracious. That this voracity begins early in life is revealed in notes on the rearing of this fish by Leon J. Pray, published in *Aquatic Life* (1918, Vol. IV, pp. 77-79). He found that his baby bass early developed cannibalistic characteristics. "The larger and stronger ones quickly swallowed the smaller, afterwards going slowly about with



A CANNIBALISTIC BASS

The tail fin of its twin brother projecting from its mouth revealed the voracious appetite of this baby black bass. After Pray, 1918

the tail fins of their brothers and sisters protruding from their mouths"—as may be seen in the figure at the bottom of this page reproduced from his sketch of



Courtesy of Field and Stream

CHOKED BY ITS PREY

A 44-pound striped bass which met with disaster when it attempted to swallow a 2-pound carp

one specimen. This kept on until only two were left, and inspection of the aquarium one morning showed but one fish. However, the aldermanic outline of the survivor and the caudal fin of his twin brother projecting from his mouth told the tale of the nocturnal tragedy.

This little bass was then supplied with small live minnows on which he fed regularly twice a day—in mid fore- and afternoon—consuming 160 before attaining an age of three months and a length of slightly under three inches. He would catch his prey midwise, deftly shift it about until he had it “head on,” when it would be quickly engulfed. But “Nearly always the tail of the minnow protruded from his mouth for two or three hours afterward.” However, as the minnows were small and the mouth and gullet of the little bass relatively large, this impetuous feeding was carried on without such a fatality as has been depicted in this article.

Of a related form, the fresh-water perch (*Perca fluviatilis*), H. Cholmondeley-

Pennell writes in his interesting book *The Angler-Naturalist* (London, 1863, p. 60), that when a perch has filled its stomach to repletion with minnows, it will still endeavor to catch others, and that “it is by no means uncommon under these circumstances to capture a Perch with the tails of the minnows, which he has already partially swallowed and been unable to pouch, protruding from his gullet.”

Corroboratory of this, C. M. Breder, Jr., of the New York Aquarium, tells me that he once found in a stream in New Jersey a black bass about 5 inches long, which had been killed in trying to swallow another bass about 3 inches long—the posterior third of the smaller fish protruding from the mouth of the larger.

A similar fate overtook a striped bass (a related marine form which ascends rivers for some distance) found in the San Joaquin River district, California. This fish's photograph was published on page 78 of *Field and Stream*, New York, for December, 1928, and is reproduced on this page. No explanation or account of

it is given other than the caption, which says "This 44-pound striped bass met with disaster when he attempted to swallow a 2-pound carp"—the tail of which protruded from his mouth. Whether the bass was choked to death, or whether it was caught in a net before the swallowing process was over, cannot be said.

The most ravenous fishes found in the fresh waters of Europe and North America are the pikes, members of the family Esocidæ. Definite accounts of mishaps among pikes, similar to those shown on pages 553, 555, are known. First of all to be quoted is E. J. Stanley, who, writing in *The Zoologist* (1845, Vol. III, page 1039), says that, once when walking by a piece of water, he heard a commotion, and coming nearer he "found two pike, of about a pound each, the head of one being entirely within the other's mouth, the snout coming out at the gills of the fish that was holding it." Stanley was able to catch these two fish since "they seemed nearly exhausted with their exertions"—a thing at which one can hardly be surprised.

A similar and equally well authenticated account is narrated by Sir Herbert Maxwell in his *British Fresh-water Fishes* (London, 1904, p. 169). In 1870 two fishermen on Loch Tay, Scotland, noticing a disturbance in the water, rowed to the spot and found two fish apparently fighting. When gaffed and pulled on board they proved to be a pair of pike weighing 19 pounds and nearly of the same size. "The head of one was firmly fixed as far as the pectoral fins within the jaws and gullet of the other."

Of the voracity of the pike and the rapidity of its digestion, Cholmondeley-Pennell gives many instances in the book previously referred to. Of these the one on page 197 is to the point. A pike, lying in a semi-torpid condition among some water weeds, was easily caught and brought ashore. The explanation of this behavior was then found in the presence

of a large eel stuck in the pike's throat, the head parts of which had been swallowed and partly digested, while the tail protruded out in the water.

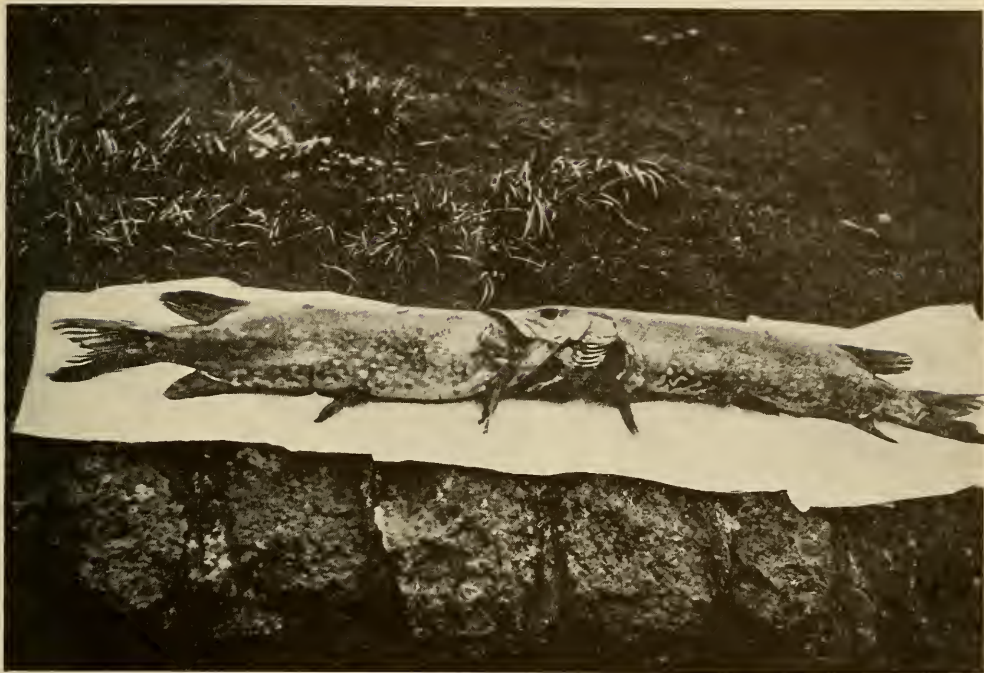
This particular matter of digestion of the head end of the prey also is corroborated by Mr. Breder's repeated observations on the fishes in the New York Aquarium. Specifically he tells of a 5-foot sand shark which captured and partially swallowed a dogfish about half its length—leaving about 10 inches of the dogfish's tail projecting beyond its jaws. For about two and one half days it swam around in the large aquarium with the tail of its prey waving in the water, until as a result of the progressive digestion of the anterior parts, the tail was slowly taken in.

Illustrative not merely of the voracity but of the cannibalistic proclivities of the pike, Cholmondeley-Pennell relates (page 198) that, on a line set overnight in the River Avon, a large and heavy pike was found. In order to get out the hook, the fish was opened and in it was found another and smaller pike with the line proceeding from its mouth. Dissection of pike number 2 revealed in its stomach a still smaller pike, number 3, the original taker of the bait. Surely this is the champion "fish story" illustrative of voracity in fishes.

Anent the matter under discussion, Jonathan Couch writes (*British Fishes*, 1869, Vol. IV, p. 152):

It [the pike] has been known on some occasions to seize and devour one of its own species almost as large as itself. When this occurs, however, the whole body of the prey cannot be received at once into the stomach; and the devourer has been seen with the tail and a portion of its victim protruding from its mouth, until by a dissolution of a part there is room afforded for the remaining portion to be in turn subjected to the power of digestion.

Not all the cannibals of the genus *Esox* are so fortunate in their attacks on their fellows. C. Tate Regan, the director of the British Museum, relates (*British*



A DUEL TO THE DEATH

Courtesy of *Field and Stream*

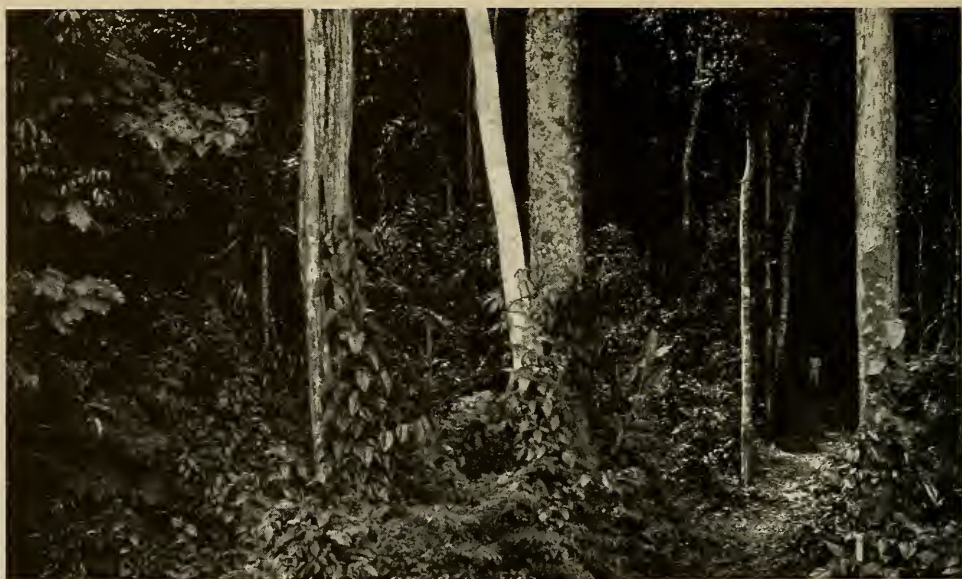
Mutual destruction of two pikes in White Loch, Scotland

Freshwater Fishes, 1911, page 145) that in one season two pikes, weighing 35 and 29 pounds respectively, were found floating dead on a lake in Dorsetshire. Each had tried vainly to swallow a fish about one third of its own size, a pike in one case and a carp in another, and each had perished miserably.

Unfortunately illustrations are lacking in the accounts just quoted, but I am pleased now to present ocular evidence of cannibalism in pikes in the form of a photograph kindly lent me by Mr. Ray Schrenkeisen, associate editor of *Field and Stream*, New York. These fish were photographed at White Loch, Monreith, Scotland, whence they were taken. This photograph was reproduced on page 78 of *Field and Stream* of December, 1928, but no data are given other than that one fish weighed 7 and the other 8 pounds. (From this one may conjecture that, as in the case of my fishes, it was possible to separate them after death). Evidently the larger

fish got the head of the smaller fish in his mouth, where the gill covers of the latter stuck in the gill arches of the former, causing a great distension of the mouth and gill covers of the aggressor as may be seen in the figure. The two fishes, being unable to get free from each other, either died a slow and painful death (let us recall here the stories of deer with interlocked horns) or possibly before this were so weakened that they were easily caught.

A possible explanation of how this state of affairs comes about is to be found in an incident related by Cholmondeley-Pennell in the book (page 214) previously quoted. Two pike were kept in a glass aquarium. When a bit of food was thrown in this about midway between them, they simultaneously dashed at it, with the singular result that the head of the smaller fish penetrated the open mouth of the larger, where it was so firmly fixed that it was some time before the two fish freed themselves from their unfortunate predicament.



At the entrance to the forest.—The figure on the trail stands at the viewpoint of the habitat group of Barro Colorado in the American Museum

AIR CASTLES IN THE TROPICS¹

A Review of "My Tropical Air Castle," Dr. Frank M. Chapman's New Book on Barro Colorado Island

BY FRANK E. LUTZ

Curator of Insect Life, American Museum

AIR Castles in the Tropics—at least the one which Doctor Chapman calls his own—are most interesting and seem to be filled with scientific realities surpassing mere dreams. He calls it his own, but, with the generosity of a scientist, he invites us to share his dream-come-true and, with the skill of an experienced writer, he makes us feel at home. There are few who have seen more of the American Tropics than he has or who are as well qualified to speak of its natural history.

What, then, is this Barro Colorado and why has it become the site of the castle? A brief notice of Doctor Chapman's book can certainly not fully answer these questions, and even the book itself, devoted as it is to the answering of them and full of

charming detail, rightly leaves the reader with an impression that the half has not been told.

Barro Colorado, speaking geographically, was a mountain in the valley of the Chagres in Panama. With the damming of that river to make the Panama Canal, Barro Colorado became an island in Gatun Lake. Speaking biologically, it is a typical example of a tropical forest, and it is now surrounded by a protecting barrier of water. Administratively, it is further protected by a governmental proclamation which has placed it in charge of a committee of the National Research Council to be used as a center for the investigation of tropical biology.

The American Museum's first contact with Barro Colorado was when one of our

¹*My Tropical Air Castle*. By Dr. Frank M. Chapman. xvi 417 pp. 29 text figures; 47 plates. D. Appleton and Co., N. Y. City.

entomologists hunting stingless bees camped on the site of the present laboratory and cut the first trail through the forest. Now "there are nearly twenty miles of these pathways and not one tree of size was felled in their construction. They are cross-sections through the life of the forest, and afford unending possibilities for intimate views of beast or bird and the forest itself. One may follow them almost as noiselessly as he glides along the shore in a cayuca. Instead of being an enmeshed, perspiring, vituperative creature he now feels more a part of the fauna."

One of the book's illustrations reproduced here gives a daylight glimpse from the laboratory clearing of a main trail, and the other photograph is a flashlight portrait of a puma made on a near-by path with the unintentional coöperation of the photographed. In fact, a novel and very

acceptable part of the book's numerous illustrations is a series of such auto-portraits in connection with a chapter on "Who Treads Our Trails?"

The American Museum's second contact with Barro Colorado and Doctor Chapman's discovery of his long-sought Air Castle was his expedition to make studies for the habitat group of tropical American forest birds now on exhibition here. Since then we have come to look upon the Barro Colorado laboratory as a regular part of our Museum activities. So, this book is by way of being an American Museum report, but it is a very readable report that will appeal to all who are interested in tropical natural history—"beast or bird and the forest itself"—described by one who knows and who does not hesitate to season his descriptions with humor and human feeling.



A PUMA PHOTOGRAPHS HIMSELF

Note the broken wire which was connected with the camera. The presence of this species, tapirs, and other large animals on Barro Colorado is an indication of the primeval character of its fauna



A restoration model of the Miocene camel group, made by Louise Waller Germann under the direction of Barnum Brown

A MIOCENE CAMEL BED-GROUND

A Recently Installed Exhibit at the American Museum, Showing a Phase in the Lives of the Now Extinct Camels that Originally Ranged the Grassy Plains of Western Nebraska

By BARNUM BROWN

Curator of Fossil Reptiles, American Museum

SINGLE skeletons of prehistoric animals are not uncommon, but to find a herd, dozens of which are complete, entombed at one place, is a rare occurrence. Such was the find near Agate Spring in Western Nebraska, where nearly a hundred skeletons of the little camel *Stenomylus hitchcocki* were found close together.

This remarkable deposit was discovered by Dr. F. B. Loomis, of Amherst College, in 1907. In 1908 he excavated twenty-one skeletons there for Amherst College, and several other institutions shared in the find. Yale University secured three skeletons, and the Carnegie Museum, in 1908 and 1909, about thirty skeletons.

In 1908 Mr. Albert Thomson collected nine skeletons from the same deposit for the American Museum of Natural History. It is this group of nine skeletons that recently has been mounted, and displayed with models, five in characteristic, life-like camel attitudes, four lying in the original matrix as found.

Judging from the number of skeletons buried in this quarry and their rarity elsewhere, we suppose that *Stenomylus* was in habits similar to the guanaco of South America.

The guanaco feed over the pampas singly and in small groups during the summer but, as winter approaches, they band together in great herds of thousands. During severe winter weather in Patagonia, the writer has seen a herd of five thousand bedded close together like sheep. When they arose from the bed-ground in the morning, a hundred bodies remained dead of starvation and winter kill.

Our mounted group recalls such a morning scene; a section of the bed-ground from which most of the living have departed. A few stragglers remain, the largest presumably a male. A mother stands close to her young which lies, like all camels, with legs folded, the front feet palms up—the hind feet with palms down. Another is rising, in which movement the hind feet are first straightened, the

forward part of the body resting on the elbows; with a spring the animal comes up on all fours.

It was similar bed-grounds that Charles Darwin observed on the pampas during his summer's visit to South America, described in the *Naturalist's Voyage Round the World*, but as the guanaco were then feeding singly and in small groups, he thought it was their habit to go to certain places to die.

Like the guanaco, most of the *Stenomylus* skeletons were close together, with bones articulated and heads drawn back, although some of the bodies had been mutilated and torn apart by carnivorous animals. Later these bodies were covered first by wind-blown sands and later by river drift.

The camel family originated in North

America and flourished here until near the close of the Pleistocene period, when they, like the horses, died out before the coming of the white man.

The family is now represented by the genus *Camelus* of which there are two species; in North Africa and Arabia, the Arabian camel with one hump, and in Central Asia the Bactrian with two humps. The true camels are distinguished by these humps, which are in reality huge masses of fat that serve as a reserve store of food. A closely related genus is the *Auchenia* of South America, of which there are two wild species, the guanaco and the smaller vicuna. The llama and alpaca, beasts of burden, are regarded as domesticated varieties of the two wild species.

The South American camels are grass grazers and in habits very different from



EARLY MORNING

Miocene camels (*Stenomylus hitchcocki*) leaving a bed-ground. The herd leaves behind it each morning those of its numbers that have succumbed to starvation, old age, or inclement weather. From a painting based on the group, by Mrs. E. Rungius Fulda



QUARRY WHERE THE CAMEL SKELETONS WERE FOUND

Scene of the American Museum's operations in 1908, five miles southeast of Agate Spring, Sioux County, Nebraska

Asiatic and Arabian camels, so important to the inhabitants of those countries. No desert traveler equipped with a well organized camel caravan could fail to respect this interesting animal. Sometimes called stupid; often complaining, but never failing. His wants are few and his burdens many.

With Arab drivers who know their camels, a white tent village will literally melt away and the long caravan be on the march with scarcely a sound. But with Somali drivers and the same camels, to break camp is confusion confounded.

The Arabian camel never falters; over blistering, slithering sand, or jagged lava flow, his footfalls are as regular as heartbeats, and after the long day's march, with burdens removed, he ambles away, never seeing the grass he tramples, to carefully choose his thorny titbits, from mimosa or acacia trees. Truly he is a marvelous beast.

Next to the horses, the camels furnish

the most striking and best known series illustrating the evolution of a race of mammals. They passed through nearly the whole of their development in North America and did not migrate to other continents until the late Miocene or Early Pliocene.

Camels appear first in the Eocene as very small animals with four complete toes on each foot; the neck and limbs of only moderate length. Probably, like other races, they were descended from a five-toed animal, but this initial ancestor has not yet been discovered. *Protylopus*, one of the first genera known, is probably not in direct line of descent, but it nearly represents the proper ancestral stage. It was an animal scarcely larger than a jack rabbit.

In each succeeding epoch we find the race increasing in size and gradually losing its side toes, which become slender, then the tips of the toes disappear leaving only splint-bones, then the splint-bones

are reduced to small nodules and finally disappear completely. The two central toes are at first entirely separate, but their upper bones become consolidated into a "cannon-bone." The toes at first had small sharp hoofs like those of deer or antelopes, but gradually a large, soft, elastic fibrous pad was formed, which enables the animal to walk on soft, shifting desert sands or equally well on the sharp irregular surfaces of lava fields.

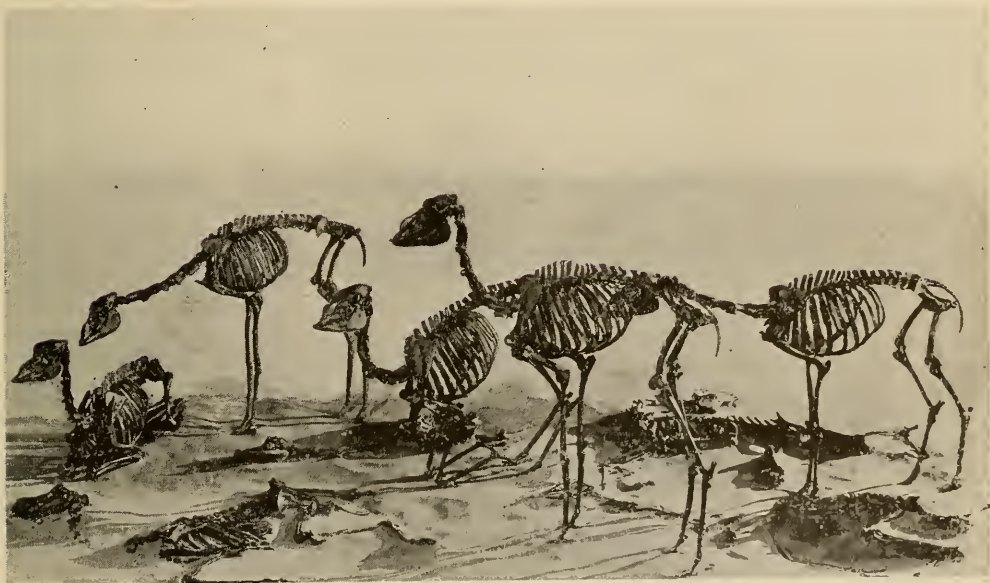
The teeth in the earliest camels are of primitive pattern, adapted to an omnivorous diet; but they gradually become fitted for browsing with grinding teeth of four crescentic ridges. The premolar teeth become dwarfed and disappear; so do the upper incisor teeth, the lower incisors being pressed against a flexible upper lip to nip off the leaves or grasses.

During the Miocene, the period in which our little *Stenomylus* lived, the family became diverse in size and is represented by several genera and many species. *Stenomylus* lived during Lower Miocene

times, and its race apparently had a brief career—disappearing in the Lower Miocene. It was an upland feeder, unique among camels in having the first premolars and canines developed like incisors; a modification that doubtless related to its feeding habits. *Oxydactylus*, a contemporary of *Stenomylus*, was a more hardy type and precursor of the "giraffe-camels."

Camels reached their maximum size and abundance in the Pliocene Epoch. In the Lower Pliocene the two modern phyla had separated, and there was a third now extinct—a very long-legged, long-necked group, the "giraffe-camels" whose appearance and habits probably were much like the giraffe.

At this time camels were the most numerous of all the large animals of the plains, and some were of gigantic size, one species discovered in Arizona in 1928 being a third larger than the largest living camel. They ranged all over North America, and the uniting of this continent with



THE GROUP OF MIOCENE CAMEL SKELETONS

(*Stenomylus hutchcocki*)

Five of the skeletons in the group are mounted in characteristic camel attitudes, and four others are lying in the original matrix as found. Mounted by Charles J. Lang



GENERAL VIEW OF *STENOMYLUS* REGION

It was here in 1907 that Dr. F. B. Loomis of Amherst College made the remarkable find of nearly 100 skeletons of *Stenomylus hitchcocki*, and in 1908 Albert Thomson collected nine skeletons for the American Museum, which have been mounted and are now on display with restoration models

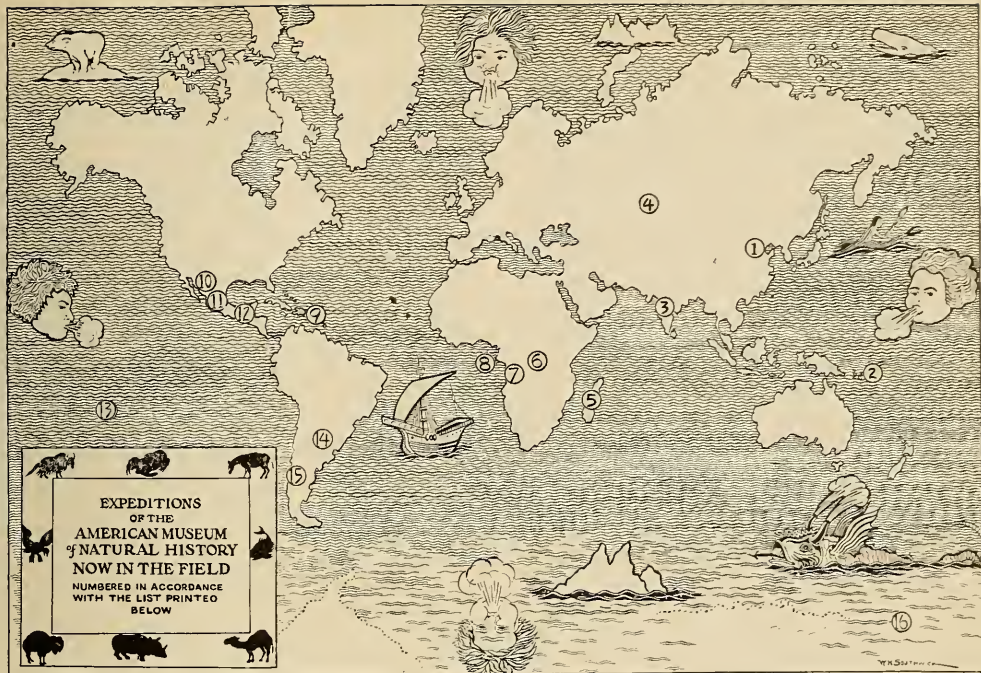
South America and Asia enabled them to spread over the greater part of the Old World and most of South America. Since that epoch they have declined in numbers and their range has become more restricted.

The camel has entirely disappeared

from North America where it originated and reached its maximum size. In short, the race is becoming extinct, to be replaced by the higher ruminants (antelopes, sheep, and cattle) which are now at the zenith of their prosperity.



AMHERST HILL AND
Stenomylus QUARRY



1. Central Asiatic; 2. Whitney South Sea, Solomon Islands, for birds; 3. Vernay-Faunthorpe for Asiatic Mammals; 4. Morden-Graves, Turkestan, for mammals; 5. Madagascar, for birds, mammals, and fossils; 6. Tanganyika, for birds and mammals; 7. Columbia University-American Museum, to Africa for anatomical study; 8. Thorne-Correia, Gulf of Guinea, for birds; 9. Heilprin-Hassler, Haiti, for reptiles; 10. Frick-Rak-Falkenbach, Sante Fé, for fossils; 11. Vaillant, Valley of Mexico, archaeological study; 12. Heilprin-Hatt, Yucatan, for mammals and fossils; 13. Shapiro, Polynesia, physical anthropology; 14. Naumburg-Kaempfer, Southeastern Brazil, for birds; 15. Ottley-Anthony, South America, biological reconnaissance; 16. Byrd, Antarctic

AMERICAN MUSEUM EXPEDITIONS

EDITED BY A. KATHERINE BERGER

It is the purpose of this department to keep readers of NATURAL HISTORY informed as to the latest news of Museum expeditions in the field at the time the magazine goes to press. In many instances, however, the sources of information are so distant that it is not possible to include up-to-date data

THE Columbia University-American Museum Expedition to Africa reports that it has obtained one of the two gorillas permitted it by the Belgian government. The gorilla, a magnificent male in the prime of life, was a staggering load for twenty-five porters. Inasmuch as the party can collect but two specimens, great care was exercised in the selection. Doing this was complicated by the fact that they live in the thickest bush where one can seldom see more than an indefinite shadow. After the second gorilla has been obtained, the work of photographing living gorillas will begin, but Dr. William King Gregory writes that the conditions are most difficult, and only a fortunate chance can yield any photographs of value. The gorillas are masters in the art of concealment and of disappearance. Doctor McGregor managed to get within speak-

ing distance of a family party of them nearly a week ago, and, writes Doctor Gregory, all are hoping for similar opportunities soon.

Of Africa, Doctor Gregory continues:

At every step, east and central Africa contradict all one's preconceptions. In the first place we have as yet experienced no really hot weather except at Djibuti near the Red Sea. Here in the mountains at 6700 feet elevation, it is moderately hot at midday and almost freezing at night. Then, too, I expected to see deadly snakes and venomous insects, but although I have searched constantly in the bush and jungle for snakes I have seen not one, while insects are relatively few and largely innocuous. Probably this paucity of life is largely due to the constant burning of grass and bush by the natives in order to gain grazing space for their cattle. Goats and cattle are devastating Africa as they are Australia.

We are fortunate in being camped here in a paradise of lush green fields sprinkled with brilliant trees and flowers. The natives furnish us with a continuous performance. We see them everywhere in their settlements, and at present we are surrounded by forty porters and four "personnel" boys. Every one of them could be studied individually by a staff of anthropologists, sociologists, humanists, physicians and others. Moreover they are equally interesting, from the larval stage to tottering old age. With what gusto the

tiny boys greet one with a snappy salute and a quavering "jambo," and how the mothers love to have their babies photographed, from all sides and angles, especially if a franc (3¼¢) is forthcoming. Yesterday three of us walked down and up the mountains to a great native market about eight miles from here. We were like pilgrims marching to Mecca in the midst of a toiling stream of black humanity.

WORD has just come from Mr. and Mrs. R. T. Hatt of the Angelo Heilprin Yucatan Expedition that they arrived at Chichen Itza on October 12. They say:

The country here is strikingly different from what we anticipated. Instead of being xerophytic, everything is covered with a dense tangle of wet green brush—all overgrown with convolvulus (twining herbs). There has been rain every day since we arrived.

The ruins are beautiful beyond description. We have not had time to study and visit them all yet. The carvings and paintings take a long time to study and one cannot grasp all the details at one glance. Before we leave we will take a day off to see what we have not seen and take a few pictures.

Speaking of pets, we should tell you that our thatch roof contains as much life as the sea. Scorpions, tarantulas, big cockroaches, geckos, bats, different kinds of wasps, mantis, spiders, and many more live about our heads. We do not mind them, but wish that the scorpions and tarantulas

would stay there instead of falling or perhaps walking down and coming so near our feet. Almost every day we meet a tarantula or scorpion. Last night we had two tarantulas. An entomologist would have a good time here. By the way, roaches fly in this country.

ON November 1, Dr. George C. Vaillant left New York to resume the stratigraphical excavations in the Valley of Mexico, continuing at the sites of Ticoman and possibly Teotihuacan, the work begun last season. In January he plans to go to a conference at Chichen Itza at the invitation of the Carnegie Institution at Washington, to report on the progress of his archaeological work.

ACARD from William J. Morden of the Morden-Graves Expedition for mammals states that on September 27 his party was at Tashkent. From there they plan to go on to Samarkand and Bokhara, and shortly after the first of November to strike eastward to Siberia.

NOTES

ASTRONOMY

BY invitation of the Bond Astronomical Club of Harvard College, Dr. Clyde Fisher, president of the Amateur Astronomers Association, made the opening address at their meeting, October 28, 1929, at the Harvard College Observatory, in which he described the mechanism of the Zeiss Planetarium. The following evening Doctor Fisher addressed the American Association of Variable Star Observers at their annual fall meeting at the Harvard Observatory.

COMMENCING Saturday, December 7, from 5:30 to 5:45 P.M., Station WOR will broadcast a series of radio talks on astronomy under the auspices of the Amateur Astronomers Association. Dr. Clyde Fisher, president of the Association, will give the initial talk. Dr. C. S. Brainin of Columbia University, Dr. Oswald Schlockow, and Anthony Fiala are scheduled for the three succeeding broadcasts, respectively.

THE December program of the Amateur Astronomers Association will include the following speakers:

December 4, Dr. John A. Miller, professor of mathematics and astronomy, Swarthmore College. "The Eclipse of 1929." (Illustrated).

December 18, Dr. John C. Duncan, professor of astronomy at Wellesley College. "The Nebulae." (Illustrated).

THE motion picture reels illustrating the Einstein Theory of Relativity, which were the feature of the November 6 meeting of the

Amateur Astronomers Association, attracted an attendance of 3000 people. It had to be projected on the screen twice during the evening to accommodate this record audience. Many calls are being received for another showing, and it is possible that this may be done later for members only.

The November 20 meeting was devoted to a description of "Our Place in the Milky Way Galaxy" by Dr. Clyde Fisher.

THE MARTIN JOHNSON- AFRICAN EXPEDITION

ON November 2 Mr. and Mrs. Martin Johnson sailed for Africa, to be gone for a period of two years. Accompanying them on this trip are Mr. George Dryden of Chicago, and his son, who will be with the Johnsons for the first three months.

DeWitt Sage of New York will join the Johnsons in Nairobi to assist Mr. Johnson in his photographic work. Also on this trip there will be a sound and camera man from Fox Movietone.

Mr. Johnson is taking along the new Grandeur Movietone outfit, (70 millimeter), also a camera for making color pictures, and an outfit to make sound pictures.

The party after visiting the Johnson's Nairobi home, will go to the slopes of Mt. Kenya, where Mr. Johnson hopes to photograph the bonga.

Next they will go to the Ituri forest in the Belgian Congo and make camp on the Ituri river. Here they expect to photograph the gorilla, pygmy people, pygmy elephants if they

exist, and also the okapi, which Mr. Johnson describes as a cross between a giraffe and a zebra, although it really is not. The okapi is a very rare animal and has almost never been seen by a white man, although the natives have killed them from time to time and brought them in.

EDUCATION

THE Cultural Courses for Teachers, inaugurated this fall by the department of public education of the American Museum, proved to be very attractive to hundreds who were evidently impressed by the illustrative resources of the Museum and by the quality of the lectures.

Enrollment in the Tuesday afternoon course in geography for elementary school teachers climbed to the unprecedented total of 1311. The course on Wednesday afternoons arranged for teachers in secondary schools totaled 232.

Dr. George H. Sherwood, director of the Museum, gave the opening lecture in each course. He used photographs of wild animals contrasted with pictures of the habitat groups of the same animals, prepared by the experts of the Museum for exhibition in the various halls, to show the scientific fidelity of the exhibits of the Museum. He also analyzed the development and growth of the Museum, particularly in education. His slides and films were enthusiastically received by both audiences, and his entertaining and valuable talks were generally taken to be harbingers of the good things to come in the courses.

While the extremely large registration has compelled some adjustments in the methods of presenting the courses, it is hoped that it will still be possible for each of the registrants to complement the lectures with a certain amount of laboratory work and accessory reading.

BEAR MOUNTAIN NATURE TRAILS

ALL trails leading through the woods, along the margins of lakes, or over the tops of mountains, are, in effect "nature trails." Unfortunately, however, not many trails aid in disseminating information about nature to the uninitiated who tread their paths. The purpose of labeled "nature trails" and of "trailside museums" is to present opportunity to nature lovers to gain a real conception of the meaning of "nature-mindedness," by providing them with simple, visual means of becoming better acquainted with the wonderful world in which they live.

The dwellers of the cities are turning their eyes, their steps, and their mental perceptions to the woods, the fields, and the streams. In ever increasing numbers they are availing themselves of many opportunities to spend hours in the open. State and national parks are being

used eagerly by the general public, who have learned to journey away from the crowded centers of population in search of recreation and fresh, pure air.

The department of public education of the American Museum has kept pace with the times in following the footsteps of the people of Greater New York in their exodus to the open. Many other organizations throughout the United States have seen the value and importance of this form of nature education and now support similar projects, all with the one purpose of stimulating a more lively and lasting interest in the out-of-doors on the part of the American public. The Nature Trails and the Trailside Museum, maintained by the American Museum of Natural History, in coöperation with the Commissioners of the Palisade Interstate Park at Bear Mountain, New York, have been visited by more than 200,000 people since 1927.

The development during the season from May to October, 1929, has progressed rapidly in several directions. The third year of operation has seen an increase in attendance nearly double that of 1928. The trails are now completely indicated and marked, and the museum building, provided by the Laura Spelman Rockefeller Foundation, is fully equipped with exhibits and demonstration materials, nearly all of which have been made at the Trailside Workshop. This new workshop has proved a most valuable acquisition. Coöperation with the educational and camping department of the Interstate Park has been carried on in a more extended way than heretofore. A new branch of the work, initiated this year, is that of aiding in a very definite way nature counselors and directors, throughout the Park, with their individual museum and general educational problems. The evident increase in interest on the part of the public in trailside museums and in the nature of the trails has shown itself in many ways, and is most encouraging.

Major William A. Welch, general manager and chief engineer of the Interstate Park, has been most kind in his willingness to aid the nature program of the Trailside Museum. Miss Ruby M. Jolliffe, superintendent of camping in the Park, by her friendly assistance aided the extension work of the Museum very materially. Mr. John Tampsen, chief of construction, has also been very helpful as have the entire police force of Bear Mountain under the direction of Captain Mandago. Dr. George H. Sherwood, director of the American Museum, has given valuable help and has made possible many new features of the work. The support of Dr. Clyde Fisher, curator

of visual instruction at the American Museum, has also been of great assistance.

The Nature Trails, the Trailside Museum, and the educational extension work, have again been directed by William H. Carr, assistant curator of education at the American Museum. Mr. Carr has been assisted by his wife, Marion B. Carr.

A relief model of the Nature Trail area has been installed in the Trailside Museum this summer. It shows, in raised contours, the different trails, and points of interest, and not only gives specific direction as to the location of certain "natural history events," but it also serves as a general guide to the region, teaching the visitor at the same time how to read contour maps correctly.

Indoor exhibits of living animals have been greatly increased, both as to numbers of species exhibited and interesting species cared for. A complete equipment of new cages and other physical means of exhibiting the creatures to the best advantage have been designed and made in the Trailside Workshop. About fifty of these new cages have been in use. At one time during the season the Trailside Museum had thirteen species of local snakes, all properly housed.

The exhibit of microscopes continued to be the most popular educational feature in the museum building. Indeed, the floor in front of the microscope table was quite worn by the feet of people, many of whom were permitted for the first time actually to use a microscope.

A new exhibit that showed "something to do with leaves" attracted many visitors, both adults and children. The only glass case in the building was used for this exhibit. Here were shown the various steps by which different kinds of impressions could be taken of leaves.

This year the "Return Trail," the "Swamp Trail," and the "Hidden Label Trail," were completely marked. The labels on the historical trail were all replaced, and sturdy chestnut posts were firmly fixed so that this particular trail should be virtually permanent. New exhibits along the trails included the insect table and the turtle pens. Many new labels were added to the entire trail system. All damaged labels were replaced almost as rapidly as they became scratched or otherwise mutilated.

The new building at the end of the trail designated as the "Trailside Workshop" has given excellent service to the entire nature project. It served as living quarters for four people, as a workshop for the trails and the museum, and as a nature laboratory for more than one hundred nature councilors and directors in the camps of the Interstate Park.

During the early part of the camping season, announcement was made through Miss Jolliffe, of the Park Staff, to many of the camp directors in the Park area, to the effect that the directors of the Trailside Museum would be glad to give instruction to Nature Teachers in the way of caring for their captive animals. The teachers responded at once, and during July and August, fifteen bird houses, eighty-two animal cages, eight museum models, and three museum aquariums were made by the campers in the Trailside Workshop. The American Museum furnished transportation, materials, tools, and instruction for all of this work.

The result of this service was that many camps that could not provide museum equipment were thus given exhibit materials that soon proved to be of considerable value in the nature educational life of the individual camps. As a direct result of this activity, at least five of the camps have planned to "carry on" in a much larger way during the next season.

It was our privilege during the camping season of 1929 to cooperate with the camping department of the Interstate Park to a much greater extent than we have ever been able to do heretofore. This was largely made possible because of the automobile supplied to the Nature Trail by the American Museum. This automobile traveled more than 5000 miles, thus bringing nature education to the 90,000 children, who visited the camps during July and August.

The four regional museums in the principal camping centers of the Park received a major share of attention. Individual camps were also served. This work consisted of lending slides and other material, and of giving lectures.

CONSERVATION

GIFTS totalling \$75,000 have been announced by Dr. Frank Aydelotte, president of Swarthmore College, for the establishment at Swarthmore of the Arthur H. Scott Foundation of Horticulture.

This foundation is to be in memory of the late Arthur H. Scott, former president of the Scott Paper Company, who graduated from Swarthmore in the class of '95. The sum total is composed of gifts contributed by his widow, Edith Wilder Scott, '96, of Rose Valley, and his sister, Mrs. Margaret Scott Moon and her husband, Owen Moon, '94, of Winston-Salem, N. C.

The terms of the foundation state that it "is created for three purposes: (1) The founding of an arboretum; (2) the development of floriculture; (3) the promotion of interest in better gardens." President Aydelotte explained that

in the furtherance of these aims, three projects are proposed: the horticultural development of the Swarthmore campus, the Crum Creek region and the Crum-Martin woods, recently given by Dr. and Mrs. Martin; endowment of a chair of horticulture in the faculty at Swarthmore; and the annual award of a medal and a prize of \$1,000 based on a nation-wide competition for outstanding service for better gardens.

President Aydelotte explained that the project for the development of the arboretum would fulfill an early dream and wish of Arthur H. Scott. His enthusiasm as a naturalist and flower lover led him to become a contributor to the Arnold Arboretum at Cambridge, and he always felt the need of a similar undertaking in the Philadelphia region. He knew Crum Creek and its territory since boyhood and college days and believed it was "an ideal location for such a project, having water and high land, rolling land and flat land, rock land and rich land, with all varieties of exposure." Mr. Scott enlisted the coöperation of his friend and classmate, Prof. Samuel C. Palmer, of the Swarthmore Botany Department, of John C. Wister and other horticulturists in and around Philadelphia. The thought of Mr. Scott, left uncompleted by his sudden death in 1927, will now find fulfillment in the undertaking of his widow, his sister and various friends.

THE abnormally long fire season which has harassed the National Forests of the West since early summer has not yet closed, says the Forest Service, U. S. Department of Agriculture, upon receipt of reports in Washington from its forest districts. Dry conditions and dangerous "fire weather" still prevail in most of the western districts, a condition unprecedented in the history of the U. S. Forest Service for this time of year. Forest officers regret that the danger of man-caused fires has made it necessary temporarily to close a number of National Forests to public entry.

This year, up to October 20, approximately 900,000 acres of the National Forests have been burned over and fire suppression has cost \$3,145,000. Combinations of drouth, low precipitation, and humidity, high winds and temperatures, made 1929 an extremely bad fire year.

FISHES

THE will of the late Dr. Bashford Dean, first curator of the department of fishes, and later honorary curator, leaves to the American Museum his ichthyological library and the sum of \$5,000 for its upkeep.

This library, a large part of which is in the Dean Research Room, consists of approximately seven hundred bound volumes and a collection of unbound papers and pamphlets. It is an invaluable asset to the department and to students of both fossil and recent fishes.

The bequest also includes a beautiful and very valuable collection of unpublished embryological drawings made by Doctor Dean himself.

FOSSIL VERTEBRATES

IN a recent issue of *Palæobiologica*, Prof. Julius Vigh of Budapest describes a natural mummy of a house cat. After death the cadaver of the cat dried out thoroughly without decay and has been preserved for more than ten years.

This is of interest as an example of the process by which the skin of some extinct animals has been preserved, particularly that of ground sloths found in caves—one in Patagonia and one in southern New Mexico. It also illustrates the first step in the formation of such fossils as the so-called dinosaur mummy preserved in the American Museum, in which the skin is not preserved but a natural cast of the skin has been formed.

DURING November, Mr. Barnum Brown visited Arizona to investigate dinosaur tracks which had been reported there. He also went to the University of Utah to study the dinosaur collections in that institution.

HONORS

IN recognition of Prof. Henry Fairfield Osborn's splendid work in the field of palæontology, he has been notified of his election as a foreign member of the Royal Academy of Lincei, Italy, in the class of geology, palæontology, and mineralogy of the physical, mathematical, and natural sciences.

OTHER MUSEUMS

IN the hope partly of seeing rich local Indian collections, Curator N. C. Nelson of the department of anthropology in the American Museum, recently made a six weeks' vacation trip through parts of the provinces of Ontario, Quebec, and New Brunswick. All told, ten public museums were visited: the Royal Ontario Museum and the Ontario Provincial Museum in Toronto; the Victoria Memorial Museum (the National Museum of Canada) at Ottawa; the Redpath, the McCord, and the Strathcona museums at McGill University, Montreal; the Ramesay Museum in the old French governors' chateau, Montreal city proper; the Laval University Museum in Quebec city;

the New Brunswick University Museum at Fredericton and the Natural History Museum at St. John, New Brunswick. The list includes probably all the more important institutions of the kind in central and eastern Canada.

These museums vary greatly in size, in age, in purpose, and in importance. One or two are old-fashioned curio places, some are essentially historical museums, and several of the best are well organized departmental institutions serving primarily as adjuncts to the different universities with which they are affiliated. Unfortunately nearly every curator was away on vacation, or else was in the field, so that little could be learned either about past history or future prospects, and the visitor was left to judge merely from appearance. Some of the institutions would seem—after the European manner perhaps—to be monuments to the principal donors as well as places for the preservation of specimens. Everywhere there was shortage of space; but this is about to be remedied in a number of places. Thus St. John is preparing to erect an entirely new and larger building which is to be advanced to the rank of Provincial Museum. Quebec is in the act of finishing what is probably her first Municipal Museum, beautifully situated on the historic battlefield—the Plains of Abraham—recently converted into a public park. The largest and most richly stored institution, the Royal Ontario Museum in Toronto, is also looking forward to expansion in the near future. Indeed, there is evidence in Canada not only of normal progress along museum lines, but of something like a resuscitation in recent years.

All of these museums, whatever their main purpose, contain more or less strictly anthropological material, though—except for the Toronto and possibly the Ottawa institutions—not merely so much of local origin as had been hoped for. However, there was little opportunity for loafing. No American can visit French Canada for the first time without finding himself fully occupied with interesting cultural facts not mentioned in his school histories. Those who are selling Canada to the foreign tourists call these facts “quaint” and “romantic;” but the student of culture history is likely to find them of sufficiently deep significance to cause a rearrangement of some of his fixed ideas.—N. C. N.

ORIGIN OF LIFE

THE Energy Concept of Evolution.—Félix Sartiaux, administrative engineer on the Chemin de Fer du Nord, author of numerous and delightfully written archaeological volumes

and essays, translator of Osborn's *Origin and Evolution of Life*, writes as follows on September 4, 1929, regarding the energy concept of evolution and the chromosomal or genetic concept:

A new edition of your fine work, *Origin and Evolution of Life*, would be extremely interesting; there have been, in fact, so many discoveries made since 1917. But your fundamental ideas on the forms of energy are always true. Are we not on the point of discovery of forms intermediate between inert matter and life, in what is called here “les Virus filtrants?” I have read on this subject a very interesting communication to our Academy of Sciences by a French biologist, Hondouroy—the theory of the “factors”—and the rôle of the chromosomes is very much in favor among us at present (Caullery, Guyenot; see a remarkable little book, *Les Chromosomes*, by J. Rostand, son of the poet, published by Hachette in 1928, or 1929, which is a very good popular résumé). But I object to much of it; your point of view seems to me superior.

SCIENCE OF MAN

MENTAL Development of Primitive Children.—Doctor Margaret Mead has just returned from a year's leave of absence which she spent in field work in the Mandated Territory of New Guinea, working under a fellowship grant from the Social Science Research Council. Doctor Mead made an intensive study of the young children in an isolated sea village of the Manus tribe in the Admiralty Islands. In addition to an ethnological study of the Manus people, she made an ethnographic survey of some of the related peoples in the Admiralty Islands and collected a large number of specimens for the American Museum of Natural History. This representative collection which contains many specimens of artistic interest will be placed on exhibit in the South Seas Hall in the course of the next few months. Doctor Mead also spent six weeks in northern New Britain, making a historical study of the rôle played by Samoan half castes and Samoans in the development of the Bizmark Archipelago, once a part of German New Guinea, now an Australian Mandate under the League of Nations.

THE American Museum has received a gift from Mr. E. Hope Norton of more than two hundred archaeological specimens from the highlands of Ecuador. The value of this collection is enhanced by the fact that it is accompanied by full data as to the places and conditions when each object was found. Such location data adds greatly to the value of any museum collection. The gift consists chiefly of pottery vessels, stone axes, and stone pottery figurines and pendants. The highly developed technique of metal working attained by the ancient peoples of Ecuador is exemplified in this collection by a number of copper and bronze objects, both cast and hammered, and by a splendid gold ornament decorated in low relief. The relation of the high cultures of Peru and Bolivia to those of Columbia,

Central America, and Mexico is one of the major problems of American archæology, and its solution must depend partially upon the acquisition of abundant materials from the intervening areas. The collection just given is therefore of more than ordinary interest.

AMERICAN Archæology.—Every year there come to the Museum a large number of letters relating to archæological possibilities in various parts of the country. Most of these communications are of the bona fide sort, often well worth investigating; but not a few are merely additional proofs that archæology still is a peculiar touchstone which readily sends off unwary minds on a course of wild imaginings such as even the hardened professional may not succeed in bringing to a halt. Disposing of these cases in some way or other, there remain for serious consideration many more inviting suggestions than any one institution can possibly attend to. Some correspondents are consequently referred to workers or institutions in their own state and the rest are given satisfaction in some instances by letter, in others by examination of their specimens sent in for the purpose, and, lastly, if circumstances warrant, by an actual visit by a member of the Museum staff.

This year has been no exception to the rule. In the spring many requests for some qualified person to come were on hand from several of the western and middle western states. In an effort to comply, the department of anthropology took advantage of the fact that our newly appointed staff member, Dr. Ronald Olson, was planning to drive his car here from California. The result was that stops were recorded for cursory surveys or test excavations, as the case seemed to require, at no less than thirty-seven different places: two in New Mexico, thirty-two in Texas, one in Oklahoma, two in Iowa, and one in Minnesota. The sites included pueblo ruins, house and village remains of less substantial character, quarry and workshop places, caves with evidence of former occupation, refuse mounds and cemeteries, as well as geological exposures containing flints of eolithic type. Small collections of one sort or another were obtained at all but one or two of the places visited, totaling several hundred specimens, all of which have been catalogued and in part placed on exhibit.

The most important data obtained by Doctor Olson, considered both qualitatively and quantitatively, were those from Texas. Texas, for various reasons, is little known archæologically and not all that is known has been adequately published. The American Museum has hitherto

possessed only a few handfuls of specimens from the great Lone Star State, and this miscellaneous lot has now been increased by about four times. The new accessions are also of miscellaneous character, to be sure, but we at least know where and under what conditions they occurred. The general localities sampled range over the greater part of the state, as follows: Alpine, in the southwest; Brackettville, in the south central; Amarillo, in the northwest; Abilene, in the north central; and Waco, in the east central section. Aside from the skeletal material collected, the artifacts include mealing stones, rubbing stones, hammerstones, red paint stones, notched sinkers (?), flaked blanks of various stages of finish, knives, spear and arrowpoints, end-scrappers, shell spoons or scrapers, shell disk beads, bone awls, notched bones, blunt antler implement, reed arrowshafts (?), checker and twilled matting, twined basketry, two-ply cords, postherds of non-Pueblo type, traces of charred maize and obsidian. The available information, such as it is, seems to warrant the conclusion that while the Texas aborigines had some traits in common with those of their neighbors of the arid Southwest, in general, their culture cannot be grouped with that of the Pueblo Indians proper.—N. C. N.

THE Alaskan explorer, George Thornton Emmons, recently visited the American Museum, bringing the completed manuscript of an invaluable memoir on the Tlingit Indians of southeastern Alaska, which is now in preparation and which will be published by the American Museum Press as a final contribution from this lifelong explorer in our great Northwestern Territory. A lieutenant in the U. S. Navy, the author began his exploration in the year 1882 while still on duty, and is now completing forty years of naval duty and exploration in Alaska and British Columbia, having attained his seventy-eighth year. He is one of the senior explorers of the American Museum, in the front rank in ethnological and anthropological exploration.

LENGTHENING Human Life.—Dr. T. Wingate Todd comments on the relatively brief life of our classic ancestors as well as of men of the Bronze age and men of uncivilized races.

"Some twenty years ago Karl Pearson analyzed the mortality curve of English males and resolved the complex curve into its simpler components with peaks of mortality at three, twenty-three, forty-two and seventy-two years respectively. We may call these the peaks of childhood, adolescence, middle age and old age. *It is the old age peak which is characteristic of modern days.* If we take the records of the Roman colonies in

Africa, we find an attempt at formation of this peak at the same age of seventy-two years, although its apex is there much lower than that of adolescence. This means that the great majority of African Roman citizens died young, though a minority lived to a considerable age."

"In 1925, through the kindness of Sir Arthur Keith, I examined the collection of West African Negro skulls in the College of Surgeons Museum. I found the middle age peak of mortality among these native people the same as among our American Negroes and I found no old age peak at all. In the native Tasmanians of the same museum similar results were encountered. From London I went to a Bronze Age burial place in the English Lake District and on this site among seventeen skeletons, found none over thirty years. From the Lake District I was called across country to Scarborough on the east coast to examine a cemetery of eleventh and twelfth century people. Among the 143 burials the peaks of childhood, adolescence and middle age were readily identified but no old age peak."

THE Miocene Gibbon of France and Germany.—

It is difficult to believe that the tree-living gibbon, now confined to the tropical forests of the East Indies, in Miocene times ranged widely through the forests of France, Switzerland, Germany, and Austria, as described in an earlier article by Prof. E. Stromer of Munich under the scientific name of *Pliopithecus antiquus* which was applied to it by the French palæontologist Gervais a hundred years ago. Doctor Stromer observes:

Pliopithecus is especially an example of how much the palæontological study of mammals is dependent on a single fortunate discovery, and how slow and painful must be its exact progress. One hundred years ago the type of this beautiful fossil of the lower jaw of *Pliopithecus* was found in the French Miocene, and from that day, in correlated strata in other parts of France, Switzerland, Germany, and Austria toothed fragments or single teeth have been found which may be doubtfully referred to the species, but it is only in the lignites of Göriach, Austria, that such fossils, in a crushed condition, have been isolated in any quantity. Over and over the teeth have been studied to the last little point, and conviction has been reached that this species was widely distributed throughout middle Europe in the Miocene, that time in which deciduously-treed forests were partly filled with southern species and various mammals existed whose nearest living relatives today are found only in the primeval forests of Southern Asia, as the Muntjac-Deer and the rhinoceri of the genus *Dicerorhinus*.

The skeleton is still lacking, the very skull of *Pliopithecus* itself is unknown; we do not even know whether the brain-capacity was less than in living species, and above all whether that most striking specialization, the great arm-length, had already developed, if the *Pliopithecus* was completely equipped for arboreal life, as are the living Gibbons. —H. F. O.

CONTEMPORARY of Heidelberg Man.—

The lower Pleistocene gravels of Bammenthal near Heidelberg are of the same geologic age as the classic sands of Mauer which yielded the type jaw of Heidelberg man, technically known as *Paleanthropus heidelbergensis*. On July 1,

1927, Dr. Wilhelm Freudenberg found in Bammenthal parts of the cranium, face, jaw and scapula of what he believes to be a new primate species and genus named *Hemianthropus osborni* in honor of Professor Osborn on the occasion of his seventieth birthday. The brain surpasses in width that of any anthropoid ape; the face across the gorilla-like cheek bones is extremely broad. The femur of the young *Hemianthropus* when restored is the same length as that of a young chimpanzee. The author describes *Hemianthropus* as an intelligent being with a large brain, surpassing the Trinil man (*Pithecanthropus*) and equalling in size that of *Homo neanderthalensis*. The fragment of the jaw shows that there cannot have been a prominent chin, in fact, it must have been even less prominent than in the Heidelberg man. The lower border rather resembles that of *Pithecanthropus*, the ape-man of Java. The question of the validity of *Hemianthropus osborni* as distinct from Heidelberg man remains an open question.

Recently Doctor Freudenberg found a portion of a broken and water-worn femur which he attributes to a fossil gibbon, *Postpliopithecus hominoides*. In discussing these fossils before the session of the physical anthropologists in 1929 a colleague remarked: "One must praise highly the extreme patience and persistence with which Herr Freudenberg has searched for primate fossils for so many years and in so many places. I wish him and science the happy reward which crowned Schoetensack's equally diligent search in Mauer."

IN Section XIV of *South Africa and Science* Dr. Raymond A. Dart comments as follows on the Rhodesian and Boskop races:

"It was in 1913, with the discovery, near Potchefstroom in the Transvaal, of a new and unknown, bizarre, big-brained, human type, which has hitherto not been retrieved outside of Africa, the so-called Boskop man or *Homo capensis* of Broome, that the attention of scientists was first seriously directed to the likelihood that South Africa had played something more than a subsidiary role in the early history of the human race. That probability was greatly increased by the finding of a skull in 1921 at Broken Hill with the most bestial, human muzzle known, and with receding forehead and enormous overhanging eyebrows simulating in these features the gorilla. For the reception of this being whose nearest known human relatives were the extinct Neanderthal race of Europe, the creation of a new species *Homo rhodesiensis*, more primitive even than the Neanderthal's, has been necessitated.

Unfortunately, nothing is yet known of its geological age or its geographical distribution.

"With respect to a knowledge of Boskop men, we are in a much more happy condition than with regard to *Homo rhodesiensis*. Between 1923 and 1926 by the unearthing of remains by Mr. Fitzsimons, at Zitzikama, near Port Elizabeth, and by Major T. G. Trevor, at Kalomo in Northern Rhodesia, it was shown that the Boskop type of mankind was a very distinctive one with a widespread distribution in Southern Africa. Mr. H. S. Gear has been able to give us much information concerning the Boskop skeleton and two other points of great importance were established; firstly, that Boskop man preceded the Bushman because his remains have been found at lower stratigraphical levels than Bush remains at Zitzikama and other sites along the coastal area, and secondly, that the type was not so removed zoologically from the Bush type as to rule out hybridisation between the two races. The most startling evidence in this latter respect came from the occurrence in the dissecting room of the Anatomy Department at Cape Town of a typical Boskopoid skull as announced by Professor Drennan in 1925. Actual Boskopoid hybridisation amongst the Zitzikama material of the higher Bush levels at Zitzikama was demonstrated by Dr. Gordon D. Laing (1925)."

BOOK REVIEWS

Audacious Audubon. By Edward Muschamp. Brentano's. 312 pages.

THE romance of the life of John James Audubon, the charm of his personality, and the marvel of his achievements have tempted the pen of numerous biographers, and in the authoritative work of his granddaughter, Maria R. Audubon,¹ and scholarly volumes of Francis Herrick,² we have eminently satisfactory records of his life. The present volume, however, is better adapted to the general reader. Freely acknowledging his indebtedness to the sources mentioned, Mr. Muschamp gives us a more closely woven whole. His well-written story moves swiftly and quickly succeeds in arousing our interest in Audubon the naturalist, artist, and man, and in holding our attention to its closing pages. It pays, therefore, an adequate and effective tribute to this remarkable man, one which should make him and his achievements familiar to thousands to whom he is now little more than a name. One cannot but regret that the author could not have found a title more worthy of his theme.—F. M. C.

¹ *Audubon and His Journals.*

² *Audubon the Naturalist.*

The Desert Road to Turkestan. By Owen Lattimore.

THE beginnings of the caravan trade between China, Mongolia, and what is now Chinese Turkestan are lost in antiquity, but from beyond the memory of man, long files of silent-footed camels have plodded their way across the Gobi Desert, carrying westward the silks and manufactures of China and bringing back skins of wild animals, gold, and jade to the markets of the East. The profession of the caravans is among the oldest in the world, and the business was once so lucrative that great family fortunes were built upon it. It is a world far removed from modern existence; it goes on today, however, almost exactly as it has for centuries. And it is of this World of the Caravans that Mr. Lattimore tells in his well written and beautifully illustrated volume.

In the troubled times of 1926, when he made his journey from Kuei-hua in western China to Ku Ch'eng-tze in Turkestan, political conditions in Outer Mongolia were such that the comparatively easy and well traveled routes through that country had to be abandoned. Caravans, therefore, were forced to use another way to the westward, the dim "Winding Road," least known of all the routes to Central Asia. Though it is an ancient trail, scarcity of water and great areas of sand take a heavy toll of lost camels from the heavily laden caravans, so until just before Mr. Lattimore made his journey, the "Winding Road" had been almost forgotten. He was the first white traveler over it.

The lure of the far places of Inner Asia has drawn many explorers, travelers and adventurers, but few have brought back from their wanderings such a wealth of information. Mr. Lattimore's excellent knowledge of the Chinese language particularly fitted him for the gathering of fascinating sidelights on the lives and customs of the desert travelers who were his only companions. He belonged to no mission or expedition, but, impelled by the urge of the unknown, he went simply "for to admire and for to see." He traveled and lived as a caravan man in a world of caravan men; he ate their food and sat listening among them when they talked of "the prices of wool and camels, of cart-hire, of journeys counted in many tens of days into the remote hinterland of Asia, and of the bandits besetting this road or the soldiers obstructing that."

There is a tremendous amount of all sorts of information in the book, but it is never heavy or wearisome. Delightful anecdotes of the road and striking word pictures of the country and of the

weird existences of the caravan men hold the reader's interest from beginning to end. Nor are thrills lacking—as when, one night on Dead Mongol Pass, a thousand camels were trapped by deep snow and had to be turned around in the darkness and bitter cold. Only one familiar with winter caravan travel in Central Asia can fully realize the almost impossibility of such a feat.

Altogether, *The Desert Road to Turkestan* will take its place among the foremost volumes of Central Asian travel.—WILLIAM J. MORDEN.

"Insects" Volume VII of the Jubilee Issue of Brehm's *Tierleben*. Jubiläums-Ausgabe in acht Bänden-Herausgegeben von Carl W. Neumann. Siebenter Band: Die Insekten. Verlag von Philipp Reclam Jun., Leipzig.

THE newest edition of Brehm's *Tierleben*—a work originally brought out in the sixties of the last century, but republished with revisions and additions at intervals of from ten to twenty years—is designated a Jubilee Issue, for it commemorates the one hundredth anniversary of the birth of Brehm. Although Brehm's name is rightly associated with the series, for he was the author of five of the six volumes that constituted the first edition, Taschenberg was responsible for the section on the insects and for the additions to and revisions of this section in the second and third editions. His name, therefore, is still featured in the present edition as the author of the volume on the insects, but his text, as the title page tells us, has been thoroughly recast by Carl W. Neumann.

In the new edition the reader will find amplifications in some parts, but in general there has been condensation both of subject matter and of statement, with the result that the compass of the book has been reduced by possibly one half. Attention is focused on the insects exclusively by the elimination from the volume of the spiders and of other invertebrates that competed for space with the insects in the earlier editions. These have doubtless been relegated to some other volume of the series, and their interesting habits certainly entitle them to independent treatment.

Taschenberg in his day was confronted by the bewilderingly rich fauna that clamored for inclusion in his volume. He decided the question, as he tells us in the second and third editions, by giving preference to common, native forms, and including only to a limited extent exotic insects. This is the method pursued also in the present edition, which even eliminates some of the foreigners to which Taschenberg had given often

more than passing attention. Indeed it would be impossible for anyone to begin to tell in the space available more than a fractional part of all that is known about insects, and the tendency of Doctor Neumann still further to strengthen the focus upon the native fauna by limiting the quota of eligible aliens, far from being a defect, is, under the circumstances, a virtue.

While in general the work is one to be commended for its authoritative character, it contains some errors, the result of carelessness often rather than of unfamiliarity. Thus on page 47 the number of described species of ants is referred to as 4000, but on page 71 as 5000. The latter figure is nearer the truth. On page 83 the impression is given that the young queen sets forth with the new swarm of honey bees; on page 94 this rôle is correctly assigned to the old queen. Without wishing to undervalue the important researches of Möller, the distinction of being the "first investigator" of the leaf-cutting ants belongs rather to Belt, who reached the conclusion that the leaves are employed not as food but for the rearing of "a minute species of fungus, on which the ants feed." The statement (p. 105) that there are only two species of *Eucera* in Germany should be qualified by the phrase "common species," as other *Eucera* of rarer occurrence have been reported. There seems no need, in view of the researches of Sladen and others, to express uncertainty as to the agency through which the larvæ of *Psithyrus*, the inquiline in the nests of *Bombus*, are fed. Additional infelicities of this type might be cited.

Unless the lay reader is unfamiliar with simple German, he need not be deterred from reading the volume. The subject matter is presented without ensnaring technicalities, and the fact that the insects are predominantly European rather than American should not alienate the reader's interest as many close relatives of these insects with similar habits are represented in our own fauna.

The volume contains eight illustrations in color and sixty-four in black and white. Among the illustrations some are duplications of the previously issued plates of Flanderky and Specht, while others represent the work of a new collaborating artist, Franz Schmidt-Kahring.

—HERBERT F. SCHWARZ.

"Field Book of the Marine Fishes of the Atlantic Coast from Labrador to Texas." By Charles M. Breder, Jr.

TO the series of Putnam's *Nature Field Books*, there has recently been added a "Field Book of the Marine Fishes of the Atlantic Coast from Labrador to Texas" by Charles M. Breder, Jr.

of the New York Aquarium, who is also a research associate in the department of ichthyology of the American Museum of Natural History. It contains keys for identification, a very full series of outline figures of the many species of salt-water fishes of our coast, which will be helpful to the same end, and a number of attractive color plates and half tone reproductions from photographs. All in all this book should prove invaluable to the salt-water fisherman or casual seashore visitor who wishes accurate knowledge of all the different kinds of fishes met with, and we know of none other that will serve this purpose. It is an attractive little volume of convenient pocket size, and whereas the sales price of five dollars might seem excessive, one must bear in mind the large amount of information and the many illustrations which it contains.

—J. T. N.

LOUIS CAPITAN

WORD has recently come of the death, on September 1, of Dr. Louis Capitan, the veteran archaeologist of Paris. Doctor Capitan was born in 1854, and although he held a medical diploma, was a member of the Academy of Medicine, and an officer of the Legion of Honor with military title for war service, he occupied himself from early youth largely with problems of prehistory, including those of the two Americas. Years ago he visited Mexico and the United States, and he was one of the few Europeans who continued to write affirmatively about Paleolithic Man in America.

According to his own words, Capitan began his public career as archaeologist by exhibiting

his collections at the Paris Exposition of 1878. He remained an indefatigable collector almost to the end and was consequently the possessor of a tremendous amount of material, the bulk of which he left as a legacy to the French National Museum at St. Germain, where a hall is especially reserved for its display.

As a field investigator Capitan took a leading part, from 1893 onward, with his pupils Breuil, Peyrony, and others, in the investigation of the French caverns, helping to institute the stratigraphic method of debris excavation and a similarly refined technique for deciphering the remarkable engravings and paintings preserved on the cave walls. As a result, we may assume, he later became a member of several different civic commissions for the preservation of monuments, historic and prehistoric, holding various offices, including that of president.

As a teacher Capitan was equally active. In 1899 he succeeded Gabriel de Mortillet in the Chair of Prehistoric Anthropology at the Ecole d'Anthropologie. At some unknown early date he was also made Loubat Professor of American Archaeology at the College de France. He wrote vigorously almost to the last and kept up his lectures until past seventy.

It was the writer's pleasure to hear Capitan lecture as late as 1922, as well as to travel and work with him for a number of weeks in Belgium, Holland, and England. With him may be said to have passed the last of the distinguished group of men who first made us properly acquainted with the character and culture of Paleolithic Man.—N. C. N.

OUR CONTRIBUTORS

A chance association in early boyhood with such well-known ornithologists as T. S. Palmer, F. H. Holmes, and C. H. Keeler, furnished the stimulus that started **Rollo H. Beck** on his career as a bird collector. He has studied and collected the land and sea birds of North and South America from Alaska to Cape Horn, and in his quests he has experienced all the thrills of shipwreck, and even hunting for lost treasure on desert ocean isles.

In 1920, Mr. Beck started on a collecting trip to the South Seas for Dr. Leonard C. Sanford which lasted eight years. Following this he spent a year in New Guinea collecting birds of paradise. He tells about this trip in the present issue under the title of "A Collector in the Land of the Birds of Paradise."

Lee S. Crandall, author of "To New Guinea for Living Birds of Paradise," has been associated with the department of birds in the New York Zoological Park since 1908. He became curator in 1919, and has made a number of expeditions, principally to South and Central America to obtain birds for the Zoological Park. The expedition to New Guinea was the most important, and was the culmination of many years of hopes and planning.

No one is better qualified to tell the history of the Parc National Albert, Africa's great gorilla sanctuary and biological survey station, than **Mrs. Mary L. Jobe Akeley**, the widow of the late Carl Akeley with whom the idea of the Sanctuary first originated.

Carl Akeley passed out on his last expedition before his plans were consummated, but his widow valiantly brought to completion his part of the work of the expedition, and she is now advisor and assistant in the work of the Carl Akeley-African Hall at the American Museum. "Africa's Great National Park" is a chapter from Mrs. Akeley's new book, *Carl Akeley's Africa* which is to make its appearance this autumn.

Paul Griswold Howes, curator of the Bruce Museum of Natural History and Art at Greenwich, Connecticut, was the leader of an expedition for this Museum to Dominica, British West Indies, in 1926, and again in 1927, in company with Dickenson S. Cummings. The purpose of the later expedition was to climb, measure, and make photographic records of the two highest mountains in the islands and to make studies of Dominican wild life. "The Mountains of Dominica" tells the story of how this was accomplished. Messrs. Howes and Cummings are working out a schedule of expeditions to various parts of the world which will be undertaken by them every other year for the purpose of gathering zoogeographical data and collections for the Bruce Museum.

The earliest boyhood interest of **Barnum Brown**, author of "A Miocene Camel Bed-ground," was collecting fossil shells in the Coal Measures of Kansas, and this interest determined his future career. After graduating from the University of Kansas, he joined the scientific staff of the American Museum, with which institution he has been

affiliated since 1897. He excavated the first dinosaur for the American Museum, and the great hall of fossil reptiles has been built up under his direction. His explorations in the Americas have taken him from the Arctic to the Antarctic.

He is the author of many popular and scientific articles, a number of which have appeared in *NATURAL HISTORY*.

"A Bit of Japan in Miniature" describes in this issue the first large anthropological group built by **V. Roxor Short**, a young artist in the preparation department of the American Museum.

Mr. Short originally planned to become a civil engineer, and the practical work in wood turning, pattern making, and foundry work which he did to prepare himself for such a career, gave him a valuable background for making the

models for the Museum groups. He studied at Pratt Institute, concentrating on design, modeling, and interior decorating, and later came to the department of lower invertebrates at the Museum to do modeling and wax work on exhibits portraying marine life.

The cover design for this issue of *NATURAL HISTORY* is from a painting by **F. L. Jaques**, of *Paradisæa apoda augustæ victoriæ*, named in honor of Kaiserin Augusta Victoria in 1888. It is now regarded as a geographic race of *P. apoda*, a species in which the long flanks vary from yellow to red according to the regions inhabited by the several races. The name *apoda*, or footless, was suggested by the old belief that birds of paradise had no feet, and spent their entire lives in the air. Augusta Victoria's paradise bird is found only along a short section of the northeast coast of New Guinea.

Facts concerning other authors have appeared in former issues.

NEW MEMBERS

SINCE the last issue of *NATURAL HISTORY*, the following persons have been elected members of the American Museum, making the total number 11352.

Associate Founder

Mr. JOHN SANFORD

Patrons

Messrs. CHARLES W. BALLARD, GILBERT OTTLEY, FREDERICK STURGES, JR.

Honorary Life Members

HIS MAJESTY NEGUS TAFARI MAKONEN.
HIS HIGHNESS GENERAL MAHARAJAH OF BIKANER, G.C.S.
I. K. C. S. I.
HIS EXCELLENCY THE DESJAZMATCH IMERU.

Life Members

Mesdames HAROLD BROWN, ROBERT LEFTWICH DODGE, GEORGE MOFFETT.

Miss MARJORIE FRENCH MCKAIG.

Messrs. HERMAN F. BALL, ALFRED H. COSDEN, F. R. PARRINGTON.

Sustaining Members

Messrs. EDWARD P. ALKER, RICHARD J. BERNHARD, DONALDSON BROWN, AVERELL CLARK, JOHN WALTER CROSS, C. NEWBOLD TAYLOR.

Annual Members

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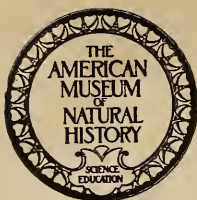
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