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'NATURAL HISTORY" IS SENT TO ALL CLASSES OF MUSEUM MEMBERS AS ONE OF THE PRIVILEGES OF MEMBERSHIP

CONTENTS OF VOLUME XXIV

November–December, No 6

Vol. XXIV JANUARY-FEBRUARY, 1924 No. 1

NATURAL HISTORY

AUSTRALIA

THE LAND OF LIVING FOSSILS BY WILLIAM K. GREGORY—MAMMALIAN LIFE IN AUSTRALIA AND TASMANIA BY HARRY C. RAVEN—BIRD PERSONALITIES OF THE AUSTRALIAN BUSH BY R. T. LITTLEJOHNS—REPTILE LIFE BY CHARLES BARRETT—THE VANISHING WILD LIFE OF AUSTRALIA BY A. S. LE SOUËF—THE GREAT BARRIER REEF BY CHARLES HEDLEY

ROTORUA AND THE GEYSER REGION OF NEW ZEALAND—SOME PLAYS AND DANCES OF THE TAOS INDIANS—THE ELAND AND ITS BIRD SENTINEL—TURRET-BUILDING TERMITES—THE PUBLIC MUSEUM OF STATEN ISLAND—REVIEWS OF "BIRDS OF THE NEW YORK REGION" AND "IN BRIGHTEST AFRICA"

The American Museum is greatly indebted to the naturalists and officials of Australia for their coöperation in assembling materials representative of their great continent

JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY
EXPLORATION·RESEARCH·EDUCATION

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Asia

Natural History for March–April, 1924, will be made up to a large extent of articles dealing with the American Museum's work in **ASIA,** a continent that has been looked upon by many as the probable cradle of the human race and which investigations tend to show was also the center of distribution from which many forms of animal life spread westward into Europe and eastward into North America.

Mongolia, until recently assumed to be devoid of fossils, has proved, as a result of the work of the Third Asiatic Expedition, to be one of the richest depositories of the zoölogical records of the past. The recovery from this region during the last year of no less than seventy skulls and ten skeletons of primitive horned Ceratopsian dinosaurs and contemporary carnivorous dinosaurs, as well as three nests and twenty-five dinosaur eggs—the first ever unearthed—is proof of the vast legacy of information that the past has bequeathed to the present, conserved in the Mongolian sands. The discoveries of the Third Asiatic Expedition in this area will be featured, according to present expectations, in the March–April issue by contributions from Professor Osborn, Mr. Roy Chapman Andrews, and Prof. Charles Berkey.

The Faunthorpe-Vernay Indian Expedition, which has already yielded the American Museum a representation of the big-game animals of India that it would be exceedingly difficult to duplicate, has been conducted with a sumptuousness that dazzles the imagination, and the dramatic incidents connected with it, as related by those who gave their time, their experience, and their funds to assure its success, will prove fascinating reading.

Another Museum undertaking that is yielding astonishing results is the fossil-gathering expedition to the Siwalik Hills of India under the leadership of Mr. Barnum Brown. On the basis of the specimens that have reached the Museum an article is being prepared by Curator William D. Matthew, indicating the importance and interest of the finds.

Other articles that deserve more than passing notice are the account prepared by Mrs. Walter Granger, of her journey up the bandit-infested Yangtze and a narrative of hunting in Kamchatka, the home of the black bear, recounted by Dr. Waldemar Jochelson.

Photograph by Harry C. Raven

THE FALLS OF THE GUY FAWKES RIVER AT EBOR

This inspiring scene will be the setting for a group of flying phalangers, planned as a part of the Australian exhibition in the American Museum

NATURAL HISTORY

VOLUME XXIV JANUARY–FEBRUARY NUMBER 1

Australia, the Land of Living Fossils

AS EXEMPLIFIED IN THE PROPOSED AUSTRALIAN EXHIBITION, AMERICAN MUSEUM

By WILLIAM K. GREGORY

Curator of Comparative Anatomy, American Museum

DIRECTOR Lucas once said that his favorite occupation in heaven would be the planning and arranging of a museum in which each of the great continents would be represented by a single large hall containing exhibits illustrating the physical geography, geologic structure, the animal and plant life, and the human inhabitants of that continent. But if the plans now being engineered by President Osborn go through, as his other plans have, Director Lucas may have the opportunity of fulfilling his aspiration in this world.

The return of Mr. H. C. Raven from Australia with his priceless collections intact brings us one step nearer the acquisition of a hall devoted exclusively to that island-continent. Ordinarily it is better in an article of this kind to write about what has been done rather than about what is hoped for, but in this case a preliminary indication of the plans may possibly help a little toward their realization.

In brief, our object is to give the visitor a vivid impression of the more salient features of Australia rather than to overwhelm him with the vast deposit of details that conceals Australia in encyclopædias. We want him to view, as if he had been there, some of the more characteristic scenes.

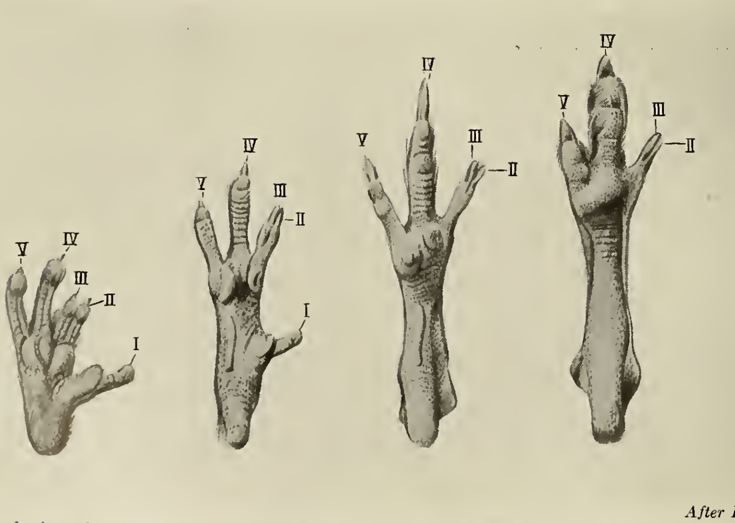
The centerpiece of the mammal exhibit will be the Kangaroo Group. The background will be the Australian "bush" (or open forest) of eucalypt trees, with the sunlight streaming through the thin foliage. In the foreground a dingo, or wild dog, has just bounded into view and is hurling himself at the nearest kangaroo, an old male. Two of the females, one of them with a large young one in her pouch, are leaping frantically in different directions. A little way back, still another kangaroo is raising its head in a startled way, and in the distance a few are feeding quietly.

As most of the Australian mammals are nocturnal in habit, it is the plan to have a moonlight scene with the beautiful gorge and falls of the Guy Fawkes River in the background. Standing in front of this exhibit, the observer will imagine himself near the brink of the gorge with his eye on a level with the upper parts of some of the trees that are down the slope. Dimly seen in the moonlight are several flying phalangers, which are hitching themselves up the branches in their characteristic way. One of them has just started on a long skimming flight, his arms and legs outstretched and the skimming membrane held taut as he swoops downward toward a near-by tree.

Other groups will show the interesting tunnels and underground chambers of the duck-billed *Platypus*, as well as its nest with the eggs that this most reptilian of mammals lays. In other groups the visitor will see the wombats, the native "bears," the tree kangaroos, and some of the other marsupial oddities for which Australia is justly famous.

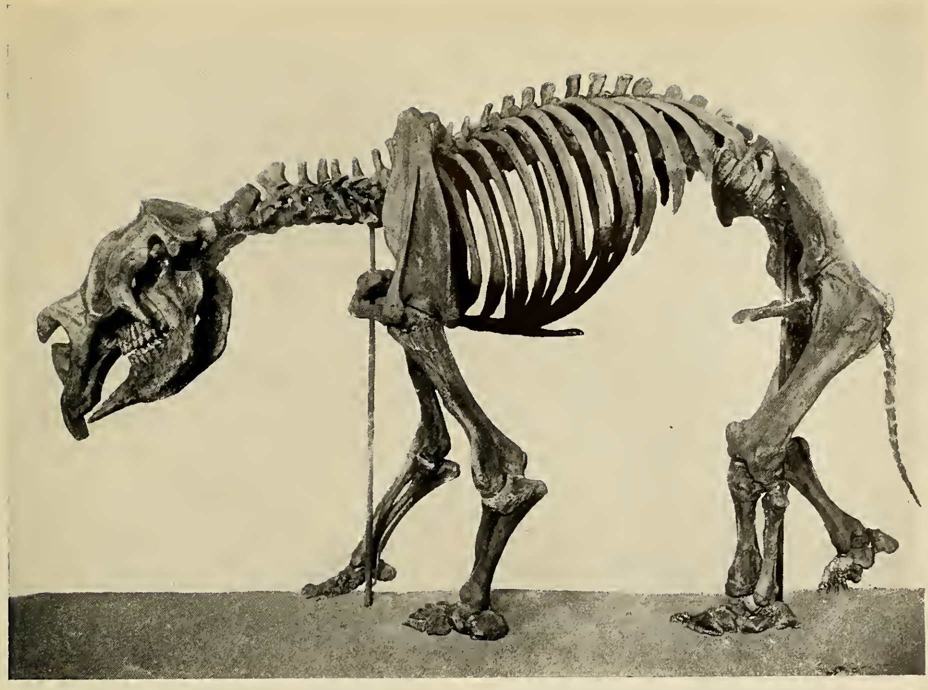
Nor will the needs of the more serious student be neglected. The Australian marsupials have a very high scientific prestige on account of the exceptionally clear evidence they afford concerning the evolutionary history of the group, and in these times they would doubtless have a considerable public interest if this fact were more widely recognized. It so happens that in that out-of-the-way corner of the world the marsupials have been shut off and protected for long ages from the overwhelming competition of the higher, or placental, mammals. Under these conditions the struggle for life within the continent has not been very bitter until relatively recent times nor has extinction been on such a vast scale as in other parts of the world. There is much evidence to show that evolution has always proceeded at unequal rates in different members of a natural group, some outdistancing others in the development of particular structures. Wherever wholesale extinction has been arrested, we should and do find many stages in the development of a particular structure. In Australia competition has doubtless eliminated many forms but we still have a surprising number of intergrading conditions.

This fact can readily be demonstrated in the Australian hall in several ways. There will be presented, for instance, a series of large models of the feet of various marsupials. The visitor will be able to see at a glance how, for example, the five-toed foot of the phalangers, although already highly adapted for climbing, leads into the elongate hopping foot of the wallabies and kangaroos. He will see how gradually the grasping great toe diminishes and finally disappears, and how at the same time the fourth toe becomes greatly elongated. He will see how even in the most advanced types of kangaroos the two little toes, the second and third of the ancestral foot, still persist, although their long bones are reduced to mere threads. Why, the



After Bensley

The gradations between the five-toed foot of the phalangers (left), adapted for climbing, and the elongated foot of the wallabies and kangaroos (right), specialized for hopping, will be shown in the Australian exhibition



A skeleton of the giant extinct marsupial *Diprotodon*, mounted in the American Museum from replicas of the original bones of this animal supplied by the South Australian Museum at Adelaide

A provisional restoration of *Diprotodon* by E. Rungius Fulda. The body of *Diprotodon* was like that of a wombat but vastly larger

From a sketch by E. Rungius Fulda

An Arkæological Epic

Father Noah and his sons, they invited to the Ark
  A distinguished group of mammals, all placental,
But they snubbed the duck-billed platypus and jumping kangaroo
  In a manner that was very far from gentle.

To the Talgai boy they hinted he was nothing but a moron
  Whom principles eugenic would condemn,
That they'd better let him perish than continue as a menace
  To society, and Japheth, Ham, and Shem.

So he called the big *Diprotodon* and on his back he climbed,
  And he whistled to the friendly dingo, too;
The platypus and wombat and the rest fell in behind,
  As frequently the simple-minded do.

They jumped upon an island that kindly floated by
  And they drifted far to southern seas unknown,
Where these brave Marsupialia in a land we call Australia
  Formed a doughty little kingdom of their own.

Now the scientists pedantic who defend the bridge Atlantic,
  When they hear this tale authentic I'd advise
To apologize quite meekly to these creatures who uniquely
  Controverted an hypothesis so wise.

E. H. Fink

visitor may well ask, does the foot of the kangaroo retain these vanishing side toes? Is it merely to baffle the curious, or is it not because nature everywhere leaves her imprints or true vestiges by which comparative anatomists and palæontologists are slowly but surely deciphering the record of life?

The visitor who will take the trouble to examine the next exhibit planned will see that although nature has fashioned the marsupials into many different forms, adapted for running, leaping, climbing, skimming, digging, etc., she has nevertheless built all these diverse forms around a common structural plan. He will see that marsupials are born in a relatively early stage of development and that they are fastened to the teats in the mother's pouch. He will see that notwithstanding the great differences in the general form of the skulls and in the dental apparatus of the grass-eating, carnivorous, leaf-eating, and gnawing marsupials, all these skull forms show many curious and striking details in common, which in the judgment of all modern students of the group have been inherited from a remote common ancestor that lived before the diverse modern lines had become differentiated.

Zoölogical science has long since sketched with considerable confidence the chief characteristics of this remote common stock of the marsupials. Huxley predicted that the common ancestors of all the existing Australian marsupials would be found to be remarkably like the existing opossums of North America: and this judgment has been confirmed and amplified by the brilliant investigations of Dollo and of Bensley. But it is only of late years that palæontologists have found true American opossums, or very close relatives of them, in association with the remains of the gigantic dinosaurs of the Upper Cretaceous in western North America. These, together with remains of related animals found in South America and in Europe, indicate that at some period, probably late in the Age of Reptiles, the opossum tribe had an almost world-wide distribution.

When Australia was cut off from the rest of the world, probably through the sinking and fragmentation of the southeastern extension of the Asiatic land mass, primitive opossum-like marsupials, together with the ancestors of the still lowlier duckbill and spiny anteater, were the only types of mammals in that part of the world. There they found themselves in forests of eucalypts, ancestral to the gum trees of today and closely related to trees and shrubs that have been found as fossils in the Upper Cretaceous of North America. Here in the old Australian land mass the primitive opossums were safe for many hundreds of thousands of years from the competition of the newer, or placental, mammals which were developing in the Northern Hemisphere. But under the stress of competition with each other the primitive marsupials began that great deployment, or adaptive radiation, which finally resulted not only in the highly diversified marsupials of today but also in the many strange and gigantic types that flourished in the broad Australian plains of Pleistocene times, when the northern world was passing through a succession of alternating glacial and interglacial periods.

Among the most interesting of the giant extinct marsupials were the *Diprotodon* and allied genera. Replicas of the original bones of *Diprotodon* have been sent to the American Museum by the South Australian Museum at Adelaide, and after careful

THE ATTACK OF THE DINGO

On the basis of this sketch by Charles R. Knight will be constructed the Kangaroo Group, the centerpiece of the Australian mammal exhibition. The wild dog of Australia is one of the chief enemies of the marsupials, being outrivaled as an agent of destruction only by man himself study the skeleton was mounted as shown in the picture on page 7. This was the first specimen to be prepared for the Australian exhibit; it is temporarily placed in the hall of the Age of Man, since it was probably a contemporary of the oldest races of men. The *Diprotodon* has been called the marsupial elephant, because its molar teeth somewhat resemble those of the mastodon. But on the whole the *Diprotodon* more nearly resembles a giant wombat, with molar teeth more like those of a kangaroo.

By means of colored maps and relief models the visitor will be able to see graphically that even at the present time Australia is connected by shallow water with New Guinea on the north and with Tasmania on the south. The very close relationships of the animals of North Queensland to those of New Guinea leaves no doubt regarding a former connection of these lands. The connection with Tasmania is indicated not only by such strong faunal evidence as the occurrence of closely allied species of the huge herbivorous marsupial *Nototherium* and of wombats on opposite sides of Bass Strait, but also by the plain geological evidence indicating recent submergence of the land beneath the strait.

The descendants of the old settlers, the marsupials, did not forever remain in undisturbed possession of the land of their fathers. Australia today has adopted the slogan "Keep out the Asiatics," but in the distant past the "Asiatics" in the form of various placental mammals somehow got in. First came the rats, ages before man. When the rats began to branch out, some of them became water rats (*Hydromys*), some (*Conilurus*) became hopping forms like certain of their marsupial rivals, while others competed with each other in field and underbrush, so that today we find five genera and about twenty species of rats and mice peculiar to Australia. A little later perhaps came the bats; and finally the dingo—a wild dog, remains of which have been found fossilized in New South Wales. All of these placental mammals competed with, or waged war upon, the old marsupials. But the latter were never seriously depleted, not even with the coming of the ancestors of the Australian aboriginals, who, as we know from the Talgai skull and other evidence, have been in Australia for thousands of years. Finally, late in the eighteenth century, there arrived in Australia by far the most destructive placental mammal the world has ever seen, namely, *Homo sapiens*, variety *europæus*, who has devastated the continent and is now completing the work of destruction.

The significance of the Australian mammal fauna, our intelligent and, we hope, still interested visitor, will readily comprehend from the exhibits that we shall gladly prepare for him. But he will by this time doubtless be willing to turn to some of the more spectacular scenes that we are holding in reserve. We shall show him the beautiful lyre bird, the amazing constructions of the famed bower bird, the great mounds heaped up by the lowans, the "Mound Builders" of the bird world, for the incubation of their eggs. Nor shall we omit the ostrich-like emu of the plains. If possible, we shall place at the visitor's disposal a phonographic record of the "song" of the astonishing kookaburra, or laughing jackass. It will be an infallible test. If the visitor is a child, he will want to hear that "song" (?) again and again. If he is a normal adult, a single performance may suffice.

After Dumont d' Urville

AUSTRALIAN NATIVES PERFORMING THE DINGO DANCE

After Dumont d' Urville

THE KANGAROO DANCE, ANOTHER ACT IN THE SERIES OF CEREMONIES INTRODUCED BY THE DINGO DANCE

Courtesy of Mr. J. W. Beatty

The Tasmanians, who nearly a half century ago died out as a people, represent a type far down in the scale of human evolution. The last survivors were wards of the government

There are many curious and even terrible reptiles in Australia, which will by no means be neglected in our future Australian hall.

We hope to show our visitors something of the life of the Australian and Tasmanian aboriginees. In the case of the latter not much can be done, for the simple reason that the last of the Tasmanians died in 1876 at a time when the museums of the world had secured extremely little material illustrating the appearance, habits, and bodily structure of what was undoubtedly one of the most primitive of all recent races of mankind. The last few survivors of the race, after a long and bitter warfare with the white settlers, were induced to surrender themselves to the care of the government and lived for many years in a small settlement. Fortunately a few enlightened individuals seem to have realized the extraordinary human and scientific interest of these people and took a number of photographs of them, which in our time have been carefully brought together and preserved by Mr. J. W.


Courtesy of Mr. J. W. Beatty

Front and side views of Truganini, the last of her race, who died in 1876

Beatty of Hobart, Tasmania. Mr. Beatty kindly supplied the American Museum with an excellent set of prints from the original negatives and it is the intention to exhibit these pictures in the Australian hall, together with several death masks and some of the very primitive stone implements that the Tasmanians were still using when the island was settled by the white colonists. The photographs here reproduced of Truganini, the last survivor of the race, and of some of the companions of her later days, show very well the racial traits of the Tasmanians. They differed from the aboriginal Australians in having short and woolly hair instead of long and wavy hair; their noses were excessively wide and somewhat gorilloid in appearance, and there is also something ape-like in their very wide mouths and retreating chins. They were allied in cranial and facial characters to the Papuans and Negritos. There is some evidence for the view that they preceded the Australians on the island-continent and were driven south, before the sinking of Bass Strait, by the Australians coming from the north.

The life of the Australian aboriginees will be represented by several mounted groups. A model of a man about to throw a boomerang at a fleeing wallaby seems a prime necessity, while if the material can be secured we should like to illustrate some of the curious customs of the natives, such as the kangaroo dance or the dingo dance or one of the elaborate initiation ceremonies.

Finally we hope to give our visitors some idea of the vital and stimulating Australia of today, so that he may realize that another America or, more precisely, another Canada, is being built by the Anglo-Saxon stock upon an ancient platform of the world.

In striving for the realization of these plans we confidently count upon the continued generous coöperation of our many friends and colleagues in Australian museums and universities.

A view from Point Lookout, northern New South Wales, on the upper edge of the escarpment and about forty miles from the Pacific, which lies beyond the farthest mountains visible in the picture

Glimpses of Mammalian Life in Australia and Tasmania

AN ACCOUNT OF PART OF THE WORK CARRIED ON BY THE FIRST AUSTRALIAN EXPEDITION OF THE AMERICAN MUSEUM[1]

By HARRY C. RAVEN[2]
Field Representative of the American Museum in Australia

AFTER a railway journey from Sydney northward along the coast, then inland to the top of the escarpment and along the great plateau to Armidale, followed by a fifty-mile ride, partly by motor car and partly by cart, over muddy roads, a wait of several days for floods to subside, and then a resumption of the journey for a few additional miles through forest and across streams, Doctor Gregory and I reached the site of our first camp in the open eucalyptus forest of northern New South Wales. It was July, the coldest month of the Australian winter, and we were in what is one of the coldest parts of the continent, due to the elevation of slightly more than 5000 feet. Nevertheless, the utter barrenness of a northern winter was lacking. The monotonous gray-green of the eucalypts could be seen in every direction. Their rather scant foliage, added to the fact that the trees as a rule grow several yards apart, allowed an abundance of sunlight to stream through the

[1]Although the author visited many types of country in Australia, from the humid tropical jungles of North Queensland to the almost Alpine woodlands, bogs, and rugged hills of Tasmania, in the present article only the coastal belt of the eastern part of the continent and western Tasmania are considered, and not the great arid plateau of the interior of Australia, where mammals are relatively scarce. The account is also limited to four of the types of country visited, with the native mammals found in these various habitats.
[2]The photographs accompanying this article were taken by the author.

Flood of the Guy Fawkes River in northern New South Wales.—Though this region, where the expedition began its work, is not one of exceptionally heavy rainfall, winter floods are common and rivers rise suddenly, inundate fields, wash away bridges, and frequently make travel impossible

An open eucalyptus forest in northern New South Wales, haunt of the flying phalanger and the great gray kangaroo. Much of the country has been cleared by ring-barking the trees

The flying phalanger (*Petauroides volans*) is a beautiful animal that inhabits the open eucalyptus forest, hiding in hollow trees during the day, feeding on eucalyptus leaves by night

The pygmy flying phalanger (*Acrobates pygmæus*) of northern New South Wales is a tiny relative of *Petauroides volans.* It is about as small as a mouse while the larger phalanger is comparable in size to a cat. Both of these animals were found in the first type of country visited branches striking the light-colored trunks and the pale, bleached dead grass beneath.

It was here that we first saw the great gray kangaroo (*Macropus giganteus*). When sighted, the animals were close to the ground, on all fours, quietly feeding. A moment later, aware of our presence, they sat upright looking in our direction; then suddenly turning, made off, leaping with amazing speed and grace, their small fore limbs pressed close to the body, their great hind legs working in unison like gigantic springs to throw the body forward. An adult female kangaroo was secured, with a tiny young one in the pouch.

The clearing of the forests by the settlers produces a better crop of grass and the kangaroos and wallabies are quick to take advantage of this improved food supply. Favored by such conditions, they multiply greatly, only to be persecuted by the settlers, who want to stock the land with cattle or sheep to its fullest capacity. Thus the native wild animals are driven back into unsettled country, rocky hills and ravines, or sometimes completely exterminated. The principal factors in the destruction of the kangaroos and wallabies over thousands of square miles of territory are, in the order of their importance: man, the dingo, the fox, and the cat, while to these aggressive agents must be added the pacific competition of the rabbit, which, itself a grass-feeder, limits the available pasturage by its incessant nibbling. There are, however, still extensive areas of uncleared land in the coastal belt where the marsupials take refuge.

The flying phalanger (*Petauroides volans*), like our flying squirrel, lives in trees, and in the moonlight may be seen making long gliding leaps from tree to tree. This animal is about the size of a cat but extremely slender.

The common "opossum" (*Trichosurus vulpecula*), which in many localities of New South Wales has been almost entirely exterminated, is still common in parts of Queensland

A TREE KANGAROO

The foot of *Dendrolagus lumholtzi* is broad and especially adapted for climbing in contrast to the elongated foot of the jumping kangaroos

Possibly it has developed its gliding habit to avoid the peril of a slow trip along the ground to the next tree. Fortunately, its skin is of little value commercially. For this reason it is not persecuted while its relative, the common vulpine phalanger or "opossum" (*Trichosurus vulpecula*), has fallen in millions to the fur hunter and has disappeared from many localities. The pygmy flying phalanger (*Acrobates pygmæus*) is a little animal, the body of which is about three inches long. It makes its nest in the "spout" of a tall gum tree and is very difficult to find. These flying phalangers, with the "opossum" (*Trichosurus*), the native "bear" (*Phascolarctos*), and the tree kangaroo (*Dendrolagus lumholtzi*), present peculiar adaptations of the marsupial type for life in the trees.

The second type of country that I visited (Doctor Gregory had returned to the United States to resume his duties in the American Museum) was the tropical rain forest of North Queensland. These tropical "scrubs," as they are called, are humid, dark jungles—the haunt of the cassowary, the bird of paradise, and the tree kangaroo. Here there are no eucalypts but many huge tropical trees take their place, trees that are very valuable for their timber. From their branches hang long lianas and rattans. There is a great profusion of ferns and epiphytic plants, all rich green in color, usually dripping with moisture, looking fresh and clean from nightly baths of heavy dew and frequent tropical showers. The flora of the rain forest suggests relationship with that of the tropical islands of the north, New Guinea, Celebes, and others.

The tree kangaroo, one of the most curious of all marsupials, was found in this rain forest. It is nocturnal in its habits, sitting quietly by day on the branch of a large tree, usually where it is protected from the sight of its enemies by gnarled lianas, orchids, and leaves. When night comes on, it descends the tree trunk, tail first, to hop along the ground among the thick underbrush, the leaves of which comprise most of its food. If alarmed or otherwise disturbed on the ground at night, it immediately takes to the trees. On the other hand, when the Australian blackfellow climbs up the tree after it, it will sometimes jump down to seek safety on the ground, leaping from a height of thirty feet or more.

Another denizen of the tropical rain forest is a little animal not as large as a rabbit, called the musk kangaroo (*Hypsiprymnodon moschatus*). To the evolutionist it is the most interesting of all the kangaroos, because of the characters that establish its place as a connecting link between the family of phalangers and the more specialized kangaroos.

The third type of country in which collections were made was the cleared alluvial plain, resulting from the destruction of the tropical rain forest, for the cultivation of sugar cane and other crops, principally the former. The country best suited for cane-growing in the Cairns district to which I refer, is the alluvial plain at the base of the mountains. Here there is a great depth of soil in a region of very heavy rainfall—more than one hundred inches a year. The cane fields have become the favorite haunt of bandicoots (*Perameles*), which are peculiar, long-nosed, pouched animals about the size of a rabbit. They make their nests among the cane and feed upon the larvæ of beetles which they find about the roots of the plants. The cane growers consider the bandicoots an asset, for the grubs they eat are said to be destructive to the cane. Prior to cutting the cane, it was the practice of the cutters to burn off the leaves. When this was done, all the animals that secluded themselves in the cane fields were obliged to flee if they wanted to avoid being roasted. By waiting on the outskirts of the field at such times it was possible to gather in many a fine specimen. Of course, with the destruction of the original forest, all the arboreal forms, such as phalangers and the tree kangaroo, were driven away; only those animals that adapted themselves to the changed conditions are today found in this new environment.

The fourth variety of country which I explored was that of western Tasmania, where I spent more than four months. It is a region of exceptionally heavy rainfall—from fifty to one hundred inches a year—though the area of the heaviest fall is comparatively small. The suddenness, frequency, and severity of the storms were always a source of surprise. The great eucalypts would sway back and forth as the wind that accompanied the rain or sleet swept howling through the branches, which towered in some cases more than two hundred feet above our tent. The forest was not composed entirely of eucalypts or of evergreen myrtles, which are really beeches (*Fagus*). In most cases the low hills and better drained slopes were forested with the pale-colored giant gums, beneath which were thickets composed of shrubs of several varieties, bracken, and acacias. On the flats, where the soil was deep and very rich, were growing evergreen

A Tasmanian forest of beech, or evergreen myrtle, with undergrowth of tree ferns. It is in country like this that the Tasmanian "devil" is at home myrtles, with their straight trunks and small leaves of much darker tone than those of the gums and acacias. Beneath the myrtles were a dense undergrowth and many palmlike tree ferns with their thick trunks dripping moisture. Then there would be flats where there was no forest—just a boggy plain with bunches of button grass (*Mesomelæna sphærocephala*) and innumerable small plants with pink, white, and yellow flowers.

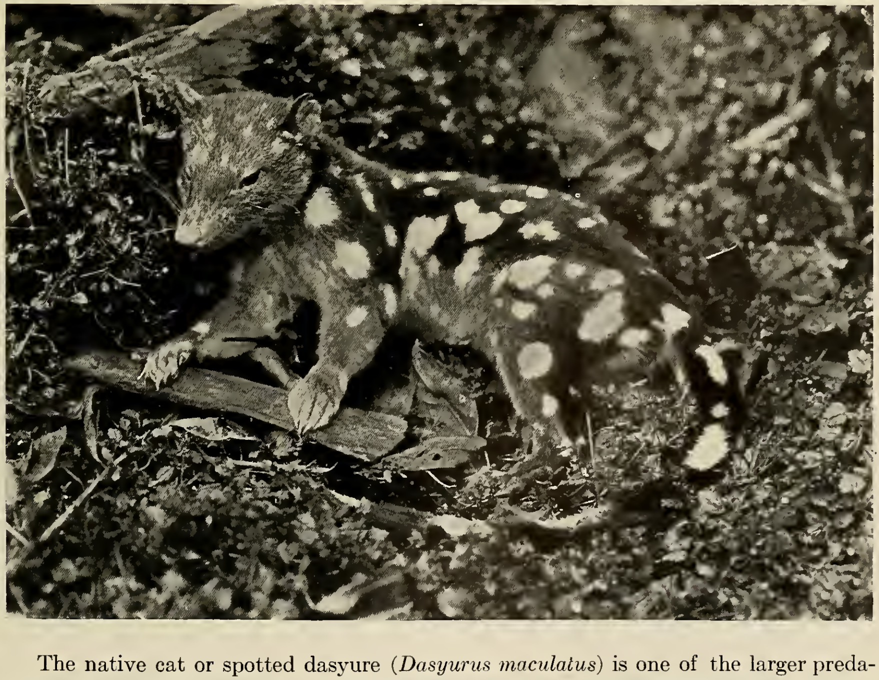
These plains are the favorite haunt of the wombat, which digs its deep burrows near the edge of the plain and feeds at night on the vegetation. Here, too, is the haunt of the thylacine (*Thylacynus cynocephalus*), the largest

A Tasmanian forest of eucalypts, principally stringy-barks (*Eucalyptus obliqua*) and peppermint gums (*E. amygdalina*). The banks of the streams in Tasmania are frequently overgrown with wattles (*Acacia*)

The Tasmanian wombat makes deep burrows in the sandy and rocky hills that surround the Arve Plain. A fox terrier can easily crawl into these burrows but cannot dislodge a wombat, should one be located. To do so, a man must dig in front of the animal

A young Tasmanian wombat.—It took three men digging from 3 P.M. till 1 A.M. to catch this youngster and his mother

The Tasmanian "devil" is doubtless a terror to the rats and small marsupials upon which it preys, but in captivity it is rather an interesting pet and gives no strong evidence of Mephistophelian traits



The native cat or spotted dasyure (*Dasyurus maculatus*) is one of the larger predatory marsupials of Australia. It is now being replaced by the domestic cat and the fox, both introduced by man

The spiny anteater (*Tachyglossus setosus*) feeds on ants and termites. With its powerful forelimbs it pulls apart the decaying logs and thrusts its narrow snout into the passageways made by the insects

living carnivorous marsupial, locally known as the "tiger," now, however, exceedingly rare. The Tasmanian "devil" was found in the forest, where it preys upon rats, small marsupials, and whatever other flesh and carrion it is able to obtain. One of the most curious of all the mammals of Tasmania was the spiny anteater (*Tachyglossus setosus*). This clumsy little monotreme wanders about the country both by day and by night, seeking its food, termites and ants, on the ground and in decaying vegetation, especially among fallen tree trunks, which are favorite nesting places of these insects. I was surprised to find this animal a good climber, an expert swimmer, as well as a marvelous burrower, able to dig straight down into firm soil. In climbing it makes use of its spines and snout to brace itself while securing a fresh foothold.

Before summarizing the rise and decline of the Australian marsupials, it may be well to note that broadly there are three main lines along which marsupial adaptation has taken place. First, and relatively primitive, are the arboreal forms, which feed mostly on leaves. From this primarily arboreal, phyllophagous stock some groups developed terrestrial habits (e.g., the extinct *Diprotodon*, the wombats, etc.) and became highly specialized for nipping and grinding tough vegetation. The second line of adaptation includes the small, chiefly ground-living, insectivorous forms—pouched mice (*Phascogale, Sminthopsis,* etc.) grading to large, thoroughly terrestrial, carnivorous forms represented by the native cats, the Tasmanian "wolf," and the Tasmanian "devil." The third line is the essentially grazing-and-hopping type, represented by many species of kangaroos and wallabies. The tree kangaroo is only a specialized

The spiny anteater is an expert swimmer and a brook proves no obstacle to its traverse of the country

member of this group that has become secondarily adapted for arboreal life.

Another group of animals characteristic of Australia and of great interest consists of the monotremes, or egg-laying mammals. They take the place both of aquatic mammals and of anteaters in other parts of the world.

Everywhere may be found evidences of the vast damage done to the main lines of the adaptive radiation described above, and of the struggle that has been going on between the Australian marsupial mammals and the comparatively recent invaders, the higher mammals. Probably the Australian blackfellow of today and the wild dog, or dingo, arrived on the scene at about the same time and were the first mammalian competitors of the marsupials. The separation of Tasmania from the mainland, perhaps near the time of the arrival of the blackfellow and the dingo in Australia, prevented the latter two from ever reaching Tasmania. The Tasmanian natives (now extinct) were probably in Tasmania long before the present blackfellow and dingo came to play a part in Australia's history. What may be the first evidence of a defeat of the marsupials at the hands of the invaders is the discovery of skeletons of two species of flesh-eating marsupials (*Sarcophilus* and *Thylacynus*) in cave deposits in New South Wales. These animals are no longer found alive on the mainland of Australia but are still extant in Tasmania, where the dingo did not get a foothold. By their habits they would naturally have come into direct competition with the dingo. I have seen a small dog quickly kill a Tasmanian "devil" and therefore do not doubt that the larger dingo proved more than a match for the marsupial carnivores. The blackfellows were apparently never sufficiently numerous to endanger the marsupials as a whole, and as they preyed upon all sorts alike solely for food, the destruction of the native animals was not so marked.

With the advent of the white man conditions changed again. Probably the settlement of Australia by Europeans will account for the destruction of more species of native animals than did the growing aridity in recent geologic times, when many large marsupials perished apparently through lack of vegetation for which they were adapted. The skeletons of many forms of the large herbivorous marsupials which died off at that time have been found in various parts of Australia.

The land the white people now occupy is naturally the most fertile part of the continent, consequently the part which supported the greatest number of native animals before they were driven off. Now these animals must occupy the less fertile areas and besides are killed by hundreds of thousands yearly for their skins; then, too, man has introduced dogs, which have become feral, strengthening the ranks of the dingo. He has also introduced other animals,—the fox, cat, and rabbit, which have taken to the "bush" and strengthened the current that has already set against the native fauna.

Unlike most of the Australian marsupials the small insectivorous forms (*Phascogale* and *Sminthopsis*) have no real pouch, just folds of integument surrounded by long hairs which cover and protect the young when they are very small. There may be as many as ten young in a litter

Bird Personalities of the Australian Bush

SOME FAVORITES OF THE PHOTOGRAPHER[1]

By R. T. LITTLEJOHNS, R.A.O.U.
Assistant Editor of *The Emu*

AMONG those city dwellers who find "a pleasure in the pathless woods" there is a growing uneasiness because civilization has spread gaunt arms through the "bush" and has swept aside the wild life from many of its accustomed haunts. But the seasoned nature lover knows still a few spots, quiet and undisturbed, where he may shake the dust of the city from his feet and the worries of business from his brain. During the last fourteen years my own invasions of the wild have been made with a camera as constant companion, and the present article speaks of some Australian birds as a photographer knows them. The species I have selected are not the most remarkable nor yet the best known but simply those which, by their habits and their characteristics, have most endeared themselves to me. Many of them possibly will be unknown even by name, to American nature lovers.

The kookaburra, or laughing kingfisher (*Dacelo gigas*), on the other hand, is one of Australia's best-known birds, though that is not the reason for his inclusion here. It is because the quaintness of his appearance and manner appeals to me. He is a slow-moving, easy-going, thoughtful old fellow whose one aversion is to be hustled. His search for breakfast lacks that display of energy which characterizes the efforts of most species. He sits, pensive and motionless, on a limb or on a stump in earnest contemplation of the ground. Despite the nonchalant attitude, however, both eyes and ears are fully employed, until sooner or later some hapless grub or insect betrays its presence by sound or movement. Then there is a heavy and rather slow flight to earth, the landing being effected literally on the stout bill. But if his methods are a little clumsy, they are efficient nevertheless and his period of watchfulness is seldom in vain.

In the ranges about twenty miles from Melbourne another camera enthusiast and I had the use of a weekend cottage a few years ago. Each Saturday our arrival at the house was noted by one or the other of a pair of kookaburras that resided in the vicinity, and their jovial, rather unmusical chorus sounded down the gully. By the time our luggage was unpacked they had taken up their favorite positions near the back door in anticipation of the weekly distribution of raw meat. In return for our hospitality we considered ourselves entitled to their portraits, but they regarded the camera with suspicion and continued snapping up the meat with expert beaks while on the wing. Eventually they were outwitted when we tacked the meat to a stump.

The only circumstance which ruffled the temper of these old birds was to have the impudent introduced starlings peeping into their nesting hole in an old gum tree near by. They appeared to regard the curiosity of certain small native species with good-humored tolerance. But those "furriners"; Ugh!

The yellow-breasted shrike robin (*Eopsaltria australis*) is another bird

[1]All of the pictures accompanying this article, with the exception noted, are by the author.

with much the same thoughtful expression. It is not in any way related to the kookaburra; in fact, the little yellow robin settles the closer on her nest should the kookaburra appear in the vicinity of it. Probably, almost certainly, the old humorist occasionally makes a meal of young "yellow Bobs." That is one of the few things I have against him. But nothing can be said

A bird of thoughtful expression is the old kookaburra. He is rather famous, too,—one of Australia's best-known species

Photographed by Mrs. R. T. Littlejohns

The yellow-breasted shrike robin is a quietly beautiful bird and a great favorite among nature lovers. "Breakfast in bed" is the human counterpart of the little ceremony here pictured

against the yellow robin. For quiet beauty he is unsurpassed and he is at once the most trustful and the most likable of our birds. Certainly he is the one most photographed and that speaks volumes for his popularity. As a songster, however, he is an absolute failure, his vocal efforts being devoted almost entirely to one piping note, oft repeated.

A few years ago I cherished hopes that cinema pictures of Australian birds would be popular with or receive some support from Australian picture managements. I was quickly disillusioned but, after much pleading, I did induce one firm to give me a trial. Even this firm was not greatly kindled by my enthusiasm, so that it was extremely necessary that my first attempt should be a success. Without hesitation I sought the nest of a yellow robin and was not disappointed. A cinema camera in action rattles and roars prodigiously and, when operated but two feet from a nest, is sufficiently fearsome to terrify most birds. Yet in a very few minutes those yellow robins were performing their domestic duties with scarcely a trace of suspicion in their large brown eyes. The completed film showed clearly the breathing of the birds and photographically was as successful as I could have wished. The picture on page 31 was taken by my wife with an ordinary camera while the cinema whirred. It depicts that most touchingly human of all bird habits, the male feeding his mate upon the nest. I am anxiously awaiting the day when educational films of this class will be commercially possible in Australia.

The head of the yellow robin is a slaty gray while the back and wings are a greenish brown. The breast and underparts are lemon-yellow, the whole blending to make a pleasant picture. The nest, too, is a beautiful example of natural architecture. It is built of bark in an upright fork, usually near the ground, and is decorated externally with lichens and hanging shreds of bark.

Then there are the fantails, small fussy birds with tails which account for about half of their entire length. Their flight is an erratic zig-zag, partly by reason of the extreme length of their tail and partly because of many sideward dashes after passing insects. The white-shafted fantail (*Rhipidura flabellifera*) is one of the commonest of these birds and its pleasant metallic song is a feature of creekside music. The photograph shows the head of a trustful individual, the subject, also, of a "movie" film. Even if the picture conveys little idea of the appearance of the bird, it illustrates the characteristic cobweb and bark nest and shows clearly the stem, which is added apparently for the sake of stability. Three fully-fledged young fantails, piled high on the woefully overcrowded nest, is a sight to be remembered.

The yellow robin is my favorite bird; but there is another species of somewhat similar build which runs it very close in my regard. This is the brown flycatcher (*Micrœca fascinans*), familiarly known as the "Peter Peter" because its nesting call note may, with some imagination, be said to resemble those words. It is a dainty bird in every way with a very musical little song and plumage of soft browns and grays. While on the lookout for insects the brown flycatcher habitually swings its tail with a curious circular movement, during which two white outer feathers are prominently shown.

The brown flycatcher is also a builder in bark and cobweb and its nest, too, is a study in daintiness. It is a shallow structure, built so flat upon a horizontal branch as to be almost invisible from beneath. Often a small brown head peeping inquisitively over the edge of the nest just above one's head leads to the discovery of the home. The brown flycatcher usually chooses to make its dwelling in lightly timbered country, where small gum

The nest of the white-shafted fantail is a delicate structure of bark and cobweb, deep in the bowl and with a stem or tail added. This particular bird refused to leave her eggs even when handled

trees, with their lower branches dry and dead, are a feature.

When the young are hatched and clothed in streaked gray feathers, the difficulty of locating the nest is increased rather than diminished. One stormy day last spring I found a pair of "Peter Peters" gathering insects with such enthusiasm that I knew there must be young birds somewhere near. There were but three or four trees in the vicinity which provided the class of nesting site that I knew the birds favored, yet I searched most carefully

The brown flycatcher is a small dainty bird of soft browns and grays, whose nest when newly built is rather attractive. By the time the young birds have grown to the stage shown in this picture the house presents a dilapidated appearance

for ten minutes without result. It was only when one of the adult birds visited the nest and fed the young ones that I discovered the little flat platform heaped high with young flycatchers. After much battling against the elements the accompanying picture was obtained. It will serve to illustrate the shallowness of the nest and its usual position. The choice of a dry branch as a foundation is prompted almost certainly by the fact that the eggs would be in great danger of rolling over the edge were the nest built on a swaying leafy bough.

The wood-swallow family is a typical and widely distributed one in Australia. In the southeastern corner of the Commonwealth there are three species, one a permanent resident and two summer visitors. All three are smooth-plumaged birds of graceful soaring flight. The white-browed species (*Artamus superciliosus*), one of the visitors, is illustrated on p. 35. It is a striking bird with gray back, almost black head, and a bright cinnamon-brown breast. A conspicuous white eyebrow and a dark-tipped, slightly curved, blue beak give it a rather ferocious appearance. In point of fact it is unusually ferocious in the protection of its nest, and often the photographer is subjected to a prolonged attack during which his hat may be dislodged several times by an angry bird. The nest is a flimsy one of twigs and rootlets, built with much haste in a fork, usually near the ground but sometimes as high as twenty feet above it. As a rule a dozen or a score of pairs of birds make their homes in an area a few acres in extent, but

The Australian wood swallows are characterized by their graceful flight. The male white-browed wood swallow is here shown near the frail nest in a native shrub

never are two nests closer together than fifty yards or so. From a photographer's point of view wood swallows are not satisfactory subjects, yet there is some subtle attraction about the proud defiance of their attitude which would induce me to go miles out of my way to see a nesting colony.

In suitable country one may find a dozen small holes drilled in a creek bank within a distance of a quarter of a mile. Each small tunnel is the special property and the anxious care of a pair of pardalotes, whose cosy nest of grass and bark has been built in the darkness eighteen inches or two feet in the earth. The nearness of these nesting tunnels to one another is not an indication, as in the case of the nests of wood swallows, of any gregarious habit. Rather is it an evidence of the number of pairs which take advantage of a suitable nesting ground.

Around Melbourne there are two species of these small birds. One is much spangled with white and conspicuously marked with red orange and yellow. The other species is less gaudy, a plain brown bird with but a suggestion of yellow markings. Both species have ridiculously short tails; in fact, short tails are characteristic of all the pardalotes.

Where the soil is very hard or otherwise unsuitable, the plainer bird, known as the red-tipped pardalote, will nest in the hollow of a tree or even in a fallen branch upon the ground. Such a position was chosen by a pair of birds whose domestic routine was interrupted, not once, but on two or three occasions, during a fortnight. On the last occasion young birds with lusty voices could be heard about two feet from the small round entrance hole.

Besides a pleasant, if rather monotonous, call, usually interpreted as "wit-e-chew," the pardalote has a plaintive little note specially reserved for pathetic occasions. Thus, when

The red-tipped pardalote builds a complete nest in the darkness of a tunnel, either in the ground, in a tree, or, as in this case, in a log lying on the ground. When prevented, temporarily, from reaching its home, the bird affects a pathetic attitude and utters a plaintive note of entreaty

The mistletoe bird builds a wonderful nest of feltlike texture. The small bird is here shown bringing two sticky mistletoe berries to the young in the nest

access to the nest was barred temporarily by a piece of stick, one of this pair of birds sat upon the topmost point of the branch and called most piteously in its distress. Each entreaty was accompanied by a peculiar stretching of the neck and a sidewise turn of the head, which I have attempted to illustrate in the accompanying photograph.

Pardalotes perform much useful service among the gum trees by attacking the noxious scale insect that plays havoc with the leaves and small branches. Although scarcely four inches long, the bird has an enormous capacity for this particular pest.

Related to the pardalotes and like them in shape and size is the mistletoe bird (*Dicæum hirundinaceum*), a brilliant species not altogether uncommon but seldom observed closely. The height and speed of its flight may explain the fact that the bird is not better known. Some years ago, after much searching, Mr. S. A. Lawrence and I discovered the wonderful home of a pair of these birds about twenty miles from Melbourne. At the end of four days of hard and patient work we were able to take back with us pictures of both the male and the female; not only that, but these birds, admittedly among the least trustful in Australia, eventually fed their young ones while perched upon our hands.

The male mistletoe bird is beautifully colored. The throat is a brilliant scarlet while the back and wings are a glossy blue-black. The female is very soberly garbed in brown and gray and is scarcely recognizable as the consort of the male. During the summer months the birds are very partial to the sticky seeds of the parasitic mistletoe (*Loranthus*) as an article of food. In fact, when the berries are available, the birds appear to feed on little else. It is a curious partnership between bird and plant. In return for its gift of food the parasite receives the assistance of the bird in distributing its seed. It would appear, even, that the mistletoe is spread primarily through the agency of the mistletoe bird.

The nest of the species deserves mention. It is the most wonderful piece of work I have seen. Built of wool, where obtainable, and woolly substances taken from plants, it is woven so closely as to resemble felt. It is difficult to understand how the structure, lacking the long fibers we find in most other nests of the closed-in type, stands the strain of wind and weather besides supporting three young birds and one adult. It will be noticed, too, that the slender branch above is the only support afforded to the breeze-swung home.

Of protectively colored species there are many, and all are interesting. The dotterels are particular favorites of mine, whose primitive nests among the pebbles of a creek hold some irresistible charm. In many of the old gold-mining districts of Victoria the whole countryside is strewn with stones and pebbles disturbed from their rightful places deep in the earth. Streams now meander through wide flat wastes of these pebbles and the usual creekside undergrowth has disappeared entirely,—a desolate enough scene.

When the dotterel's eggs lie unattended in the nest, they harmonize so well with the acres of pebbles that detection by natural enemies is most unlikely. In similar manner the sitting dotterel by its coloration enjoys almost complete protection. Even the downy youngsters, born open-eyed and able to run, are clothed in protectively colored down. At a note of warning from the ever-watchful parent they sink, with outstretched neck, flat upon the pebbles and appear literally to dissolve into the surroundings.

Now! I had not intended to mention the lyre bird (*Menura novæhollandiæ*), that greatest of all Australian bird wonders. Much has been written regarding it by ornithologists of standing, so that my only excuse for introducing pictures of the bird and its nest is my liking for the species. It is almost useless to attempt a description of the charm of "lyre-birding,"—I mean it in the harmless photographic sense. Imagine a half-mile climb from the main gully up the steep course of a trickling crystal stream. Realize that dignified progress is rendered impossible by tangled undergrowth, fallen tree ferns, and the sodden spongy nature of the soil. Picture silver mists sweeping this way and that like great captive balloons and leaving twinkling drops of water on the tips of every fern frond. In the distance all the time ring the laugh of kookaburras, the carols of the magpie and the butcher bird, the screech of cockatoos and parrots, all falling one over the other in the ecstasy of the singer. Singer, I say, because all the sounds come from the same direction, from the same throat in fact. Is there a mocking bird in any other part of the world which reproduces, not the laugh of one kookaburra but the jovial chorus of half a dozen; not the screech of one parrot but the din of a whole flock? If we attempt to reach the singer of these borrowed songs, we find the stage moved ever onward, so that we never overtake it. No! That is not the way to see the lyre bird.

The black-footed dotterel—in the young stage as well as in the adult—is protectively colored, resembling the pebbles among which it makes its nest

The half-mile climb up the stream probably occupies half an hour and at the end of it a change is noted in the character of the country. One may now walk upright with ease and the ground is free of undergrowth and débris. The fern fronds form arches overhead and shed a soft green light over a scene which rivals fairyland. Above the ferns, myrtles and musk and Christmas bush clamber upward for the light, while blackwoods, still higher, do their very best to keep it from them. Above all tower giant gum trees, their wind-racked heads veritably in the clouds, their gnarled and spreading branches blotting out the last remaining patch of sky.

To the uninitiated this clearing, this change from the dense undergrowth, means nothing. To the experienced it presents itself as a likely nesting site

Although the lyre bird is credited with being exceedingly shy, the nesting female, at least, exhibits little more than a curious interest in intruders

for this mysterious bird. All is quiet, for, remember, most birds, being lovers of light, shun these places where sunshine is unknown. Then soberly, sedately down a natural path between the ferns walks the bird we seek; not the singer, but his mate. If she lived up to her reputation, she would turn and vanish like a shadow. But her nest is near and the female lyre bird, when nesting, belies that reputation which she and her consort have earned, rightly or wrongly. Speaking from my personal experience I can only say that, unless one adopts fundamentally wrong tactics and scrambles through the undergrowth after them, both male and female lyre bird are almost as easily observed as other species. When her nest is near, the female looks upon

The large nest of the lyre bird is usually built near the ground but in a position which commands a view of all avenues of approach. The female was sitting in the nest when the photograph was taken

intruders simply with wonder, curiosity, and perhaps a little anxiety. Under such circumstances the only difficulty of the photographer is lack of light. But so serious is this one difficulty that I have not yet seen a satisfactory picture of a lyre bird. The photograph reproduced is the best of three obtained after an expenditure of fifty plates.

Photograph by A. H. E. Mattingley

THE CARPET SNAKE

In the tropical parts of its range *Python variegatus* sometimes attains a length of fourteen feet, very rarely fifteen feet; in the more southern part of Australia seven or eight feet is its average size, though specimens measuring ten feet occasionally occur

Reptile Life in Australia[1]

By CHARLES BARRETT, C.M.Z.S.

ON the trail of birds in Australian wilds with field glass and camera I meet with many members of the "cold-blooded" tribes. And, being one of those "eccentric persons" who feel kindly disposed toward lizards and snakes, I linger to watch their ways. I make no claim to the title of herpetologist; I am an observer only, and my budget of notes on reptile life is mainly for nature lovers.

Though fatal cases of snake bite in Australia are rather rare, we have our share of venomous serpents, and some kinds are abundant even near populous towns. In sparsely settled districts, where conditions are favorable to reptile life, snakes, both harmless and deadly, are very plentiful.

I have encountered many snakes in my "bush" wanderings, and with few exceptions have found them fearful of man, or at least decidedly anxious to avoid him. This applies to some of our deadliest species, including the black snake (*Pseudechis porphyriacus*), a formidable foe indeed, were it eager to stay and fight instead of avoiding trouble. This, our commonest species bearing the poison fang, often grows to a length of six feet, but the average length is sixty inches. Occasionally, "seven-footers" are killed; and snake stories record monsters worthy of exhibition in a dime museum!

The black snake is rarely aggressive unless cornered, or molested in the mating season, when most serpents are inclined to take the offensive against intruders. *Pseudechis porphyriacus*, when angered, flattens and expands its neck, thus intensifying the terror of those who fear all serpents should they encounter one at close range. Nor is it wise for anyone to fence with this species in its rage. Strike swiftly, if you have the good fortune to carry a stick, and see that the blow gets home. Many a snake have I spared, but never a venomous one in fighting humor.

When camped near a jungley swamp in New South Wales a year or two ago, I met with black snakes daily. The swamp was an ideal home for them, and also for some harmless species of snakes. Orchid-hunting among ti trees (*Mela-*

Courtesy of A. H. E. Mattingley

The black snake (*Pseudechis porphyriacus*) is beautiful in its coloring: purplish black or dark slate on the upper surface; on the sides and abdominal plates, crimson-lake red, with the hind tips and edges blackish. "Black Beauty," a snake-lover has called this dreaded reptile, which has taken its toll of human life

[1]Illustrations, with one exception, from photographs by A. H. E. Mattingley, C. M. Z. S., and the author.

leuca sp.), slender-boled gum trees (*Eucalyptus* sp.), and splendid fan-leaved palms, I splashed along on the first morning afield, without a thought of reptiles. Suddenly, as I stooped to gather a lovely little bog orchid, a black snake glided past, almost touching my feet. I was startled, I confess, and for a while after that went warily. Then another "Black Beauty" appeared; and five minutes later, a third. At brief intervals three more were sighted, and I decided to quit the swamp. It was gloomy among the trees, and I might easily have found trouble.

On a track near the swamp, I surprised still another black snake. It glided toward cover, but was headed with the aid of a stick into a shallow pool. And there, like Brer Rabbit, it "lay low" for a time. It is a habit of the species to lurk, completely submerged, in swamps and streams. Some other serpents have the same power of remaining long under water. The black snake is viviparous, and its family may number from fifteen to a score. Its food consists mainly of lizards, frogs, and small mammals; it has a liking for young water rats, and in the stomach of one specimen sixteen of these were found.

Another deadly species, the brown snake (*Diemenia textilis*), has a wide distribution in Australia. It attains a length of six feet, and is greatly dreaded. The young are not produced "alive," the eggs, about a score to the clutch, being laid on the ground and concealed beneath twigs and dry leaves. The Australian copperhead (*Denisonia superba*), which must not be confused with the American copperhead, measures from four to six feet, and is plentiful in many parts of southeastern Australia, even close to the cities. During the summer of 1923, in a paddock not far from Melbourne, the second largest city of the Commonwealth, a child gathering wild flowers was fatally bitten by a copperhead. I see this species every year, in the hot months, when rambling over heath

This water lily swamp is located near the Murray River in New South Wales lands by the sea. One day, when out with a butterfly hunter, I learned to respect the copperhead. We came upon one basking, and my friend "stirred it up." In a flash the snake shot forward over the iron rim of the net and struck. The entomologist missed death by a few inches.

Yet the copperhead is not regarded as our boldest and most aggressive reptile. That honor belongs to the tiger snake (*Notechis scutatus*), which

Photograph by Charles Barrett

The edge of a "flood" islet in the swamp is seen on the right of the picture. Hither large snakes come, chiefly to prey upon rabbits and other small creatures also is one of the most venomous serpents in the world. It is partial to fairly dry areas, but is not confined to them, and ranges widely over the Commonwealth. Large specimens measure more than five feet from tip to tip, but the average length is much less. Ferocity, not size, makes the tiger the most dreaded of Australia's poisonous snakes with the exception, perhaps, of the sluggish death adder (*Acanthophis antarctica*). Tawny crossbands and its vicious, aggressive nature explain the popular name. The tiger snake is brownish olive to dark brown on the upper parts, with many "tiger" bands, and below king yellow to pale straw yellow, or yellow tinged with green—handsome coloring.

Photograph by Charles Barrett

The great brown kingfisher or kookaburra (*Dacelo gigas*) is a foe of small snakes, and sometimes kills fairly big ones. Young of the black, brown, and copperhead species doubtless are included in its menu. The author of this article has seen a "laughing Jack," which is another alias of this bird, perched on a fence post, with a snake three feet long dangling limply from its bill. It is generally believed that snakes are carried aloft by the kookaburra and dropped to the ground, so that they may be disabled, and thereupon safely and easily dispatched. This the author has not himself observed; but there is no doubt at all that "Jack" *is* a snake killer. That is one reason why he is protected

The tiger snake abounds in places well suited to its needs. A mile or two from a crowded suburb, I have known it to attack a Boy Scout belonging to a camp in its territory. This species probably has taken a heavier toll of human life than any other reptile inhabiting Australia. It is said that its venom is more swiftly fatal than that of the cobra.

Far from avoiding man, the tiger snake is usually "looking for a fight;" in the mating season especially it shows its aggressiveness. At all times its fury becomes unbounded if it be attacked without a chance to retreat. Under such circumstances its neck is flattened, and expanded laterally to twice the normal width, reminding one of a cobra, with hood spread, ready for action, and if you are facing this tawny-banded terror, and are within its range, act swiftly or your fate is certain.

It is strange to read of a tiger snake being killed by a mouse; but this actually occurred. The late Prof. Frederick McCoy put a live mouse into a box containing a specimen of *Notechis scutatus*, and on the following morning was astonished to find that the little rodent had dispatched the snake by biting the back of its neck and, moreover, had eaten some of the flesh! The professor kept several tiger snakes together in a box, and frequently saw them bite each other viciously when they had been purposely disturbed; but the poison fangs produced no ill effects.

The death adder is one of the smaller serpents of Australia, seldom attaining a greater length than two feet. Its body is thick and rounded, the head broad and flat, while the tail ends in a horny spine,—harmless of course, but in popular belief the adder's deadly weapon. "It stings with its tail," folks say; and no logic has power to convince them of their error. The death adder is one of the most venomous Australian snakes; a large dog will succumb to the effects of its bite in eighteen minutes.

This *deaf* adder, as it is commonly called, has a dangerous habit of lying still, often on soil with which its color harmonizes. Thus, it is not easily detected; and as it obstinately declines to yield the right of way, a pedestrian may tread upon it—and suffer death, for the adder strikes as swiftly as a furious tiger snake. One summer's day, when a holiday party was rambling in the "bush," a laughing girl placed her hand idly on a bowlder. Next moment, when she chanced to look down, her face grew pale and she trembled. The hand was lifted in a flash—it had lain within six inches of a basking death adder!

Though the death adder is not aggressive, it will, when aroused, snap swiftly from side to side alternately, as I have seen a horned viper (*Cerastes cornutus*) strike, out on the Libyan Desert. But the Australian snake does not move its body sideways, in the peculiar manner of the Egyptian species. Sandy places are favored by *Acanthophis antarctica,* which is widely distributed in Australia; it is found also in the great island of New Guinea and its attendant islands. It was plentiful on an isle off the coast of North Queensland, where I camped for a while.

Among the snakes that are impressive because of their size is the carpet species, *Python variegatus.* This big rock snake is, of course, non-venomous, but not "perfectly harmless," as some naturalists aver. We captured one nine feet in length on a river isle in Queensland, three men grasping the tail and hauling *Python variegatus* from its retreat in a bed of swamp lilies. It was an exciting tug of war, but the snake lost. Later the specimen was shipped to Melbourne, and became for a time a household pet. I tested its crushing powers one morning, and very soon repented. Shining, merciless coils were about my waist, and the snake's flat, ugly head came gliding over my shoulder. Constriction increased, and the snake bit savagely at my coat. Tighter still it pressed, and breathing became difficult. I called on a watchful companion, and our united strength was exerted to unwind the reluctant coils.

But unless one is rough and careless in handling the carpet snake, it is harmless enough. Recently I photographed one of these reptiles, which allowed me to pose it, without protest beyond a mild threat from open jaws. This Australian python (we have several species of *Python*) is handsomely colored, pale brown with a greenish gray tinge and darker markings in irregular carpet pattern. Its tail is short and prehensile, and, like the American boa, the "carpet" coils it around a branch, and hangs by it as easily as a ring-tailed phalanger performs the same feat. A firm hold is gained (says Professor McCoy) with two little leglike spurs acting in opposition. Small mammals (wallabies, etc.) and birds are the carpet snake's chief victims, but it is fond also of poultry and raids henhouses in country townships.

Still, it renders good service as a rat hunter, and often its presence is welcomed in places where rodents abound.

The diamond snake (*Python variegatus spilotes*) is a subspecies restricted to portions of the eastern coast of our island-continent. It is darker than the carpet snake, and has a different color pattern: normally, diamond-shaped spots occur in clusters at more or less regular intervals. Northern Australia is the home of the black-headed python (*Aspidites melanocephalus*), which attains a length of eight feet; and another, smaller, species (*Aspidites ramsayi*) is restricted to a district in north central New South Wales.

Pythons sometimes are kept as pets. A friend of mine had a small diamond snake, which enjoyed the "run of the house." When my friend entertained, he delighted in giving the guests a little surprise: the snake was coiled on a chair at the dinner table, and as a rule it behaved very well.

I come now to my favorites, the beautiful, slender tree snakes,—one being colored green, the other brown. As they glide among leaves of the jungle trees or, more rarely, over swampy ground, they resemble undulating tubes of tinted glass. All their movements are graceful, and their charm is enhanced by the knowledge that they are harmless. The common green tree snake (*Dendrophis punctulatus*) may grow to seven feet, but its more usual length is five or six feet. This species is abundant in subtropical and tropical "brushes" on the eastern coast. I have seen a dozen during a

Photograph by Charles Barrett

This swamp in central Tasmania is a well-known haunt of snakes as well as a nesting place of crakes and rails. Undeterred by the proximity of the reptiles, a settler has built his cabin at the edge of the swamp morning's ramble among palm trees and cedars in a northern "brush." The swamp described on pp. 43–4 where black snakes were so numerous, was also a haunt of green tree snakes. I found a pair at home in a hollow log, and saw many others gliding through water-laved grass and ferns or among the foliage of trees. Small birds and lizards and the tree frogs so plentiful in their haunts are victims of these snakes, but their diet is, perhaps, varied with other little bushland creatures. The brown tree snake (*Dipsadomorphus fuscus*) is a nocturnal hunter of small birds, lizards, and amphibians. Its maximum length is seven feet. The tree snakes are oviparous.

In tropical Australia there are four kinds of true fresh-water snakes, placed in four genera by systematists; but I have no personal knowledge of the ways of these reptiles.

Sea snakes, which prey chiefly upon fishes, are not uncommon in our tropical waters, especially among coral reefs, where I have seen them during trips to islands of the Great Barrier. They are found, also, in salt-water estuaries. I will freely admit that I prefer to view sea snakes at a little distance. They are highly venomous; and in traversing water lanes that run through coral causeways or along the reef's edge in a blue lagoon one is wise to be cautious.

Our most familiar species among the Hydrophinæ is the yellow-bellied sea snake (*Hydrus platurus*), which rarely grows to a length of more than three feet. It is black on the upper surface, yellow on the sides of the body and the lower parts, while the tail varies in color pattern,—yellow with black spots, or the reverse. This species is found in the Pacific and Indian Oceans, authorities say, and is recorded from Panama waters. My own slight knowledge of it was gained in North Queensland.

White-bellied sea eagles (*Haliætus leucogaster*) are great enemies of sea snakes. On an isle of the Capricorn Group, off the coast of Queensland, I found beneath the nest of a pair of sea eagles scores of skeletons of sea snakes. Sharks, also, it is said, prey upon these serpents. Their own element is sometimes their enemy; for after a storm sea snakes have been found cast up on ocean beaches.

Of crocodiles we have two species, Johnston's (*Crocodilus johnstonii*), a native of Northern Territory and North Queensland, and the salt-water crocodile (*Crocodilus porosus*). The length of the former is from six to seven feet; it is mainly a fish eater, harmless to man. One of my naturalist friends has bathed often in a Queensland river pool among the "little crocs." This practice is not exceptional, for the folk who live in districts where Johnston's crocodile abounds have no fear of it. *Crocodilus porosus*, on the other hand, a monster often measuring seventeen feet or more from the snout tip to the end of the powerful tail, is regarded with due respect. It frequents the tidal mouths of creeks and rivers, and sometimes is met with at sea. It is not confined to northern Australia, being a native, also, it has been stated, of India and Ceylon, some Pacific islands, and the southern portion of China.

Mr. A. H. E. Mattingley, C. M. Z. S., a noted Australian naturalist, relates an adventure with a salt-water crocodile.[1] He was hunting birds in the mangroves, when he came upon a female crocodile in a wallow beside her nest. She made a savage rush at him, with "a kind of hissing, grunting noise,"

[1]*The Animals of Australia*, Lucas & Le Souëf, pp 190–91.

Photograph by Charles Barrett

Green turtles coming ashore from the lagoon at Masthead Island, in the Capricorn Group, Queensland, where they deposit their eggs in burrows

but was blinded by a charge of small shot and finally dispatched.

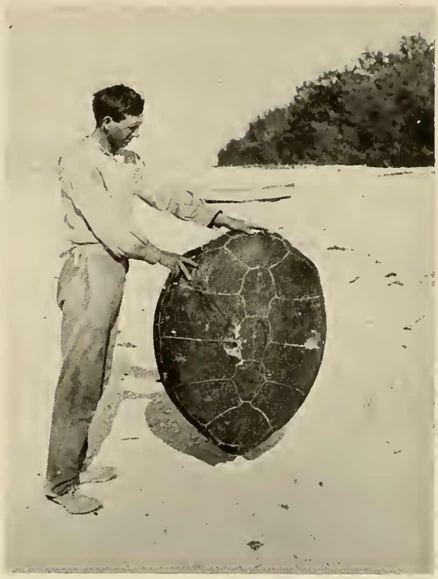
When living in North Queensland, my wife received from a grateful person, whom she had nursed through an illness, a baby crocodile. The gift, from a rough but kindly old miner, arrived without warning in a box the lid of which was nailed down. My wife and her friends of the household were curious as to the contents, and bent over the box as the top was pried off. When the crocodile's head popped up, the sharp-toothed jaws agape, all the human heads were lifted high in a flash. The gift, with a polite note of thanks, was returned to the sender, who later explained, "I thought you'd like it for a pet."

Wild pigs are killed and devoured by the salt-water crocodile, and it has the reputation of being a man-eater when the chance occurs. It is not particularly conducive to long life to swim in, or wade through, pools in crocodile-haunted water courses, for the reptiles sometimes seek a change from salt to fresh water and travel far upstream.

I am more at home in writing of green turtles (*Chelone mydas*), for I have camped on their nesting isles, swum among them in the lagoons, and even commandeered them for "joy rides" on the beaches. The green turtle, which frequents tropical and subtropical seas, is so abundant in the breeding season among our northwestern and northeastern islands that hundreds sometimes are seen at a sweep of the eye. One morning I actually counted nearly two hundred on the beach at Northwest Island, in the Capricorn Group. Many were coming ashore, too, and dark heads dotted the sea as far as my eyes could range. It was easy to steal to a basking turtle and leap upon its carapace. If you gained a firm seat (kneeling on and grasping the front of the carapace), a brief ride to the sea was possible. In the water the turtle triumphed. It might swim for a time with head uplifted, but presently it would submerge, forcing its rider to loose his hold or drown. I never could rival De Rougemont in turtle-riding feats; but many a big *Chelone mydas* has borne me over the beach to the sea.

At night, on the edge of the jungle zone, the female turtles excavated big holes in the sand and therein laid their eggs. Then they scraped damp sand into the hollow again and smoothed the surface, using their hind flippers adroitly in these operations. All was safe now, they believed, and accordingly they returned to the sea.

Many nests are robbed, of course; and turtle hunters often capture the luckless owners, as they hasten seaward after laying and hiding their eggs. Rarely, among the islands, we saw the logger-head turtle (*Thalassochelys caretta*), noted for its shell-crushing beak.



Photograph by Charles Barrett

The carapace of a green turtle found on the beach of Coral Island

We have in Australia some interesting tortoises that inhabit lakes and rivers and the large lagoons. The long-necked river tortoise (*Chelodina longicollis*) is one of the most remarkable species, common in rivers of southern Australia, especially Gippsland, Victoria, where I have met with it. The length of the snake-like neck, from the front edge of the carapace to the occiput, is about three inches, six lines, sometimes shorter, rarely a line or two longer. This is rather a handsome reptile, very dark brown above, with the plastron and under surface of marginal plates a rich yellow, the borders to the sutures being dark brown. The pure white eggs (from seven to more than a score) are deposited in a circular hole excavated in a bank, the tortoise using its hind feet for the work.

The Murray River tortoise (*Emydura macquariæ*) is popularly known as the Murray "turtle," but a glance at its feet shows the naturalist that it is one of the walking tortoises, webbed between the toes, and provided with long, acute claws. In a lake in northern Victoria I saw in early summer time a host of Murray tor-

Photograph by Charles Barrett

The burrow from which these eggs of the Murray tortoise were removed is seen to the left rear of them

Photograph by A. H. E. Mattingley

Supported by its adhesive toe pads, the Australian gecko is able to hang head downward from a branch

toises. They were gathered in warm, shallow water along the shore, and I followed the tracks for fifty yards until I came upon several nests excavated in dry soil. From one of these nests nearly a score of eggs, white and soft-shelled, were taken. Egg fights are held by schoolboys living in the neighborhood of the lake; but the turtle population does not decrease perceptibly though hundreds of eggs are destroyed.

Australia is so rich in lizards—nearly four hundred species, and many of them abundant—that I can mention only a few, notable for their quaint appearance or their engaging ways.

Our geckoes are queer little creatures, with grotesque tails and in the case of some species ogre-like heads, so that it is not strange that many persons regard them with aversion. But I like every kind I have seen. Under bark on living tree trunks and gray old logs on the ground, in rock crannies and beneath big bowlders, geckoes are found. Some kinds, especially in the subtropical and tropical parts of the Commonwealth, take up their abode in houses, huts, and outbuildings, where they prey upon moths and flies. Their adhesive foot-pads enable them to run up and down walls, and across the ceiling of a house. Sometimes they lose their hold and fall. One night I was seated, reading, in a Queensland bungalow, when a gecko dropped on the table, an inch from my book. He did not stay to apologize, but scampered down a leg of the table, across the floor, and up the wall, back to his hunting ground—the ceiling.

In the arid country of central Australia are found our strangest geckoes. One is *Nephrurus asper*, pale pinkish brown on the upper surface, with a black band on the neck, and black lines in network pattern on the head. It is under five inches in length. The small tail has a "terminal enlargement"; at the base it is swollen in a curious manner, then it tapers, and ends in a globe-shaped knob. *Rhynchœdura ornata*, of northwestern Australia, is more remarkable for the shape of its head than for that of its tail, though the latter organ is sufficiently strange,—thick, and in outline like a malformed leaf. This gecko's head suggests that of a baby bird, with bulging eyes and short, blunt bill.

Some of our lizards are gorgeously colored,—for example, the painted dragon (*Amphibolurus pictus*), which inhabits dry regions mainly, in western, central, and southern Australia. The male, on the upper part of the body, is brick red, with leaden-blue vertebral stripe; the sides are blue with yellow spots; the limbs bluish black with some yellow markings; and the long, tapering tail leaden blue, barred with light-colored, narrow bands. Truly, a

Photograph by Charles Barrett

Though living close to the ground, the bearded dragon, *Amphibolurus barbatus*, likes to bask on logs and stumps and fence posts. Annoyed or cornered, it expands its "beard"—a frill of spines—and faces the foe open-mouthed, hissing viciously the while. It will bite, too, in savage earnest, but without causing much pain. Its display is largely bluff, but succeeds sometimes in scaring very timid persons. The "dragon," although about twenty inches in length, has no chance of life when pounced upon by even a small dog. A fox terrier will dispatch two full-grown specimens in less than five minutes

dandy; but not the only one among Australian lizards to qualify as such. One small species has an orange-red tail, and blue-and-black striped body. Another kind, of the purely Australian genus *Egernia*, varies greatly in coloring; one form is bright brick red above, with some black spots; while the sides of the body are pinkish brown, also spotted with black, and the under surface of a rich, creamy-white hue. Brown, blue, red, yellow, and many other colors are exhibited by our lizards, large and small.

We have some lizards, however, that are "plain." The bearded dragon (*Amphibolurus barbatus*) is as soberly colored as a Quaker's coat. Dingy brownish or yellow gray is the prevailing tone, with darker markings in some cases. I have met with this queer lizard, which attains a length of about twenty-one inches, in many places, but most often in the wonderful Mallee country of northwestern Victoria, where the lowan (*Leipoa ocellata*) still raises mounds of soil and débris as incubators for its eggs, ranged in tiers in a hotbed. The bearded dragon, however, is found all over Australia, except in the areas farthest north. It is so common in the Mallee that a score may be seen in a morning afield. A dozen or more eggs are laid by this species.

Fortune has favored few naturalists with an introduction to the true frilled lizard (*Chlamydosaurus*) in its native wilds; and I am one of the luckless majority. *Chlamydosaurus kingii*, sole member of its genus, inhabits certain areas in western and northwestern Australia, and Queensland. Its body is slender, and the tail, proportionately, of remarkable length; from tip to tip an adult may measure almost three feet. The big frill is wonderful; but a still greater claim to distinction is this lizard's habit of running erect on the hind legs. Saville-Kent, who closely observed the species, states that in running the frilled lizard places on the ground only the three central digits of each hind foot; thus its tracks resemble those of birds and of dinosaurs.

The horned dragon (*Moloch horridus*), under nine inches in length, is a contrast to the frilled lizard in its sluggish ways. It is difficult to describe this quaint little reptile, with its rows of large and small spines, neck hump, and horned eyes. It is of a yellowish color, with chestnut-brown markings. The Australian *Moloch* lizard resembles the Texas horned lizard (*Phrynosoma cornutum*).

The horned dragon, often called "thorny devil," makes a pleasing pet. One of these lizards had the freedom of my house for a month, when it met with an untimely death—crushed by a careless foot. Another specimen I purchased for a shilling from an aboriginal at Coldea station, on the Trans-Australian Railway. I kept the lizard in my sleeping compartment on the train, and when we stopped for some minutes at a station, I would step out and place it on the ground among ants of different species. But it declined to eat in the midst of plenty. Later I learned that the *Moloch* has a special liking for the small black "sugar" ants, which commonly nest in our gardens and invade kitchens and larders. Given its favorite food, this lizard develops an amazing appetite, often devouring more than one thousand ants at a meal. The insects are picked up one by one by the reptile's slender and sticky tongue, which flashes in and out of the mouth tirelessly till the feast is ended.

Dr. J. Bequaert[1] refers to *Moloch horridus* in his fascinating paper on "The Predaceous Enemies of Ants."[1] I have evidence that our horned lizard lives solely upon ants, though apparently it is highly selective and never troubles the great majority of species.

[1]*Bulletin*, Am. Mus. Nat. History, Vol. XLV (1921–22), p. 296.

A captive specimen was tempted with living ants of several species, but declined to eat until it was placed beside a nest of the small black ants already mentioned.

My brother, in camp on a western gold field, where fortunes were lost and made, kept, as a mascot and "servant" combined, a fine little *Moloch*. It was tethered lightly to a tent peg and rarely strayed to the end of its tether. It cost nothing to keep and needed no attention; but it rendered welcome service in devouring hosts of black ants.

Australia's sluggish blue-tongued lizards (*Tiliqua*) are unfriendly in their haunts, but in captivity become more sociable. I have had several and have found them rather engaging despite their indolent ways. A "blue-tongue" is never in a hurry; but if you irritate him, he instantly shows bold resentment. The jaws are opened and the bright purplish-blue tongue flickers while the body swells and a fierce hissing noise is uttered, as if it were being pumped from the depths. These reptiles, of course, are harmless, but their display must serve to frighten some of their natural enemies. In the Mallee scrubs, I have seen a "blue-tongue" smaller and more brightly colored than the common species (*Tiliqua scincoides*), the average length of which is nearly two feet.

"Shingle-back," "stump tail," and "sleeping lizard," are the popular names for the most sluggish of all the Australian reptiles (*Trachysaurus rugosus*), which enjoys a fairly wide range. In northwestern Victoria and South Australia (near the coast), I have observed shingle-back lizards in number. In one spot, more than twenty were present, not in association but within a few yards of one another. The place must have had some special attraction for the lazy, dull-colored reptiles.

The stump-tailed lizard measures from a foot to fourteen inches in length. Its curious, broad and short, stumpy tail might be mistaken at a distance for the lizard's head, though smaller and more rounded. In some districts, indeed, the species is known as the two-headed lizard. Its appearance plainly indicates that nature never intended

Photograph by C. P. Kinane

A blue-tongued lizard (*Tiliqua scincoides*) in angry mood, with its purplish-blue tongue in action

Photograph by Charles Barrett

This brood of young brown hawks (*Hieracidea berigora*) was fed mainly on stump-tailed lizards (*Trachysaurus rugosus*). There was a half-devoured specimen of this lizard in the nest when the photograph was taken

that it should live an active life; nor does it break her law. A snail might win a race with *Trachysaurus rugosus.* The lethargy of our stump-tailed lizard is so great as to be diverting to an observer of its ways. Like some creature of a poet's fancy, this indolent reptile

Photograph by Charles Barrett

The stump-tailed lizard is also known as the double-headed lizard, a not inappropriate name as any one taking a quick unanalytic glance at this picture will admit. The photograph was taken in the Mallee country, Victoria, and shows the sluggish lizard stretched on the sand

"drags its slow length along"; only it is short instead of elongated; it waddles on its stomach, one might say.

In my latest trip to the Mallee (October, 1922) I noticed that brown hawks (*Hieracidea berigora*) were feeding their broods on stump-tailed lizards, varied with larger, and very active, species. Remains of several specimens of *rugosus* were found in a hawk's nest, and the mother bird was seen approaching with a young monitor lizard (*Varanus* sp.) dangling from her beak. Stumpy has no defence against a bird of prey; he may be sighted and captured at leisure for the mere trouble of alighting on the ground to pick him up. It is different with the monitor.

This brings me to our largest lizards, in popular parlance "goanas"—a corruption of iguana, I suppose. We have no iguanas in Australia, as every naturalist knows; but "guanas" our monitors will be called for many years

Photographs by Charles Barrett

THE MONITORS OR "GOANAS"

The genus *Varanus* includes the largest of Australia's lizards. One species, *V. varius*, attains a length of six feet; scarcely less impressive is *V. gouldii*, which is more than four feet in length. There are also intermediate and small species in the genus. The lace monitor (*varius*) is essentially a tree-climber and takes ruthless toll of birds' nests, the young birds as well as the eggs being eaten. When the close of the nesting season puts an end to its raids among the trees, this lizard takes to the ground, preying upon rabbits and other animals. Gould's monitor, on the other hand, lives habitually on the ground to come. It is difficult to lay the ghosts of popular errors. Of these long-headed lizards we have several species and varieties. At least two of the species are of considerable size, as "big as alligators," to quote a newspaper heading; others are from two to three feet in length; and finally, there are species smaller still.

The lace monitor (*Varanus varius*), mainly an arboreal lizard, inhabits eastern Australia. It varies in length, full-grown examples measuring about six feet. This reptile is a great enemy of birds. It climbs the tallest trees with wonderful facility, and few nests are safe from its raiding. Sometimes the big robber is driven off by bold and powerful birds, such as the cockatoos; the smaller birds can only threaten and loudly protest while their homes are devastated. Very often, of course, the parents are away, and the monitor gets his meal without any annoyance.

When harvest time for eggs and nestlings is over, the lace lizard seeks a living on the ground. It hunts rabbits and small native mammals, snaps up "unconsidered trifles," and in the settled districts visits poultry yards, stealing both eggs and chickens. Often I have been startled by the sudden rush of a "goana" that had been lurking in long grass or among rocks and scrub on a hillside. In a second, if a tree be handy, a monitor surprised on the ground will be racing up the trunk. It will dodge round if you watch it, keeping on the side of the bole you cannot for the moment see. "Goanas" have been killed in large numbers for the sake of oil distilled from their fat, which is valued as a remedy for various aches and pains.

Gould's monitor (*Varanus gouldii*), which ranges all over Australia, is smaller (length up to about four feet) and more handsomely colored than *Varanus varius*. Another fact in its favor is that it is less voracious and vicious than the larger "goana." Furthermore, this lizard lives mostly on the ground; alarmed, it seeks as a rule safety in holes in the earth instead of climbing a tree. Although it swims well, it is most plentiful in waterless areas. Captive specimens hiss loudly when irritated, but do not attempt to bite; at other times, to quote Professor McCoy, they give "a gentle snuffing sort of cough, such as babies emit before they are weaned."

Many rivers and creeks in eastern Australia (from Queensland to southern Victoria if varieties of the species about to be mentioned are disregarded) are frequented by a strange reptile, *Physignathus lesueurii*, known as the water lizard, or water dragon—the latter name seems most suitable when the reptile is seen "at home." Lately this reptile has become famous among thousands of people previously ignorant of its very existence. Its claims to the title of "bunyip" were advanced by some "bush" dwellers during a discussion in the columns of the *Melbourne Herald* regarding that mysterious creature of native legendary tales and white men's camp-fire stories.

Maybe, there is a real bunyip, an animal remotely resembling the imaginary creature feared for centuries by the aborigines, if indeed they had perfect faith in their tribal tales. A seal astray far inland, in river or lake, may have given rise to the bunyip legend, and the boom of the bittern may echo in its "terrible voice." Descriptions of the bunyip vary among the tribes; but the legend is wide-spread, and many persons, even today, believe that Australia is the home of a large and wonderful animal, unknown to science but familiar to black fellows! "Blood-curdling screams," heard at night in the "bush" not far from Melbourne, were attributed to the bunyip. Most probably they were uttered by a powerful owl (*Ninox strenua*) or a koala (*Phascolarctus cinereus*), both noted for making unearthly noises.

Dozens of theories were advanced, but the mystery remains unsolved. The theory that interested me was that propounded by some young men camped near a creek frequented by water dragons, and published in the *Melbourne Herald*. "A lizard is responsible for the bunyip scare," the campers declared; and they described how the reptile, the length of which is about thirty inches, rested upon a rock in the creek, and inflating its cheek pouch, produced "unearthly sounds." I have seen many water dragons in their haunts, but have no personal knowledge of their vocal powers.

The color of the water lizard on the upper surface of the body is dark olive, with cross bands light and dark. The cheek pouch is vividly colored in lines of rich yellow and blue. An expert swimmer and diver, this reptile is not entirely aquatic in its habits. It frequently is seen on the banks of streams or basking on rocks in the current. At the least sign of danger it dives into the stream and swims out of sight. Rambling beside a rocky Gippsland creek on a hot day, I came suddenly upon a "colony" of water dragons. Before I could focus the camera every lizard had splashed head first into the water. The prey of the species seems to consist chiefly of insects, including native bees.

. . . .

Only vignettes have been given of reptile life in Australia; the subject deserves large volumes.

Photograph by Charles Barrett

A creek in Gippsland, Victoria.—The rocks in the stream and along the banks are frequented by the water dragon (*Physignathus lesueurii*)

The Vanishing Wild Life of Australia

THE CAUSES OF THE SCARCITY OF CERTAIN OF THE NATIVE ANIMALS EXPLAINED BY A. S. LE SOUËF

THE preceding articles have introduced the reader to the strangely primitive mammals, the birds, and the reptiles of Australia, and the doom of extinction that has overtaken some species and that threatens others has been alluded to here and there. By way of supplement to this phase of the subject, it seems in order to print a substantial portion of an article entitled "The Australian Native Mammals," which Mr. A. S. Le Souëf contributed to a recent issue of the *Australian Zoologist*.[1]

The fact that some of our native animals are getting increasingly scarce is well known to those familiar with them in their native haunts. Mr. W. W. Froggatt drew attention to this matter (Proc. Linn. Soc. N.S.W., 1913), but little else of an authoritative nature has been published. Much uncertainty and misapprehension has been caused by many people writing and speaking about the matter without having any basic knowledge of the subject.

Actual facts are rather difficult to secure, as comparatively few people take sufficient interest to make observations, or can recognize any but the common species when seen. In the absence of any comprehensive survey this resumé is only approximate.

The cause of the disappearance of some of our animals can be stated to be (in order of importance[2]):—

(a) Introduction of the fox, the cat and the rabbit.

(b) Shooting and trapping for the fur market.

(c) Opening up the country by settlement.

(d) Disease.

(a) The Marsupials are representatives of animals that appeared very early in the history of evolution; they were in process of time completely superseded by the more advanced animals that we know today. The isolation of Australia at a time when the Marsupials were predominant, allowed them to remain unmolested, except for the later introduction of the dingo. With no competition except among themselves, they have stayed in their primitive state—remarkably harmless and with a low instinct of self-preservation.

When animals of this class suddenly find themselves placed in competition with such advanced forms as the fox, the cat and the rabbit—types that are far ahead of them in the evolutionary scale—it is just as inevitable that they should go down before the invader, as that the aboriginal should give place to the white man.

The fox is by far the greatest menace that our wild animals are faced with. It is widespread, uncontrollable, and reaches places where man has not penetrated. Its progress towards northern and central Australia will be watched with interest; if it can establish itself in the dry and also in the tropical areas, then a great many of our animals—some hardly known to science—will disappear. So far there is no evidence that it can live away from permanent water or in the tropics. It is significant that most of our animals live in the driest areas, getting their moisture from roots, bark and insects. The rabbit, the cat and the European mouse have already spread over the continent; the rabbit thriving in waterless areas in good seasons and

[1]Vol. III, Pt. 3, issued June 7, 1923.

[2]Different students of the Australian fauna will assign a different order of precedence to the agencies of destruction. In the article which Mr. Raven contributes to this issue, first place is assigned to man, while the fox is subordinated as a destroyer to the dingo. Though such differences of viewpoint will continue to prevail according to the experiences of the individual writer, there is no difference of opinion on the point that all of these agencies are tending to deplete the native wild life.—EDITOR.

being swept off again in dry times—but I do not think that they have any marked effect on the native animals.

Mr. Le Souëf then alludes briefly to the presence, in the eastern coastal areas extending from Victoria to North Queensland, of the poison tick (*Ixodes holocyclus*), which is of aid to the marsupials in that it is "fatal to canines and somewhat less harmful to cats." He calls attention to the fact that Tasmania and the islands off the coast are free from the fox but that this animal has spread along the south of Australia and has reached as far north as Geraldton in Western Australia. The depredations of the fox as they affect particular native animals are then considered:

In New South Wales the only species that are holding their own, as far as I can judge, are the larger kangaroos, the Wombat[1] and the Platypus. The Red and the Gray Kangaroos, owing to their gregarious habits and their size, are fairly safe. The Wombat is too doughty an animal for the fox to tackle, while the Platypus is protected by its environment. A large animal that seems to be affected is the Wallaroo; this species lives singly or in pairs or at most three or four together, and the female is often alone. It has been stated by observers in the Monaro District, that when a fox finds a female with young in the pouch, he chases her until the "Joey" is thrown out; this is then secured and killed. . . .

(b) The insatiable demands of the fur trade form the second heavy drain on our native animals. This trade should absorb only the natural increase, but the machinery for control is lacking, and the laws make very little difference in the number of skins taken and exported.

(c) The opening up of the country by settlement has had its effect on the native game. The first stage, after upsetting the balance of life, was an enormous increase in the Marsupials, but systematic killing and the advent of the rabbit and the poison cart soon stopped this.

(d) Under normal conditions there is a very correct balance of life among the wild animals. Occasionally, in the absence of natural enemies, a species will increase to such an extent as to overtake the food supply; then in their weakened condition, disease is apt to break out in a virulent form and sweep them off in thousands.

After citing several local instances of the decimation of particular animals through disease and after recapitulating some of the statements previously made, Mr. Le Souëf suggests certain remedies, including a zoölogical survey and the restriction of exports to the surplus or ordinary increase of each species. Toward the end of his article he states:

The asset of the fur trade has given Australia millions sterling in the past and will, if preserved, do so in the future; but unless control is based on accurate knowledge, it may be frittered away. At present it is nobody's business to ascertain what species of animals' skins are leaving the country, but if a small export tax were imposed, they would have to be examined. The funds so collected could reasonably be used to preserve the asset.

[1]In the northern part of New South Wales the wombat is now practically extinct.—EDITOR.

The Great Barrier Reef of Australia

By CHARLES HEDLEY
Principal Keeper of Collections, the Australian Museum, Sydney

IT is only in the warm seas that corals grow, and the warmer the water, the more luxuriant is the bank, or technically reef, which they build. Thus, as we sail southward in the Atlantic and pass the Bermudas and Bahamas, first one kind of coral and then another appears, till in the West Indies the coral becomes rich enough to display its architecture of reefs, atolls, and lagoons. But even in the West Indies the coral does not attain perfection. During the warmer phases of the Tertiary, there were many genera and species of coral in the Caribbean Sea which now have become extinct in those waters. For the most part these extinct forms are, however, still represented in the Pacific, so that to find the full development of coral growth we must leave the Atlantic and traverse the other great ocean. As one travels west, the variety of coral becomes greater, till a maximum is reached in the Philippine-Papuan-Solomon region. The greatest single structure which the coral has achieved, now or in the past, is the Great Barrier Reef of Australia. This extends along the coast of Queensland for more than a thousand miles. At the tropic of Capricorn, the southern end of the Great Barrier fades gradually away, the species of coral becoming fewer and the reefs smaller and more widely separated as the colder water represses their vigor and finally extinguishes them. In the north the Great Barrier Reef terminates more suddenly. From the high mountains of New Guinea numerous large rivers pour into Papua Gulf, and their muddy waters extend far out to sea. After cold, the greatest enemy of the coral is mud. Thus, a mud line formed by the Papuan rivers limits the coral islands of the Great Barrier. The soft corals, or Alcyonaria, can endure more mud than the stony corals. The eastern face of the Great Barrier is also sharply defined. From the coast of Queensland a continental shelf, from twenty to eighty miles in breadth, extends to the edge of the coral sea or, more strictly speaking, the Carpenter Deep, and there plunges down steeply to the abyss. Along the edge of this continental shelf is built the seaward wall of the Great Barrier.

The Great Barrier does not, as its name might suggest, hug the coast of the mainland. It is roughly parallel to the continent, but the space between reef and main is as wide as that between England and France.

The outside edge of the Great Barrier takes the form of narrow banks, each a few miles long followed by a break or channel of a mile or two, and continued in a general north-south direction by a chain of similar banks, most of which are covered at high water. Meeting this sunken obstacle, the ocean swell from the Pacific leaps up in a tremendous wave and falls with a crash and a smother of foam upon the reef. Passing in a vessel through one of the breaks or passages, the traveler receives an impression of an endless ribbon of foam, arising from no apparent cause and running across the ocean from horizon to horizon.

Outside of these banks and passages soundings fall away steeply to the abyss. Few mountain ranges present a

A channel between two islets hedged in by mangrove

wall so huge and steep. Probably a high rampart of coral has here grown up from a foundation of the slowly sinking continental shelf. As yet next to nothing is known of the thickness of the coral at the margin of the Great Barrier, but soundings indicate that it is at least many hundreds of feet deep.

The channels through which ships may traverse the Barrier Reef from the Lagoon Channel to the open sea mark, it is popularly supposed, the site of old river beds. A brief examination of these channels will dispel this theory. Doubtless the Australian continent once extended seaward to the present margin of the Barrier and, if so, the lost fringe probably carried a normal proportion of river channels. But the remodeling of the coast has completely obliterated these rivers; the present passages through the reef are merely a continuation of the lagoon floor that has not been built over. Soundings do not carry any trench across the reef, and the existing rivers have no relation to the passages through the reef.

Between the outer Barrier and the mainland lies the Lagoon Channel referred to above; this is the narrow waterway used by the coastwise shipping. Tropical Queensland rises from the sea in steep forest-clad hills. The heavy rainfall of the latitude is shed by numerous streams. Their muddy water is injurious to the coral polyps and so a zone along the land is maintained comparatively free of coral, to the comfort of the sailor. Between the mud zone and the outer Barrier is an area of clear water of from twenty to fifty fathoms deep, overgrown by a most intricate maze of coral patches, various in size, shape, and spacing. The term Great Barrier is apt to be misunderstood, suggesting, as it does, a compact continuous structure running without interruption like the Great Wall of China. The reef, or as one writer would call it, the reeferies, is really composed, as was indicated above, of an infinite number of separate banks and shoals of coral.

Some of these have an interesting bearing on the theory of atoll structure. No marvel reported by early explorers fascinated the northerners in the homeland as did the tale of the atoll. Picture a hollow island, a lake surrounded with a coral ring, on which grows a forest of palms,—"a garland thrown upon the waters," as Dana prettily expressed it. The origin of the atoll was a prize puzzle for scientists. Darwin wrote one of his first books about it, and dreamed of a volcanic peak sinking under the sea, while a crown of coral grew upwards till only the coral tombstone was left to show where the drowned peak lay. Sir John Murray assumed that originally there was an island of solid coral, the center of which had been hollowed out by the solvent action of water upon lime.

Darwin failed, however, to consider that atolls are confined not only to warm seas but to the narrower regions of invariable winds, and to explain why the windward side is normally better developed than the leeward. Murray failed to notice that a solvent which would remove the center of the island would also remove the margin and would even prevent its formation in the first instance.

The inner Barrier displays a long series of miniature atolls in various stages of growth. These models show the course of construction. First a point in the reef grows upward till it breaks the surface of the water, then the waves pack round it a mass of drift stones and sand, and the islet so formed assumes a crescent shape with the back to windward and the horns to leeward. The waves continue to sweep along further drift matter and the crescent thus grows first into a horseshoe and ultimately into an oval, thus enclosing a lagoon. If the process of evolution is continued, the lagoon is filled up and the atoll becomes a solid cay. Finally, seeds drift ashore and a forest clothes the new island.

These coral islands can be distinguished as far as the eye can see, because they are always low and flat. Far away they seem like a black horizontal line. Nearer, they appear like bushes afloat on a raft.

All these great and complicated coral structures are the work of small and feeble animals. It is a popular mistake to assume that the reef is the result of coördinated design by the coral-builders much as a honeycomb is the result of coöperative work by bees. But coral polyps are mere animated lumps of jelly and deposit coral as unconsciously as other animals make bone. A branch of dry coral is pitted all over with small cells; each is the cast of the body of the polyp which sat there when the coral was alive. A skin went from polyp to polyp so that though each individual had a separate life, all were of one flesh. The living polyp has a circle of waving arms set round somewhat like the petals of a flower, with a mouth in the disk. As animalculæ float past, the polyp darts little poison javelins at them. The paralyzed victim is then seized by the petal arms, pushed to the central mouth, and swallowed whole. Only when the tide is very low are the beds of living coral laid bare. Then a wonderful spectacle is displayed, like a garden in which the plants have been turned to stone but where the soft background of foliage is absent. Seaweeds are so small and scarce that in a general view they are unseen. The coral masses assume the aspect of gigantic mushrooms, of elegant vases, of flowing draperies, of stalactites and stalagmites, or of tufts of heather. A general tone of brown and yellow is brightened by a few vivid patches of blue, orange, pink, or purple.

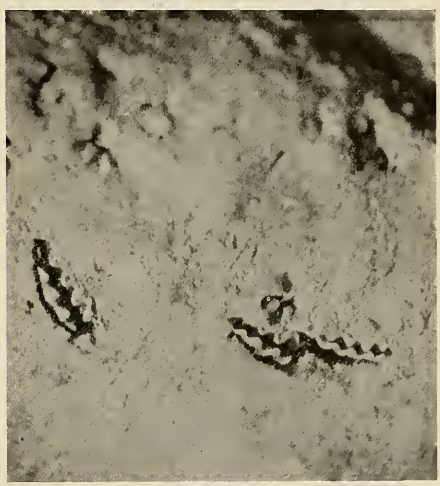
Among the coral is strewn an endless variety of animal life, some forms being quaintly shaped and richly colored. Conspicuous for their great bulk are the giant clams, two, or even three, feet across. Gaping wide, these display a myriad eyes like gold-green beads on the brown velvet mantle. There are stories of luckless divers drowned because a hand or a foot was caught in a clam shell. Other smaller clams burrow deep into the stone, till only the grinning "jaws" are seen.

Lying in shallow pools there are black sea urchins with sharp poisonous spines as long and slender as knitting needles. There are starfish of many forms, the commonest being a sky-blue *Linckia*. Some have long snakelike arms which writhe about and which at a human touch are broken and thrown off till dismemberment is complete.

A great sea anemone, the size of a dinner plate, shelters a small fish which is a brilliant scarlet with a vertical white stripe. Any ordinary fish would be severely stung or even killed by the sea anemone, but the scarlet fish is immune and when danger threatens, darts to the bosom of its host and nestles with perfect safety in the midst of poisonous tentacles. Other anemones similarly shelter little prawns.

In the shallow pools or buried in the sand are many kinds of *Holothuria*, locally called *bêche de mer*. In shape like a great sausage, in color black, brown, or yellow, they extend a circle of feelers and mop up sand and weed, which is swallowed indiscriminately on the chance that it may contain some food. These animals are boiled, peeled, dried, and exported in great quantities to China, where a palatable soup is made from them.

Such fields of coral as are described above are seen only at low spring tides. That part which is uncovered during ordinary tides is not beautiful at all, for it consists solely of piles of dead



In the upper picture is shown the clam, *Tridacna crocea*, sunk its full depth in the coral. The exposed mollusk appears in the lower picture

A much worn "nigger-head," or block tossed up by a hurricane

Beach of one of the Howick Islands; about 14° S. This is a characteristic scene on a coral cay. In the background is a low forest of mangroves and other growth; in the foreground is the coral-sand-rock, formed by solution and redeposition of lime under a cover of coral sand

and broken coral and drifts of sand. Here and there along the crest of the reef are blocks of coral blackened and weather-worn, ranging from the size of a table to that of a cottage, that have been torn from the living reef and flung up by a hurricane. Locally these are called "nigger heads." Viewed from a distance as one sails past a reef, they stand out sharply against the sky.

A coral reef is not exclusively a mass of coral. The coral may be regarded as a framework in which are packed the remains of all sorts of animals and plants. Every storm tears off masses of coral and grinds them to shingle and sand. These are swept together and transformed into beach rock by percolation, solution, and redeposition of lime.

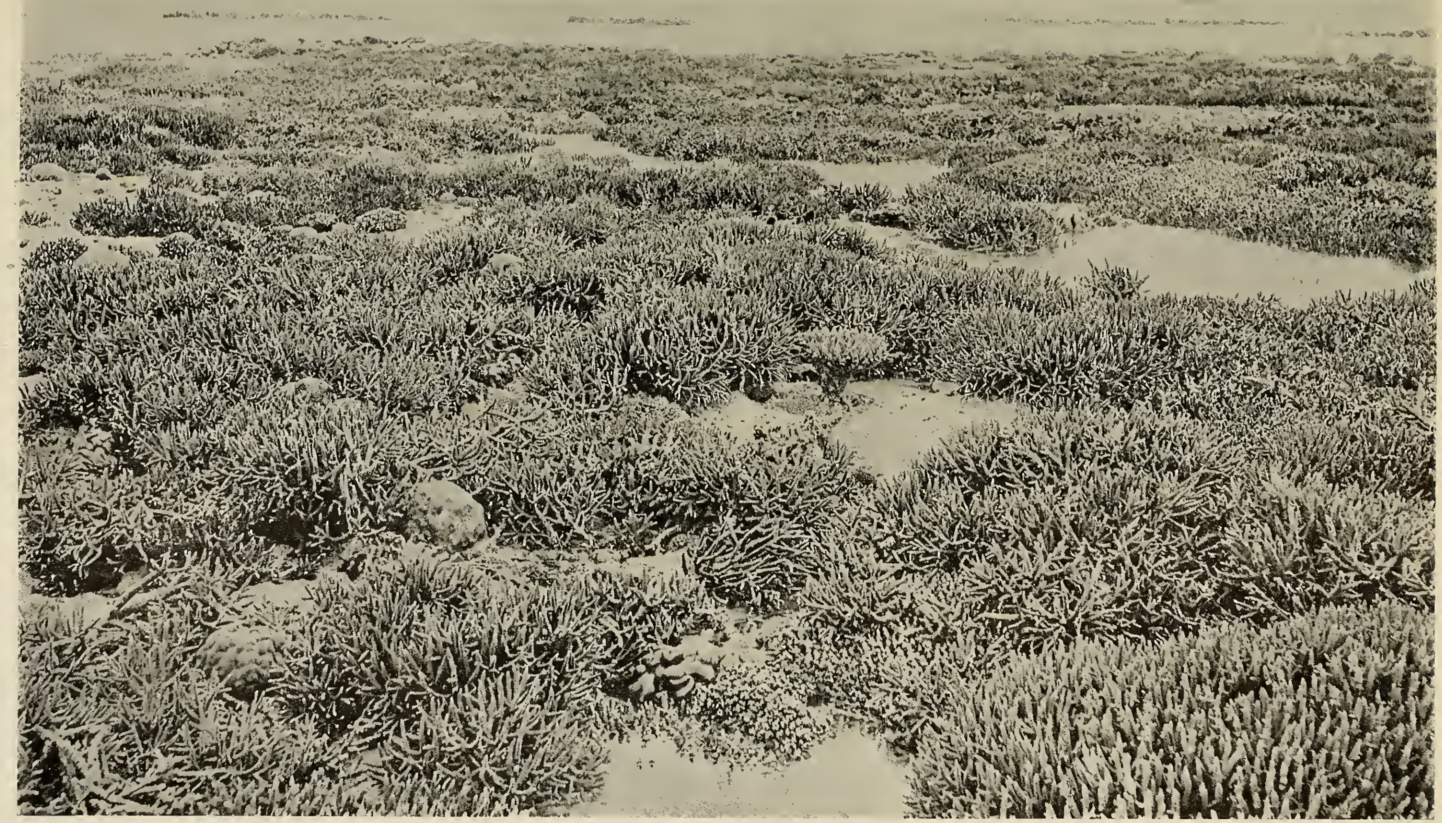
In contrast to the low coral islands are the high islands which are stationed between the reefs and the mainland like sentinels along the coast. Sometimes they stand alone but often they are clustered in groups or extend along avenues. Rarely does a voyager lose sight of one before the next appears. They represent the peaks of a drowned coast range. In a late geologic period the former coast was inundated by the sea, and as the Barrier Reef commenced to form, these peaks were isolated. These high islands afford enchanting scenery: they are often several miles long and may rise to more than a thousand feet; they are watered by brooks and clad with dense forests of palm and vine. Their bays and sandy beaches are pleasure grounds beyond compare.

The wide expanse of shallow, warm, and sheltered water included within the Barrier Reef and Torres Strait offers a field for several tropical products. An important pearl fishery is based on the giant pearl shell (*Pinctada maxima*), which may reach a diameter of a foot. Though numerous and valuable pearls are obtained, the industry's chief source of revenue is the shell. This is exported in large quantities and is manufactured into knife handles and other articles of use

A beach with a *Pandanus* tree.—The line of surf in the distance marks the reef at the edge of the lagoon

or ornament. The fishery is conducted by a large fleet of luggers manned chiefly by Japanese. The diver, fitted with dress and diving helmet, descends in several fathoms of water, and as air is pumped down to him, he walks along the bed of the sea and gathers the pearl shells in a bag. Another industry is based on the *Trochus* shell, a large gastropod striped with white and red, and nacreous within. This is exported to Japan, and cut by machinery into buttons.

W. Saville-Kent, Photo. London Stereoscopic Co. Rep.



W. Saville-Kent, Photo. *London Stereoscopic Co. Rep.*

STAG'S-HORN REEF

This picture and the one on the opposing page have been reproduced from W. Saville-Kent's sumptuous volume, *The Great Barrier Reef of Australia*, published by W. H. Allen & Co., Limited, 13, Waterloo Place, S. W., London. They form a part of the beautiful series of photographs of coral growths that embellish that work

Iles Photo. Protected 3-8-03

WAIMANGU GEYSER

For thirty years this geyser, which opened on the eruption rift after the outburst of Tarawera volcano in 1886, was the largest in the world. Its column of muddy water was thrown upward at irregular intervals to heights varying from 900 to 1500 feet. It ceased erupting after Frying Pan Flat blew up in 1917, and a pool of boiling water spread over the area formerly occupied by the Flat. This pool is presumably a safety valve, preventing the eruption of the geyser

Rotorua and the Geyser Region of New Zealand

By EDMUND OTIS HOVEY
Curator of Geology and Invertebrate Palæontology, American Museum

NEW ZEALAND is a land of natural wonders. Crowded into the 103,000 square miles of area comprising the North and South islands are many of the scenic marvels of the world: volcanoes, active and extinct, which are impressive because of their great size or towering height; one of the three famous geyser regions of the earth; beautiful river gorges and cañons, their walls heavily forested to their summits; an Alpine area that rivals Switzerland with its lofty, snow-clad peaks and its great glaciers; a lake region that is surpassing in its loveliness; a series of somber fjords that rival those of Norway and Greenland for depth, grandeur, and picturesque scenery. And all this is set in a framework of pastoral and agricultural beauty that is entrancing to the eye of the beholder in the vision it gives of fertility, prosperity, and peace.

A large part of the North Island is volcanic in origin, numberless cones and craters dotting the land, which is composed of great sheets of lava, scoriæ, pumice, and ash. The Auckland district alone contains at least sixty-five old vents, many of which still preserve their craters intact, revealing the origin of the mountains even to the layman. The volcanic activity began in Miocene time and is still manifest in reduced form. Severe explosive eruptions have taken place at Tarawera in 1886 and at Ngauruhoe in 1907, with a small outbreak at the latter place in 1923, but no streams of lava have issued from any of the New Zealand volcanoes since the islands have been known to white men or within the traditionary periods of the Maori, that is to say, for the past six hundred years.

The great thermal district of the Dominion lies almost in the center of the North Island, extending in a zone some twenty miles wide for 150 miles northeastward from Mt. Ruapehu, a dormant volcano more than 9000 feet high, nearly to the seacoast at the Bay of Plenty. White Island along the same line in the bay is a volcano in the solfataric stage. Much of the zone is an elevated plateau lying from 1000 to 1500 feet above the sea, over which are scattered thousands of steam vents, thermal springs, geysers, and mud springs, visible evidence of the close proximity of the earth's internal heat. Rotorua, a resort with a population of about three thousand, is the center from which tourists usually visit the region or where they stay for longer or shorter periods to take the numerous hot mineral baths and to drink the medicinal waters. The village lies upon the borders of one of New Zealand's most beautiful lakes, from which it derives its name, and is close to the old Maori settlement of Whakarewarewa, more commonly known to the English residents of Rotorua as Whaka. The Maori, a people of Polynesian origin, have occupied this region for generations, covering a period the beginning of which long antedates the advent of the white man, and have utilized the springs for bathing and the steam vents for cooking their food as well as for warmth in winter.

Ohinemutu, also on the lake and immediately west of the village of

Photograph by E. O. Hovey

The Maori Church of England edifice at Ohinemutu, with the parish houses adjoining.—The boiling spring that steams in front of the church had not made its appearance when the site for the church was chosen; it is indicative of the unstable conditions in the geyser region

Photograph by E. O. Hovey

A Maori whare, or community dwelling, built in the old style, but of materials procured from the white man. Native carvings adorn the front, the posts, and the rafters

Rotorua, is the original Maori settlement of the region. It is built on land which abounds in hot springs, new ones breaking out from time to time to offset old ones that have ceased their activity. A native mission church was built on a point jutting out into the lake, and later a strong boiling spring burst into life in the road in front of the building, obscuring the view with a steam column that seems incongruous in such a setting.

Lake Rotorua lies 915 feet above sea level and though it is one of the larger lakes of the Dominion, it is also one of the shallowest, being but 84 feet deep. Low environing mountains give a lovely setting to the lake and nearly in its center rises the sacred island of Mokoia. On Mokoia were celebrated the great ceremonies of the Arawa tribe of the Maori; there, too, was situated a stronghold often besieged in the frequent tribal wars, and it was the scene of many a cannibal feast. A pleasing legend attaching to the island is that it was the place to which the Maori princess Hinemoa swam from the mainland when her parents refused their sanction to her union with her royal suitor Tutanekai. Exhausted by her long swim, she sought recuperation in a hot pool on the island and there was discovered by a slave of her lover, who summoned him to the rescue. Marriage soon followed and many of the inhabitants of Ohinemutu claim to be the descendants of the happy couple. Visitors are now taken to the famous bath on their tour of the lake.

One rainy afternoon we strayed over to Whakarewarewa, and crossing a primitive wooden bridge, found ourselves in the midst of a native reservation, one and one-half miles from town. It was as if we were in another world. We were immediately approached by a Maori woman, who collected a shilling from each of us as an entrance fee to the Maori village which lies below the geyser region. The houses in this settlement are not at all native in construction, being built in rough fashion from sawn boards obtained from the white man. Here, however, the Maori live in somewhat their primitive manner and carry on carving in wood and stone and weaving in grass and fiber.

Soon there came up to us Georgina, a handsome middle-aged Maori woman with iron-gray hair, the tattooed lips and chin of a married woman, and a pleasantly modulated voice denoting refinement. Georgina is one of the official guides to the geyser region, which is a government reservation, and she has many Maori legends and myths to relate. She showed us the greenstone tiki, or family talisman, which she wore suspended from a cord about her neck. The tiki is greatly prized and the longer it has been in the family, the more highly is it valued; but the Maori is canny and will part with his tiki for a sufficient consideration. Georgina offered us hers for thirty shillings.

We were shown the village bathtubs —the hot pools—where native boys and girls love to dive for coppers and sixpenny bits thrown into the steaming water. All the Maori love bathing. An innocent-looking pool with conical walls and waters of clear aquamarine hue was pointed out to us as the place where Georgina's uncle had met a tragic end. Returning to the village late one night, he had stumbled into the spring, which lay along the pathway to his house, and had been cooked to death before help could reach him. Since the occurrence of the accident an iron railing has been built around

Photograph by E. O. Hovey

General view of a portion of the composite sinter mound and terraces built up by the geysers at Whakarewarewa, near Rotorua

Photograph by E. O. Hovey

The vent of the great Wairoa Geyser, which at intervals of about twenty-four hours spurts up a column of boiling water to a height of 80 or 90 feet

Photograph by E. O. Hovey

The cone of the Prince of Wales Geyser at Whakarewarewa, with a cauldron of violently boiling water below it

Photograph by E. O. Hovey

The Devil's Cauldron, a strongly active "paint pot" about 20 feet in diameter.—The paint pots, of which there are many at Whakarewarewa, are pools of ebullient mud, formed by decomposition of the rocks through fumarole action. They are well named, for the mud ranges from pure white, through various shades of red and orange, to gray and black

Iles Photo

TARAWERA MOUNTAIN AND LAKE ROTOMAHANA

This volcano broke into violent activity on June 11, 1886, obliterating the beautiful Pink and White Terraces shown on pp. 78–9 and leaving other evidences of destruction and desolation the spring, but it is in sad disrepair. One must be careful as he walks about among these springs and not wander from the beaten paths. The necessity for the exercise of such caution was shockingly brought home to us a few days later through the scalding to death of a young woman visitor who strayed from the recognized routes at Tokaanu, on Lake Taupo, and broke through the crust over a boiling spring.

Our guide indicated a little Catholic chapel beneath which a steam vent had opened after construction had begun. Were the Maori builders disturbed by this event? Not at all. They merely fashioned an outlet for the steam beside the chapel and went on with their work.

The government reservation, or park, lies in a shallow valley in the midst of which the geysers have built up a low mound of siliceous sinter a few acres in area. There are many hot springs here, some of which throw boiling, or nearly boiling, water at frequent intervals 10 to 20 feet into the air. About once a day the great Wairoa, or Pohutu, Geyser erupts to a height of 80 or 90 feet, but occasionally it remains quiet for weeks at a time. Just below the throat of the Prince of Wales Geyser lies a cauldron of violently boiling water, which shows well the strength of these springs and gives some hint of the amount of hot water issuing from the ground at Whakarewarewa and swelling the volume of the stream which flows through the native village and empties into Lake Rotorua. It is now considered that the water of these hot springs and geysers is mainly "juvenile" in origin: that is, it was contained in the volcanic rocks when they were in a molten state and has been given off gradually as the lavas have cooled. The water as it issues from the ground is, furthermore, highly mineralized and forms deposits not only of the familiar chalcedonic silica—siliceous sinter—which comprises the principal portion of the cones, mounds, and crusts, but also of sulphur, iron oxides, alum, and other minerals. The orifices whence steam alone issues show an abundance of crystals of sulphur in their walls.

The number of paint pots, or mud volcanoes, in the region is large. A paint pot is a place where but little steam issues and only enough hot water rises to saturate the ground thoroughly and make a paste of the rock which has been decomposed by the chemical action of the hot water and steam and reduced to an impalpable powder. It is a phase of fumarole action. The "paint" is pure white or gray, or again, its color may be yellow, orange, or red, due to the presence of small amounts of iron oxide. Some of the paint pots are pools of very liquid mud through which occasionally rises a bubble of steam breaking with a quiet little puff at the surface of the pool, as in gently boiling pea soup. In other pots the mud is so thick and viscous that the pathway, or conduit, of the ascending steam is left open near its top, the mud being thrown out of the way in gobs or splotches, which fall about the conduit and build up a more or less unstable cone. Tikitere, twelve miles northeast of Rotorua, is noted for its craters of boiling mud, while at Waiotapu, thirty miles to the south of Rotorua, near the road to Wairakei and Taupo is a large mud volcano which has built up a cone about twenty feet high with a crater in its top that is sixteen or eighteen feet in diameter.

Perhaps the most interesting excursion to be made from Rotorua is that called the "round trip." It takes one

Courtesy of Prof. R. Speight, Canterbury Museum, Christchurch, N. Z.

THE PINK TERRACES, LAKE ROTOMAHANA

Courtesy of Prof. R. Speight, Canterbury Museum, Christchurch, N. Z.

THE WHITE TERRACES, LAKE ROTOMAHANA

This superb formation, at one time the admiration of all who gazed upon it, was destroyed in the Tarawera eruption of 1886 and the site is today buried beneath a hundred feet or more of volcanic ash. The Pink Terraces (see opposing page) have likewise been obliterated

Photograph by E. O. Hovey

THE CHAMPAGNE POOL

The constant stream of ascending bubbles that burst at the surface suggest the sparkling beverage after which this pool, one of the most interesting in the Geyser Valley of Wairakei, is named. Although usually rising in orderly fashion, sometimes the bubbles ascend in such numbers that their united force lifts the surface water into an effervescing dome one or two feet above the general level of the pool

Photograph by F. G. Radcliffe

THE ORIFICE OF THE DRAGON'S MOUTH GEYSER AT WAIRAKEI over a route about forty miles long by the Blue Lake of wonderful ultramarine hue, the Green Lake, and a bit of luxuriant "bush," or forest, to the site of Te Wairoa, a Maori village, which was overwhelmed by mud thrown out during the eruption of the volcano Tarawera on June 11, 1886. From Te Wairoa one goes by motor launch across Lake Tarawera, which lies at the west foot of the great volcano of the same name, and over a spur of the mountain to Lake Rotomahana. Here a second launch is boarded that cruises along the shore where the Pink and White Terraces, once the most famous sight in all New Zealand, lie buried beneath one hundred feet or more of ash thrown out during the same great volcanic outburst, and past steaming cliffs, the waters of which make a portion of the lake too hot for bathing and are responsible for the Maori name which it bears, Rotomahana signifying "warm lake." Leaving the lake, the trail ascends the valley in which was the Waimangu Geyser and halts at the Accommodation House, four hundred feet above the lake.

The view from this house, now in ruins, is most interesting. We are standing on the line of the rift which opened in the volcano of Tarawera in the eruption of 1886 and extended southwestward through Lake Rotomahana and Waimangu Valley, out of which were thrown vast quantities of ash and lapilli, covering many square miles of the surrounding country with a thick mantle of débris. It is a scene of desolation, with here and there a patch of green where nature or man has made an effort at reforestation. The hill slopes have been furrowed by the new drainage, which has assumed a dendritic pattern with main channels and branching tributaries. Within a half mile of our viewpoint lies Frying Pan Flat, now a seething pool twenty-five yards in width, where for years had been an area of dry mud dotted over with small orifices, which were the outlets of hissing steam, giving the whole the appearance of a frying pan on a hot stove. On April 1, 1917, with but little warning the Flat blew up, covering the immediately adjacent hills with mud and wrecking the Accommodation House three hundred feet above it. Its place was taken by a deep pool of actively boiling water, which seems to be the safety valve preventing the eruption of the great Waimangu Geyser. Very near the Flat one sees the dead vent of Waimangu. This geyser had opened on the eruption rift after the outburst of Tarawera and for thirty years was the largest geyser in the world, at irregular intervals throwing a broad column of muddy water to heights varying from 900 to 1500 feet. Its last eruption took place in 1916, overwhelming a guide and two visitors who had ventured to the edge of the orifice for the purpose of taking photographs. Their bodies were found afterward in the stream carrying the overflow from the geyser itself and other hot springs. Beyond the valley we see the lakes Rotomahana and Tarawera with the cone of Mt. Tarawera rising 2500 feet above the lake and deeply cleft by the eruption rift, which left six great craters in the mountain alone.

An automobile ride of fifty miles southward from Rotorua brings one to Wairakei, a center of thermal activity more interesting in some respects than its better-known neighbor. The geyser region is in a little valley a half-mile from the hotel, and is traversed by a small stream fed by hot water from boiling springs in its banks. At least ten of

Photograph by E. O. Hovey

THE CROW'S NEST GEYSER ON THE BANK OF THE WAIKATO RIVER, FLOWING OUT OF LAKE TAUPO

Every four hours a fountain 80 feet high plays from a siliceous cone about 5 feet high and 10 feet in diameter these springs are true geysers, which throw up fountains of water from 10 to 25 feet high at intervals which at the different vents vary from five to twenty minutes in duration. The Champagne Pool is a spring about twenty feet in diameter, where myriads of small bubbles rise, usually in quiet fashion, suggesting the sparkling beverage for which the pool is named; but occasionally they crowd together and raise an effervescing dome of water one or two feet above the general level.

The Prince of Wales Feathers is the name given to a small vent at Wairakei which well illustrates the principle upon which all geysers work. Ordinarily the balance of forces is such that the outflow of the spring is underneath the silica cone, but when action is desired, the guide puts a temporary dam into a little stream which trickles down the bank above the geyser, thus diverting an excess of water into its throat. In about twenty minutes the temperature and pressure in the conduit have risen and an eruption lasting for several minutes is the result. Somewhat the same principle animates the familiar percolator coffee pot, and we thus have an artificial geyser in action on the breakfast table every morning.

Paint pots abound in the valley, while in several places the overflow from the hot siliceous springs has produced beautiful terraces. The content of silica in solution in the water is considerable and builds up fantastic forms while constructing the cone about the vent of a geyser. At the Dragon's Mouth Geyser a toothlike stalagmite of siliceous sinter projects in weird fashion part way across the mouth of the conduit, receiving constant accretions through deposits from the erupting water.

The banks of the stream flowing through the valley are coated with silica near the vents, and bits of wood immersed therein are soon coated with stone. The dead branches of trees assembled around the orifice of the Eagle's Nest Geyser have been hardened with a deposit of the same mineral. Petrifaction is going forward before one's eyes.

One of the most peculiar sights at Wairakei is the Blow Hole, two miles from the hotel. Here, in the side of the valley, there is an opening about one foot in diameter from which live steam issues with a noise like that made by steam escaping from the safety valve of a locomotive. The guide states that the steam exerts a pressure of eighty pounds to the square inch. This may well be doubted, but it is difficult to hold a bush in place in front of the vent. The visit to the locality is usually made at night and a weird effect is produced by igniting a kerosene-soaked cloth and allowing the smoke, and finally the sparks, from the burning mass to mingle with the steam. Strange fire works, indeed! A similar blow hole is in the northern flank of the volcano Tongariro, forty miles to the southwest.

It cannot be said that the geyser region of New Zealand equals in attractiveness that of the Yellowstone Park. The lofty mountains which characterize the American region are lacking in New Zealand, and the geysers, while more frequent in their activity, are far less important in the volume of water erupted and the heights to which it is thrown. There are, however, more paint pots in the Rotorua-Wairakei district than in the Yellowstone. The New Zealand region is well worth study by geologists and a visit by tourists.

Photograph by C. G. Kaadt

The North pueblo of Taos, an ancient fortress of the Taos Indians

Some Plays and Dances of the Taos Indians

By FLORENCE MERRIAM BAILEY

THE famous pueblo of Taos, well called the Queen of the Pueblos, stands at the foot of noble peaks in northern New Mexico. The pueblo consists of two great clusters of terraced houses with their associated smaller buildings, one architectural group lying a little way to the north, the other somewhat to the south of the Rio de Taos that flows between. With the general form of the pueblo we were familiar, as are most travelers who have crossed New Mexico, but when we first looked upon it, the height and breadth of its many-storied piles—historic precursors of our modern apartments—filled us with astonishment. Against the dark-brown background of the adobe walls, which, like the neutral monotints used for backgrounds in halls of statuary and painting, gave strong relief for statuesque figures and living pictures, gorgeously blanketed natives in flaming scarlet or vivid blue were climbing the ladders from story to story or walking about on the housetops in all the splendor of their old-time costumes. What color! What a setting! We seemed to be looking at a scene on the stage, representing the days before the intrusion of the white man.

The first glimpse was enough to arouse the keenest enthusiasm but our interest was further fired by an artist, one of the pioneers of the well-known colony that has established itself in the neighboring hamlet of Taos. He told us of some of the plays and dances he had witnessed. On going over to the pueblo one day, he happened on one of the comedies. A large group of men stood on the housetop. Climbing the ladders to join them, he saw that they were looking eagerly toward the mountains where a band of Taos Indians dressed like Pawnees could be seen scouting along from rock to rock. They came on until they reached the pueblo, when they proceeded to climb up the walls. The men on the roof went forward to greet them and shake hands with them, but the "Pawnees,"

Photograph by A. E. Weller

Taos men in native costume.—Eagle Star, wearing the bone breastplate, is straightening an arrow

as if suspecting treachery, came up timidly, some shrinking back as they shook hands, others standing, sullenly refusing to shake hands, while still others remained on guard with arrows in bows ready to shoot. When all of the visiting band had reached the housetop, one of the Taos headmen stepped out and announced in a loud voice that the Pawnees had come and that they had brought with them goods taken from palefaces—meaning soldiers and those traveling in the overland wagon trains—which goods they would now trade for bread. At this the visitors brought out a supply of trinkets which they had collected and the Pueblo women came up with great baskets loaded with bread, which they had been busy baking for days in preparation for this comedy.

We were fortunate enough to witness the symbolic sunset dance, called by the Indians the Foot-racing Dance, as it is preliminary to the religious relay race of San Geronimo's Day. When we reached the plaza, the afternoon light was already on the north pueblo warming its brown walls and lighting up a doorway in which was seated a young Indian girl in a soft, dull-blue dress, a picture for a painter. When we looked over to the south pueblo, on the very topmost roof there stood two splendid figures, a girl in flaming red and a man in vivid green. The Indians below were busy finishing their tasks, and while we were watching them, our attention was arrested by the loud heraldic voice of a tall stately man who walked back and forth on the top of the south pueblo admonishing the people in their own tongue to leave their work and prepare for the vesper service which was to precede the dance. Raising our field glasses we saw the red paint on his face and the red stripe down his toga-like blanket, and caught the glint of the large silver earrings which showed him to be a member of the Big-earring Clan. As the herald strode back and forth on the housetop like a Tribune addressing the people, the young girl in red leaned on a brown chimney top, making a splendid lay figure. Soon after this summons from the south pueblo, the lieutenant-governor, a dignified figure in a dark purple blanket, crossed the square. Reaching the north pueblo he mounted the ladders to the housetop and in his turn called the people to vespers as the other herald had done.

But the priest who was to officiate had not yet arrived; accordingly, utilizing the interval, two young Indians jumped on their horses and sped away on some belated errand; a woman with a baby on her back hurried across the square; and an Indian whom we had seen previously on his threshing floor passed on his way to the underground kiva to finish dressing for the dance, his face being already decorated with red paint and his hair arranged artistically, one slender braid hanging down the middle of his forehead. Small groups of mounted ranchmen gathered near the mission, wagons of sightseers came slowly drifting in, and the mission bells began to ring at intervals.

Finally the priest arrived, the bells rang more clamorously, and an old Indian took his stand by the mission door beating on a buffalo-skin drum. The courtyard filled with a motley assembly of Indians, Mexicans, and white men, prominent among whom stood the tall war chief and the governor in all the dignity of their rich ceremonial robes.

As we entered the dusky interior of the mission, a glow of candlelight in front of the chancel revealed figures of the devout kneeling upon the floor while vespers were being chanted by the choir. When we became accustomed to the dim light, we could see that the choir standing inside the chancel included several Indians whose blankets contrasted strangely with the white vestments worn by the priest and his assistants, while white men in citizens' clothes and the statue of the Virgin added to the picture. During the service a simple-minded man who wandered in beating a drum was quietly led out by dignified Indian officials, and when an old blind man tried to grope his way out, a young Indian came quickly forward and took him gently by the hand, guiding him through the doorway.

At the close of the vesper service came the short but beautiful, symbolic Foot-racing Dance, the relay race of the following day being the last of a series of foot races which are explained as "a sacrifice to our father the Sun, to help him on his long run, so that he will give us light forever." Two bands of dancers in ceremonial regalia came up from the kivas that are at the northeast end of their respective pueblos and formed in solid rank, each band at the foot of its own wall, presenting splendid masses of color striped by figures in red, white, and yellow, and topped by branches of yellow and green aspens which had that day been brought from high up on the mountain-sides. These branches, we were told, were used by each of the rival sides to signify that their respective representatives in the ceremonial relay race of the following day would sweep their way to victory.

"Ha-yah′-ha-yah′-ha-yah′-ha-yah′," the two bands broke out in high shrill chorus, advancing in converging lines with branches waving and drums beating till they met in the courtyard of the mission, when nothing could be seen above the white walls but the bright swaying aspens.

In coming out of the mission the dancers formed in one compact band of two facing rows, those from the north pueblo on one side, those from the south on the other. Then began the dance, which was merely a slow progression of the whole color mass by short sidewise steps, the movement accompanied by a strange but truly musical Indian chant. From the front

Photograph by Bert G. Phillips

TAOS INDIANS SINGING FOR A DANCE

Drums, two of which are shown in the photograph, mark the rhythm in ceremonial dances, and the symbolic religious and poetic songs interpret the ceremonial of the dances.

Music, with the Indians, is much more vital than with us: it is an integral part of their lives. Not only every public ceremony, it is said, but "each important act in the career of an individual, has its accompaniment of song . . . fasting and prayer, setting of traps, hunting, courtship, playing of games, facing and defying death," for the voice is supposed to be able to reach the "power that permeates nature and animates all natural forces." (*Handbook of American Indians*. Edited by F. W. Hodge. Vol. I. pp. 958–59.)

Ceremonial songs are "formal appeals to the supernatural." The beating of the high bass drum, once heard as we passed the Taos pueblo at sunset, pulsed through the quiet air with solemn suggestion, for was not the drummer a devout sun-worshiper watching the disappearance of the sun father?

Singularly appealing is the folk music of these children of nature, full of color, of mystery and magic, of poetic suggestion, of sadness, of rejoicing, of dramatic fire. Their heritage it is from the long-distant past, but like all their distinctive Indian life, menaced by the materialistic policy which would deny them religious liberty and mold them in the white man's image

Photograph by Bert G. Phillips

NA-AH-KUN-AH, A TAOS INDIAN, TEACHING HIS BOYS A DANCE

Photograph by Bert G. Phillips

THE WAR DANCE

Photograph by Bert G. Phillips

CAREFUL AIM

of the north pueblo the column moved slowly across the square to the front of the south pueblo. We watched the beautiful spectacle with intense enjoyment, marveling at the rare æsthetic sense of a people who could originate and find satisfaction in a ceremony of such pure artistic and religious quality.

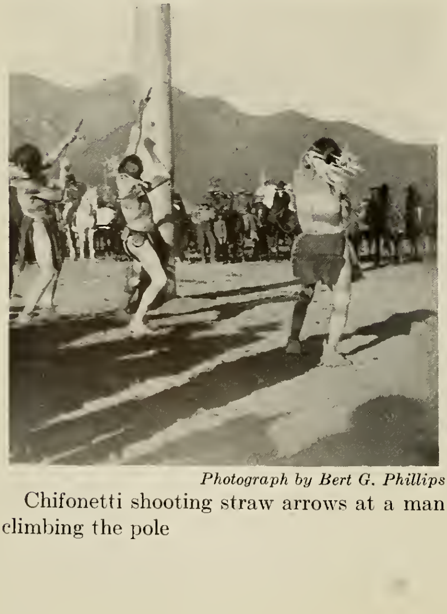
Another phase of the imaginative endowment of the Taos Indians was illustrated the day after the relay race by a play of humorous character given by the Chifonetti, or Delight Makers. In preparation, a forty-foot pole had been brought from the mountains and set up in the plaza between the two pueblos, and at our arrival a picturesque group of blanketed figures in orange, red, and green, stood at the foot of the pole looking up at an Indian in a red shirt, who was seated on a crossbar near the top arranging the prizes for which the Chifonetti were to climb the pole—a string of watermelons, a great bag of bread with a long red streamer dangling from it, and the whole carcass of a sheep in its wool.

The Chifonetti, with bodies and limbs fantastically banded with black

Climbing the pole to obtain the prizes at the top. Drawn from a photograph

and white, their faces, with their noses as centers, blackened in radiating lines or concentric circles, and their ears decorated with bristling bunches of corn husk, made a bizarre group. At first they went about playing pranks on the people, their fun being taken in great good part by all except one old woman, accidentally hit by a flying apple, who scolded them roundly, much to the amusement of the crowd.

When tired of making sport of the onlookers, one of the Delight Makers



Photograph by Bert G. Phillips

Chifonetti shooting straw arrows at a man climbing the pole walked up under the pole on which the sheep was hanging and made sheep tracks with his fingers in the dust. Then the acting began. Another of the band strolled by, and, discovering sheep tracks, began trailing the animal eagerly, looking everywhere until, glancing up, the dangling sheep caught his eye. Then with tiny straw bows and arrows the actors began shooting at the sheep with great glee and horseplay. Afterwards, they went through a long performance pretending to climb the pole. When the first man slipped down, they put earth on the shaft, and when he had climbed part way up, the others dropped on all fours, acting the part of furious bulls, pawing, throwing up the earth, and bellowing to discourage the climber's descent. After this they went for a short ladder and one of the group, climbing it, raised his hands in mock dramatic manner toward the sheep and melons beyond his reach. All sorts of clownish play and a running fire of jokes followed, but finally a long ladder was brought and when a chain of men had reached the upper rungs of this and then mounted on each other's shoulders, the top man climbed a few feet and successfully reached the crossbars.

The Pueblo dances, in distinction from the comedies, are, like the Foot-racing Dance, mainly of a serious character,—really not dances at all but, as Bandelier explains, religious ceremonials, with incantation and invocation, the least detail of which has symbolic significance. Even the Buffalo and Deer dances, which were described to us by the artist who witnessed the Pawnee comedy, while having the same dramatic quality as the comedies, were religious ceremonies, performed "as a sacrifice to the game gods." They served for incantation to help in the hunt, the buffalo song before the hunt being sung "to gentle the herd." This was peculiarly important at Taos, which was one of the pueblos whose warriors for many long generations hunted buffalo on the plains east of the Rocky Mountains. Gray Buffalo, a former war chief, whom we saw, was one of the last of these. Another of the old hunters of whom we were told had kept a valuable and much-sought buffalo robe to be buried in, stoutly refusing all offers for it. Finally, like a patriarch he was carried to his grave wrapped in the great robe, a relic of his own prowess, a relic of the hardy race which he had known and which was gone. In the Buffalo Dance the young men act out what the old men have recounted to them regarding the habits of the animals. The actors, representing a buffalo herd, at one point stop short, swaying their heads from side to side to simulate the grazing of the herd, accompanying the motion with a low munching sound like the cutting of grass with the teeth. After this the big drums beat loudly for the stampeding of the herd.

The Deer Dance, full of charming mythological suggestion, is considered one of the most beautiful of the many Taos dances. The first scene opens with the camp fire of a party of Indian hunters. Then comes the procession of the deer, impersonated by Indians wearing antlers, followed by Indian children dressed in skins of rabbits, foxes, coyotes, wild cats, and owls. Flanking the procession are figures in buffalo skins, representing the spirits that guard the deer herd, to outwit which the hunters carry charms that render them invisible. In the play, when the unsuspecting deer, supposed to be dancing in the woods, are dis-

GRAY BUFFALO

This strong-faced old hunter, with abalone shell earrings, when asked how many buffaloes he had killed, said that he had lost count covered by the hunters, the guardian spirits try to stampede the herd, and as the animals run, they endeavor to keep between the pursued and their pursuers. Unable to secure a deer, a hunter will run in and snatch a rabbit or coyote, but when he puts it behind his back, the watchful spirit sneaks up and snatches it away.

The necessarily seasonal character of the most important of the Pueblo dances, which has been lightly put aside in the suggestion that the dances be relegated to the winter months, has been carefully explained to me by one of the Taos Indians. As he shows, the specific dates were originally fixed by the Spanish priests who came with the explorers and, finding the Indians with only "their own Indian religion," imparted the Catholic religion to them. With shrewd psychology the old priests told the Indians to celebrate certain appointed saints' days with dances or feasts, as for instance Santa Cruz on the third of May, San Antonio on the thirteenth of June, Santiago on the twenty-fifth of July, Santa Anna on the twenty-sixth of July, San Geronimo on September thirtieth, Christmas on the twenty-fifth of December. While the Mexicans have dropped most of their observances, the Taos Indian says, "We are still celebrating those saints' days."

But in accepting the white man's dates for their dances, the Indians decided to give those which, according to their own religion, must come at approximately the same dates. As my friend puts it, "When we were forced to do this in those old days, the Indians agreed to celebrate the summer saints' days by dancing Corn Dance. They had to dance Corn Dance anyway. The Spaniards thought it was a dance for pleasure in such hot days, but it is a sacrifice that we do to the rain gods or angels, so that we may get plenty water and rain for our crops, not only for this place but for all over the world for the benefit of every living thing and plants." (Here we see the broad outlook and the generous spirit of the Indians.)

Another important dance, given in late August after the corn dances and also concerned with the crops, is the Blue Lake Dance, "to please the rain gods that are in that big lake."

The Buffalo and Deer dances are given respectively on Christmas and a January saint's day, because before there were restricting game laws, the Indians, having the leisure, hunted in winter. So important is the performance of these various religious dances that, my friend says, "If the Indians of this place, Taos, give up and break the rules of their religion, according to their traditions, they (especially the old people) fear the end of the world will soon come." And he concludes with the touching appeal—"Now I hope you will have a better idea about why the Indians insist to dance those dances."

An eland cow grazing on a termite hill (white ants' nest) with three oxpeckers on its back. Photograph taken near Donya Sabuk, Athi Plains, British East Africa. Courtesy of Monsieur V. Forbin, Paris

The Eland and Its Bird Sentinel

By HERBERT LANG

Assistant Curator, African Mammals, American Museum

Of all the magnificent sights on the East African plains, none can rival in beauty the spectacle of vast herds of game. Antelopes, though less conspicuous individually than giraffes, elephants, rhinoceroses, and zebras, occur there in such numbers and variety that they are among the most impressive of the herds. No other continent offers such suitable conditions for their development. The herds graze, browse, and move about apparently in perfect indifference to any possible danger, confident that the scattered outposts of their number are always on the alert to give the warning signal.

In the accompanying photograph is shown an eland cow that has strayed away from the herd to graze upon the more succulent grass growing upon a termite hill. Engaged in feeding, she cares little for sentry duty, apparently conscious that no watchdog, however keen, could render her better service than the three tiny birds perched upon her back. These oxpeckers (*Buphagus erythrorhynchus*), which in the picture appear as dark specks, also accompany other game and cattle. Feeding on ticks, they clear their hosts of their tiny tormentors, and also keep watch with an unabated vigilance that can seldom be foiled. Their sharp, shrill, warning notes send the eland off at a gallop, and your chances of coming closer to your quarry are gone. Nothing is gained if you try to follow, for it is a well-known fact that even during their undulating flight high in the air these little sentinels still utter warnings, thereby increasing the speed of their protégés.

The elands are the largest of existing antelopes. The old, nearly hairless, "blue" bulls, with the dewlap reaching close to the ground, attain the size of an ox; the brownish or rufous females, with their lighter horns, are less heavily built than the males and show the lateral stripes more clearly.

The East African eland here pictured is of the northern race, discovered in 1860 by Speke and Grant, who became famous for clearing up the mystery regarding the Victoria Nyanza and some of its affluents. Not until many years later, in 1902, was this eland named *Taurotragus oryx pattersonianus* by Lydekker in honor of Colonel Patterson, well-known for his fascinating volume, *The Man-Eaters of Tsavo.*

This form ranges from Tanganyika Territory northward through British East Africa to about the Lorian Swamp and Laikipia Plateau, and westward all through Uganda and along the east side of the Nile as far as Mongalla. Eight races of eland are known, extending from South Africa to East Africa, as stated, and westward to Senegambia. Before the rinderpest swept these regions in the nineties, herds of several hundreds of the Patterson eland were recorded on the plains and high plateaus, where in diminished numbers they still graze at an altitude of 8000 feet; but though greatly decimated along their northern range, all reports confirm the fact that in later years they have again increased.

Although often common in dry districts, the elands prefer the country of luxuriant pasturage and on the plains frequently mingle with other antelopes and with zebras. Elands are heavy, cumbersome-looking animals and are not speedy in a long run. The surprise is all the greater, therefore, to see them leap one over another's back apparently as playfully as gazelles. Such leaps are, however, the result of excessive fright due to their being suddenly startled rather than a deliberate exhibition of skill.

During the heat of the day these antelopes frequently rest by lying down in the shade or by standing among the bushes. In regions where zebras are abundant elands suffer little from the depredations of lions, though in certain high plateaus where game is scarcer and where the elands come regularly to the water, their ranks are more frequently depleted.

Although elands are easily tamed, the experiments of different governments have proved that domestication is not practicable. When subjected to confinement in the regions they inhabit, they succumb to various diseases much in the manner of corralled zebras. In European zoölogical gardens, however, elands thrive and reproduce fairly well, having either one or two young; but they cannot be trained to render any useful service, though mildness is one of their chief characteristics.

The turret on the left, housing a colony of termites, was erected by the insects at a distance of about two feet from the concrete foundation of a house. This turret reached a height of $8\frac{1}{2}$ inches. The turret on the right shows that the termites do not exercise very good engineering ability, for in this instance at least they failed to keep the center of gravity over the base of the turret

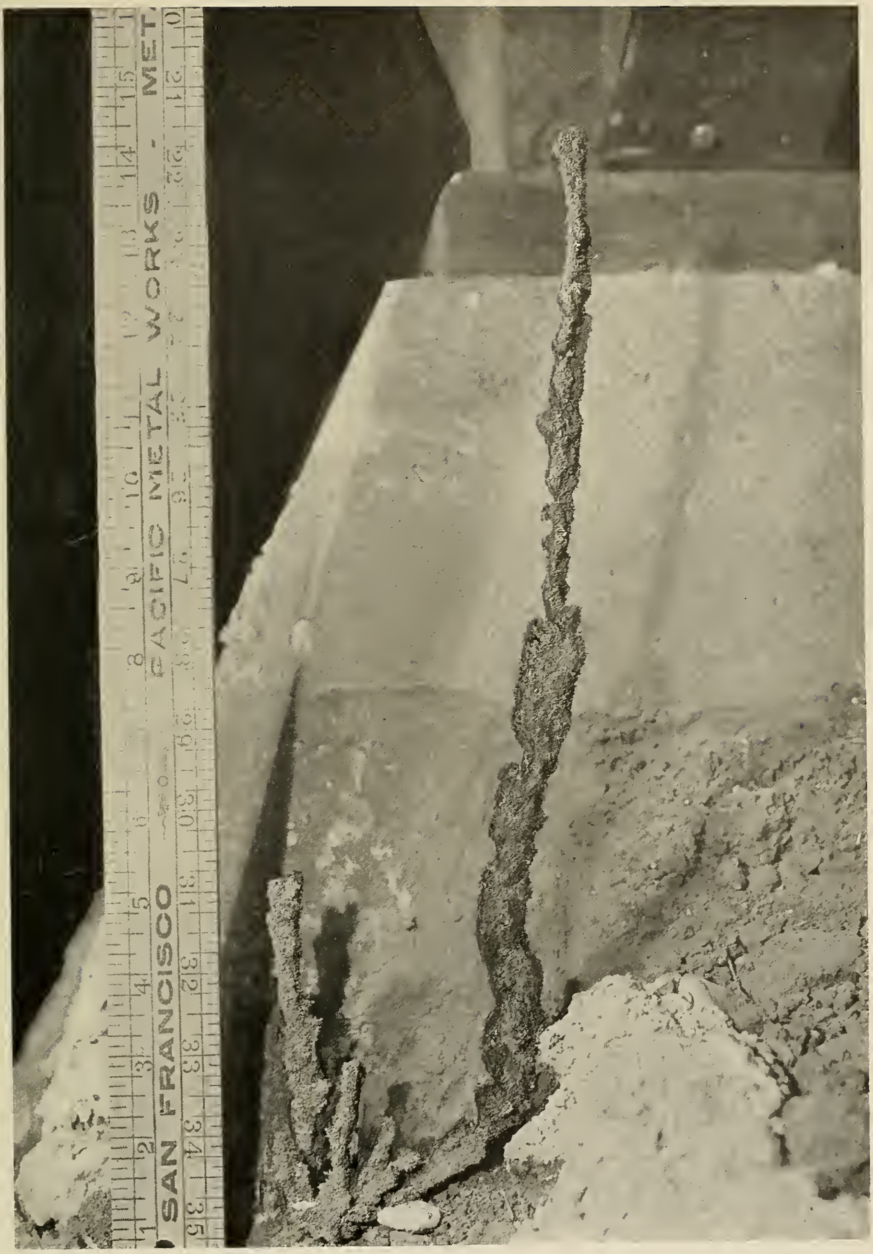
Turret-building Termites

By R. W. DOANE
Associate Professor of Entomology, Leland Stanford Jr. University

In April, 1919, my attention was called to some unusual turrets that were being made by termites in the basement of a house in Palo Alto, California. The first one of these was found rising from a concrete wall that surrounded the lower part of the basement. It was nearly fifteen inches high, the first three inches lying against the beveled base of a concrete pillar, the rest standing entirely free from the pillar or any other support. Around the base of this turret were other smaller ones rising to a height of from two to five inches.

Later additional groups of these turrets were noticed in other parts of the basement. In one of these groups there were several turrets varying in height from three or four inches to

[1]With photographs by the author



AN INSECT SKYSCRAPER

Termites, misleadingly known as white "ants," differ from the true ants in many other respects besides color. Yet like the ants they lead a communal existence, have different castes, and erect structures that may well excite admiration. The large turret shown in the picture reached a height of nearly fifteen inches, the first three inches lying against the beveled base of a concrete pillar, but the terminal twelve standing entirely free seventeen inches. These rose directly from the ground about two feet away from the concrete foundation of the house.

All of the turrets were very brittle, a slight touch being enough to send them crumbling to the ground. In order that they might be taken to the laboratory for further study, some of them were sprayed with very thin shellac. Only a few could be saved even in this way, however, as the light blast of air from the atomizer that was used for spraying caused most of them to topple over and break into small fragments.

As soon as any part of a turret was broken, a few termites would crawl out and wander about until they could find some crack or crevice in which to hide. Nearly all of these turrets were populated by workers, soldiers, and winged individuals.

Soon after the turrets referred to were observed, some smaller ones were discovered in a greenhouse. When they were first seen, the owner of the greenhouse thought that the children had been driving sticks in one of the walks between the benches. When he attempted to pull up these "sticks," he was surprised to find them crumbling to pieces and to see the white "ants" crawling out. Some of these structures were about three inches high. Most of them consisted of a slender, upright shaft; others were broader and branched like coral.

A little later three additional colonies were found building low turrets from one half to one inch high in cracks of the sidewalk in the business district of Palo Alto, where the streets have all been paved for many years. These turrets were destroyed every day by people walking over them but they would be rebuilt during the night.

Still another colony was located on the University campus. These turrets were in exposed places and were only one or two inches high. The winged termites were issuing from them.

The termites that built these turrets belong to the species *Reticulitermes hesperus*.

A group of turrets found in a greenhouse

The Public Museum of Staten Island, though small in size, has a distinct sphere of usefulness because of its emphasis on things local. The basement and first story have been built by contributions from 126 citizens of Staten Island; a second and third story are planned but not yet erected

The Public Museum of Staten Island

A TREASURE HOUSE OF LOCAL NATURAL HISTORY, ART, AND ANTIQUITIES

By CHARLES W. LENG

Director of the above-mentioned institution and Research Associate of Coleoptera, American Museum

THE Public Museum of Staten Island, though the smallest of Greater New York's museums, has, viewed from one angle, a broader scope than any of them, for it must combine within itself interests as contrasted as natural history and art, which in larger communities are represented by different institutions. However, a scheme apparently so embracing is made feasible by the fact that the chief concern is with things pertinent to Staten Island. The arts, industrial and fine, as practised on Staten Island; natural history, botanical and zoölogical, as exemplified on Staten Island; the civic history and antiquities of Staten Island,—these are the prime objects of its collections, researches, and publications. The progress of arts and sciences elsewhere in the world is the subject of many of its lectures and of occasional comparative exhibits, but Staten Island is its basic endeavor. Its library includes, in addition to standard works for reference purposes, a fine collection of books and pamphlets on Staten Island history, genealogy, and natural history. This policy was of course, not reached completely when the parent association started November 12, 1881, but has been gradually evolved and is now succinctly expressed in the charter.

Photograph by William T. Davis

The natural history division of the Public Museum of Staten Island, with the cases of local minerals and birds, and the drawers containing insects, shells, and other material, is well worth visiting

The intensive study of a limited area produces results that interest many others besides those living within such an area. The discoveries of Indian relics made by local students on Staten Island have been quoted wherever the subject has been treated, and the stone head found in 1884 remains almost unique; the discoveries about the old British forts on Staten Island of revolutionary relics have aided the writing of the history of the events of that war in the vicinity of New York; the new species of insects that have been described from the collections of Staten Island entomologists are too many to recount; and Staten Island records of occurrence for both plants and animals are constantly being cited. Thus, whether viewed from the practical side, as interesting the people of Staten Island, or from the scientific side, as producing results of value, the policy of restricting the scope of the Museum to Staten Island, but covering that small area in every phase, has proved wise and a prime cause of the Museum's prosperity.

While the pursuance of such a policy, combined with the small amount of space available, has necessitated at times declining objects, especially large ones, of value, it has also resulted in the acquisition and preparation of some exhibits of importance. Among such are the types of fossil plants described from the Cretaceous beds at Kreischerville by Dr. Arthur Hollick, and the great display of fossil amber from the same locality. These have been visited by geologists from many lands. The herbarium contains many historic specimens. Its foundation dates back to the early collecting by Dr. N. L. Britton when many species, since exterminated by fire and vandalism, could still be found. Of terrestrial orchids, for instance, it contains twenty-three species, though it would be hard to find more than three today growing wild on Staten Island. The same is true of the beetle collection, made by Mr. Davis and the writer, containing many species caught forty years ago which certainly could not be duplicated now. The bird collection contains the passenger pigeon and Carolina parrakeet that once lived on Staten Island but live there no more. The geological collection contains a mastodon's tooth, dredged from the Arthur Kill in the days when the oyster industry was thriving, and another found at the bottom of a kettle hole in the Middletown forest when the locality in question still deserved the name. These and many other similar specimens give the collection of the Staten Island Museum an historical value that will increase as time goes on. Its treasures include no less than sixty maps of the island beginning with 1610, one year after its discovery by Hudson.

Among the recently arranged exhibits that appear to be especially useful to visitors is one comprising all the common insects of Staten Island, arranged to show their classification (following that in *Field Book of Insects* by Dr. Frank E. Lutz, of the American Museum), their metamorphoses, their nest structures, and the benefits which insect friends confer and the injuries which insect enemies inflict upon mankind. Although only about two hundred specimens are used, they have been selected with a view to presenting the principal types in each order. As far as possible comparatively large as well as common forms have been chosen for the purpose, so that the visitor soon feels at home and is led from seeing insects he knows to an appreciation of the relationship of those less known to him, and from that to a knowledge of the immature stages and the work that insects do.

Other exhibits of even greater local interest are three historical groups modeled by Edward J. Burns while a member of the museum staff, showing respectively Indian life on Staten Island three hundred years ago, Indian Wars, and the Billop House Conference.

The museum is a center of activity for numerous local societies with objects akin to its own. Sections of fine arts, history, engineering, and natural science were early formed and are intimately connected with the museum. Twenty-six art loan exhibits have been held at the museum during the last few years as a result of the labors of the section of fine arts; and about five thousand ecclesiastical records and epitaphs have been copied and indexed by the section of history.

The Staten Island Bird Club takes a monthly nature hike for the purpose of observing birds, plants, and insects; the Horticultural Society is interested in growing fine flowers. The Nature Study Club—a collection of "tramps" of all ages and both sexes—exists happily, without by-laws or dues, for the purpose of an informal interchange of information and enthusiasm over the camp fire or in the museum, with or without coffee, but preferably with. The Children's Museum League, inaugurated by Miss Pollard, of the museum staff, is composed of the children who visit the museum. These children choose their own officers and speakers, and with little guidance from adults, develop a love of nature and the spirit of individual research. Emphasis should be given to the Women's Auxiliary, an influential body which has directed several important exhibits, as well as superintending the work with children in the museum and the schools.

The membership in the institute supporting the museum and its affiliated societies exceeds six hundred. An additional four hundred individuals are connected with organizations that, while not affiliated, enjoy the museum's hospitality. A monthly *Bulletin* is mailed to all members, notices are sent to schools, libraries, and other special centers, and the local press of Staten Island is kept supplied with items regarding the museum's activities.

This miniature group (actual size 3½ ft. wide by 2 ft. high) was recently completed by Mr. Edward J. Burns.

It represents the early morning of September 16, 1655, when the Dutch settlers on Staten Island, about ninety in number, under the leadership of Capt. Adriaen Post, representative in the colony of Baron Hans van Capelle, were attacked by a large number of Indians. The Indians had been angered by the shooting of a squaw for stealing peaches on Manhattan Island; their assault upon the population of Manhattan had been repulsed on the preceding day, but their attack on Staten Island was so successful that the local settlement was destroyed, a few settlers being killed and about fifty taken prisoners.

The figures in the group are 6½ inches tall, modeled of beeswax and colored with oil paints; the tree trunks are modeled in plaster; the stockade is carved in wood; the cabin is partly wood, partly plaster; the background represents an autumn sunrise over the forest, studied from nature on early September mornings along the water front on Staten Island where the settlement was located

"Birds of the New York Region"

A REVIEW OF MR. LUDLOW GRISCOM'S RECENTLY PUBLISHED HANDBOOK

By WITMER STONE

Executive Curator, Academy of Natural Sciences of Philadelphia

THERE has recently been published, as one of the Handbook Series of the American Museum of Natural History, an attractive little volume by Ludlow Griscom on the *Birds of the New York Region.* It is intended to take the place of Dr. Frank M. Chapman's pamphlet of similar title published seventeen years ago as a guide to those studying the wild birds of the metropolitan district.

In the nomenclature of ornithological works this volume would, we suppose, be classified as a "local list," but it is far more than that, and differs in many essential particulars from any local list of our acquaintance. In these very points of difference, moreover, it accentuates the marked changes that have taken place in methods of bird study, changes which, while for many years evident in practice, are only just beginning to make themselves apparent in local publications of this kind. So admirably indeed does Mr. Griscom's little book reflect the modern methods that it stands as perhaps our best exponent of what we might term the "new ornithology."

In the annotated list of the last generation a general statement of the character of the occurrence of each species of bird in the district under consideration, with dates and localities of such specimens of the rarer species as had been shot by the author or others, seemed to suffice; and if descriptions were deemed necessary, they were drawn up from specimens and were mainly of value in identifying other specimens which might be collected. In other words, the keynote to the whole study was the collecting of specimens.

All this has now changed. The necessity—yes, in most cases even the excuse, for collecting no longer exists except in the case of ornithologists working in our larger museums or carrying on original research, and the binocular field glass has taken the place of the gun. We do not mean to intimate that Mr. Griscom is one of those who would not under any circumstances kill a bird, but he realizes that for the great majority of our local bird students collecting is unnecessary. His aim has been to render their work without a gun as free from errors as it is possible to make it, but he believes in collecting specimens when a critical scientific question can be settled in no other way. As a Kentucky mountaineer friend of the writer once said to him in another connection, "This is a perfectly law-abiding country; no man is ever killed here unless he needs killing." However, in spite of the great army of bird students who are studying the live birds, most of our books still follow the old model and minutely describe museum specimens instead of giving us the field marks by which we may most easily recognize the bird in life, and in breaking away from this custom Mr. Griscom's book comes nearer to what the field ornithologist of today needs than anything we have seen. For some years he has been making a special study of field identification, determining just what species can be positively identified from the living wild bird, and what color markings or other characters in each species are best suited to serve as identification marks.

Such information is what the field-glass ornithologist needs and what *ornithology needs* in order to eliminate errors in sight records, and it is upon sight records that most of our studies of migration, distribution, and similar problems are going to be based. We require a vast amount of data for this work, far more than could ever be secured by collecting specimens, but the observer must be instructed how to identify positively the live birds which he sees. In this book on the birds of the New York region Mr. Griscom has embodied much of the results of his studies along these lines, and the volume becomes therefore of much wider importance than its title would indicate and should really be in the hands of every serious field student of our eastern avifauna.

Another important point in Mr. Griscom's treatment of his subject is that he carefully delimits the country he covers, including only areas with which he or his associates are reasonably familiar, and refrains from making any "blanket" statements supposed to cover a given circle of so many miles radius, in portions of which perhaps the details of bird life are quite unknown to him. We find therefore in his text (1) a general statement of each bird's occurrence on Long Island, which has long been a Mecca for the ornithologists of New York, with more exact data for Orient, Mastic, and Long Beach, three stations where much intensive work has been carried on; (2) statements covering the bird's occurrence in that portion of New York in or just north of the city proper, with detailed accounts for Central Park and the Bronx, favorite resorts of city bird students unable to go farther afield; and (3) a general statement for northern New Jersey, with special details for Englewood, the home of Doctor Chapman and other active bird students. The results of an intensive study of the bird life of a limited field are always more satisfactory than generalizations covering a larger area, as all local students will testify, since each locality has its peculiarities, and when these are known to the bird student, each of his observations takes on an added value. Moreover, Mr. Griscom's method indicates just which areas about New York City are still in need of intensive study—such as Orange, Rockland, and Putnam counties, New York State, and the most northern portion of the New Jersey coast—all included in Doctor Chapman's fifty-mile limit. Doubtless Doctor Chapman's general statements—all that it was possible for him to make at the time his list was published—cover the bird life of these regions fairly well, but now that the fact of their neglect is forcibly brought out, intensive studies will undoubtedly be made there and the detailed results will be most interesting when compared with those given in the present work for the other sections near by.

Considering the bird life of the entire region covered by Mr. Griscom, many persons will doubtless be surprised to learn that no less than 377 species have been recorded as occurring so near to New York City, and that of these only 12 are rated as now extinct in this area and 84 as casual or accidental. California with her immense territory has but 530 kinds of birds, of which 120 are closely related geographic races and a number of others are casual or accidental, so that our eastern avifauna is not so poor after all.

Of several of the localities where intensive study has been carried on, we find that Orient is credited with 283 species, Mastic with 227, and Long Beach with 239, Central Park 186, Bronx 227, and Englewood 232, while on a single day no less than 66 species were seen in the "Ramble" in Central Park. The summary further shows that, of the entire list, there are 37 resident species, 89 summer residents, 6 summer visitants, 30 regular winter visitants, 20 irregular winter visitants, 78 regular transients, 21 irregular transients, 18 casuals, and 66 accidentals, together with the 12 now extinct near New York.

Let us now take up the author's account of one of the familiar species to ascertain just what information the student may obtain from the work. The white-throated sparrow, for example, is not dismissed with the statement that it is an "abundant transient and less common or local winter resident." On the contrary, we find that: "It arrives in the fall with the first decided drop in temperature in September. By the middle of November only the wintering flocks remain. These break up about the middle of March, and then it is often impossible to find the species locally, until the transients arrive from the South the middle of April. The last individuals retire northward with the height of the migration in May." Besides this we learn further that on Long Island it is an "abundant transient, fairly common winter resident, particularly at the western end; September 10 to May 30." In the rest of the New York area it winters "commonly near the coast, rarely up the river to Ossining," while in the New Jersey area it is an "abundant transient throughout; common winter resident near the coast and along the southern boundary of our area, decreasing inland, and unrecorded at this season in the extreme north and northwest." There are also extreme dates for all of the special localities previously mentioned. A more explicit account could hardly be desired!

The life zones and species characteristic of each have been considered with much care, the difficulty of delimiting them in this region being fully discussed. This is due, of course, to the fact that New York City lies just on the border line between the Carolinian, an austral or southern zone, which follows up the coastal plain, and the Alleghanian, a more northern zone. The Canadian or Boreal element appears mainly on the higher mountains of New Jersey and upon eastern Long Island.

Most interesting to the amateur bird student is the careful and detailed account of the migrations and the grouping of the species which migrate together and form the so-called "bird waves" of spring. Students in other "regions" will eagerly compare these lists and dates with their own.

The painstaking work which field students of birds have been doing in the New York region and which has made possible the detailed statements presented in this volume, is shown by the fact that one of Mr. Griscom's collaborators, Miss Anne A. Crolius, visited Central Park in search of bird records more than 250 times *annually* from 1895 to 1915. The sifting out and summarizing of the vast amount of data that the author has collected have been an enormous job, of which the consideration of the published records has constituted no small part. To decide which sight records to accept and which to reject is a difficult and thankless task. We can usually detect the careless and unreliable observer, but there are many well-meaning students who, lacking the knowledge of how best to recognize birds in the field, make errors by trying to find characters that are to be seen only when the bird is in the hand. And, again, many of our popular names prove to be sources of error. Misled by the names, the beginner tries to separate the yellow-billed and black-billed cuckoos by the color of the bill, whereas it is the tail that furnishes the best distinguishing character; or, to take another case, many an adult male white-throated sparrow, differing so much from the more somber-colored female and young male, is recorded as a white-crowned sparrow, for has he not a splendid white stripe down his crown? Doubtless just such cases as these impressed Mr. Griscom with the importance of setting forth the real field characters of each species as an aid to field students of the future and to eliminate errors in the constantly increasing mass of sight records being published.

The sad side of Mr. Griscom's account of the bird life of the vicinity of New York is his reference to the changing conditions inevitable in the vicinity of a great city. The Florida gallinule, coot, and pied-billed grebe, we are told, are disappearing or have disappeared as breeding birds because the marshes "are constantly being drained or filled in to 'improve' the neighborhood by providing another slum district on the outskirts of the metropolis"; while "Staten Island, which fifteen years ago was chiefly unspoiled country. . . is now almost ruined for birds." "Over a sufficiently long period," says our author, "the survival of any species depends upon its adaptability to a changing environment, but how acid the test which man has furnished in the New World! There is no doubt that some [birds] could not endure this test; they have utterly disappeared from this region. Many others are retreating as a great city sends out ever-stretching tentacles into the rural districts. No bird can live on asphalt and concrete. But if city blocks are contrasted with primeval forest, most of this area may be regarded as a half-way compromise. This compromise a great majority of our birds have accepted."

"May the time never come," Mr. Griscom concludes, "when I can hear only the harsh chatter of the Starlings from my house in the suburbs. May the time never come when I stand some May morning on the beach and miss the little Sandpipers trotting innocently ahead of the tide, and gaze out to sea over a birdless ocean."

An aroused public sentiment is our greatest reliance in preventing the annihilation of our wild bird life, while the increase of bird students is the best way to arouse sentiment, and Mr. Griscom's volume, which will stimulate and increase bird study in the New York region, will aid not a little in warding off that evil day against the coming of which he cries out.

The volume is attractively gotten up, well printed, and illustrated with thirty bird portraits from photographs from life by various contributors, half a dozen colored plates selected from the National Audubon Society *Leaflets*, and a good map.

"In Brightest Africa"

A REVIEW OF CARL E. AKELEY'S NEW VOLUME ON WHAT HAS BEEN MISNAMED THE DARK CONTINENT[1]

BY HERBERT F. SCHWARZ
Editor of NATURAL HISTORY

A TRAVELER through a new country sees in the landscape the things that accord with his tastes and training. An artist has an eye for its pictorial beauty, its groupings of color, its strength or delicacy of contour, its contrasts of light and shadow under the ever-changing play of the clouds. To the historian, on the other hand, the same region is the scene of great events of the past or the present; the topographical features stand out not for their beauty of form but as points of vantage from which an occupying force succeeded in turning the fortunes of battle. To a geologist the same stretch of territory is a tablet on which has been inscribed the story of the ages antedating the coming of man.

So in journeying through Carl E. Akeley's *Brightest Africa* different points of significance will be seized upon by different readers, for this unusual volume is as many-sided in its appeal as its author is versatile in his attainments. The sportsman will read it, feeling that it is a collection of adventures such as few big-game hunters have been fortunate enough to live through and relate, culminating in the account of a bare-handed fight with a leopard when with his right arm chewed along practically its entire length, Mr. Akeley still struggled on, the leopard beneath him, his right hand in her mouth, his left hand clutching her throat, his knees on her lungs, his elbows in her armpits spreading her front legs apart so as to render futile her frantic clawing. And with this incident the reader who kindles to the narrative of dangers heroically faced will couple the dramatic account that Mr. Akeley gives of the time when to escape being gored by an infuriated elephant, he swung himself between the animal's tusks, only to be flung down to earth as the elephant drove its tusks into the ground in an attempt to crush him, an attempt that failed providentially because these ivory weapons struck a rock or other resistant object and thus prevented the mighty head from mashing the intended victim.

Perhaps the reader is an inventor or one interested in invention. To him the volume will present a different angle of interest, for he will see in it the record of a man who in the course of opening up a new field of achievement had to devise new tools, and who when confronted with a mechanical difficulty that threatened to arrest further progress never failed to puzzle out the means with which to overcome it. In 1909, Mr. Akeley endeavored to get moving pictures of the Nandi spearing lions. His results were unsatisfactory because "to have even a fair chance of following the action with a camera you need one that you can aim up, down, or in any direction with about the same ease that you can point a pistol." There being no such camera, Mr. Akeley, relying—and not vainly—on

[1]*In Brightest Africa.* By Carl E. Akeley. With a Foreword by Henry Fairfield Osborn. Published by Doubleday, Page & Co.

his supreme resourcefulness, proceeded to construct one. In like manner years previously he had invented the cement gun to meet a special emergency, elaborating it from a device he had used in connection with the making of manikins. In the course of the world war, he was a specialist on mechanical devices and optical equipment in the Division of Investigation, Research, and Development of the Engineer Corps, and among other achievements, developed a device for searchlight control.

Again, the volume may be viewed not from the standpoint of the hunter, nor as a record of invention, but as the account of the birth of a new art, the art of taxidermy. When Mr. Akeley began his career in Ward's Natural Science Establishment, taxidermy was merely a trade and the taxidermist "a man who took an animal's skin from a hunter or collector and stuffed it or upholstered it." It is thanks largely to the tireless energy of Mr. Akeley, to his unfaltering fidelity to an ideal, to his practical sense and his artistic outlook that the world owes the marvelous transformation in the methods and technique of mounting animals. To any one who has stepped into Mr. Akeley's studio, it must be obvious that taxidermy to find its highest form of expression requires the convergence of a number of qualities and special talents that only now and then are summarized in a single individual, and that of these artistic vision is not the least important.

While Mr. Akeley has taken a leading part in creating the new art of taxidermy, he has been a successful exponent of an art that antedates Phidias. His animal sculptures owe their appeal not only to truth of conception and beauty of form but to the fact that, as he tells us, he decided never to make a bronze unless he had a real story to tell, and most of the dramatic stories that he has carved in the plastic clay are based on his personal experiences in the wild.

That brings us to another phase of interest which this volume presents, the surprising richness of its information regarding the great jungle beasts. It is the record of one who has gone to Africa with an alert eye and, more important still, a mind that welcomes the opportunity to study animals under natural conditions. An ivory hunter, he tells us somewhere, sees only the tusks of an elephant; Mr. Akeley sees his animals whole. The trunk of an elephant, the front legs of a lion—how easily they might be slurred over in a general description by some one less keenly sensitive to their marvelous structure and their functions than is Mr. Akeley! The natural impulse of an animal to defend itself—how often has it been libeled by writers whose interest in the great beasts of the jungle is merely as objects of the chase! Mr. Akeley knows as few have known the strength and fury of a wild animal's charge, and yet from cover to cover his book teems with evidences of an understanding of, and interest in, the animals among whom he has moved, again and again hazarding his life to obtain a fuller knowledge of them.

The question may be asked, has a volume so many-sided as this is, unity of appeal; is it not merely a series of papers raked together and labeled with a general title more or less pertinent? To ask the question reveals an ignorance of the goal of all of Mr. Akeley's varied activities. Among the several things he lists as prerequisites of a real taxidermist he places first experience as a field man, for a field man can collect his own specimens, take accurate measurements of them, and study the animals in their own environment as a preliminary to making natural groups. That is why Mr. Akeley went to Africa; that is why the African chapters have a close connection with the portions of the book that are devoted to taxidermy. In like manner animal sculpture is a natural product of the field experiences of one who in the course of establishing an art of taxidermy has found that the modeling of animal forms is a prerequisite of the effective mounting of skins. His inventions are essentially devices which he needed for the successful prosecution of his work or their extension with modifications to meet other emergencies as these arose.

At the close of his first chapter Mr. Akeley says: "When I got back from Africa in 1911 I was dreaming of a great African Hall which would combine all the advances that had been made in taxidermy and the arts of museum exhibition and at the same time would make a permanent record of the fast-disappearing wild life of that most interesting animal kingdom, Africa." One cannot help feeling that the hope of realizing such a hall has been the main incentive of Mr. Akeley's later work, and it is fitting therefore that the final chapter of the volume should be on "Roosevelt African Hall." The work demanded for the realization of this dream is on so vast a scale that it will require the coöperation of many hands, but the directing mind assures absolute unity of plan. There will be forty groups, dominated by the magnificent elephant group that is at present installed on the second floor of the American Museum, and as part of the architectural decoration of the hall there will be twenty-four bas relief panels in bronze, each six by eleven feet. The association of Roosevelt's name with this splendid memorial recalls the fact that it was through Mr. Akeley's glowing description of Africa that the President was influenced, upon completing his term of office, to go to that continent in preference to any other.

"Sculptor and Biographer of the vanishing wild life of Africa" is the way Prof. Henry Fairfield Osborn describes Mr. Akeley in the eloquent foreword he has written for the volume, and those who turn the pages of *In Brightest Africa* will find among the illustrations (several of which are photographs of Mr. Akeley's masterpieces) full justification for the former designation, and in his text, so replete with admirable records of animal life, indisputable support for the latter.

NOTES

ASIA

Welcome by the Geological Society of China.—During Prof. Henry Fairfield Osborn's sojourn in Peking he was, with Mr. Roy Chapman Andrews, a guest of honor at a number of brilliant functions. On September 27 he addressed the Geological Society of China on the topic "The Broader Aspects of the Work of the Third Asiatic Expedition." Chinese men of science as well as resident European and American scholars, leaders in different fields of intellectual endeavor, attended the gathering in numbers and extended a warm welcome to him as he arose to deliver his address at the conclusion of the cordial words of introduction spoken by Dr. V. K. Ting, the president of the society. Professor Osborn expressed the deep indebtedness of himself and his colleagues of the Third Asiatic Expedition, who were present at the gathering, for the hospitality extended to them by the Geological Survey and the Geological Society of China, which, he said, would be treasured in their memory as one of the pleasantest experiences of their sojourn in a land "where scholarship and learning have always been held in high esteem." Turning to the subject of his address, "The Broader Aspects of the Work of the Third Asiatic Expedition," he compared the survey made in Mongolia by Mr. Andrews and his associates with that conducted by Hayden, the middle of the last century, in the then virgin field of our own West. The astounding results obtained in Mongolia within a period of only a few months as contrasted with the span of years required by the Hayden survey were made possible by the effective modern means of transportation at the command of the expedition.

Mongolia, Professor Osborn pointed out, has been a continent ever since Jurassic time, and this stable condition was conducive to a continuous development of life. Some of the deposits containing fossils are, moreover, of enormous thickness, others of surprising extent, and these deposits have yielded types of animals adapted to all varieties of environment that existed in the successive periods of the sedimentation. During the second year of the expedition the sites located in the reconnaissance of the first year have been worked systematically and with such a marvelous abundance of yield that had Professor Osborn been asked at the inception of the expedition what he desired to secure in the way of collections, he would have deemed it "an act of tyranny to request Mr. Andrews to obtain just what he has brought back." Professor Osborn then spoke of the objectives still ahead of the expedition and ventured the opinion that if primates are found in any of the deposits, they will prove to be of the higher type. Another discovery that, it is hoped, the expedition may be able to make is of the assumed five-toed ancestors of the early four-toed mammals. Professor Osborn closed with a warm tribute to the character of the men engaged in the expedition and to the splendid generalship of Mr. Andrews. The latter succeeded him as speaker and was followed in turn by Mr. Granger and Doctor Morris. Mr. Andrews in the course of his remarks dealt with the problems of organization, the equipment, and the field work of the expedition, while Mr. Granger and Doctor Morris spoke respectively of the palæontological and geological work undertaken and the observations made.

At a dinner held at the conclusion of the day's proceedings Doctor Ting presided and Mr. Andrews, Dr. W. H. Wong, director of the Geological Survey of China, Prof. J. S. Lee, of the Geological Institute of the National University, and Professor Osborn delivered addresses. In closing his remarks, Doctor Ting announced that the Geological Society of China had unanimously elected Professor Osborn an honorary member of that body. He referred to Professor Osborn as "the man most prominent in carrying on the Huxleyan tradition."

An Estimate of the Mongolian Discoveries.—Under date of December 3 Prof. W. B. Scott of Princeton wrote Prof. Henry Fairfield Osborn as follows:

I was delighted to get your letter, posted at Seattle, and congratulate you most heartily on the magnificent success of your Mongolian expeditions. To me one of the most gratifying features of your results is the fact that they all go to confirm the inferences which we had made from American data and do not require us to tear down all the building which we have been so laboriously erecting. The discovery of *Loxolophodon* is precisely in line with what one might expect, but the Paleocene, which will surely come to light some day, will be the key to the whole story. The dinosaur eggs are delightful, all the more so for not being revolutionary. When Professor Pumpelly (of whose recent death you have doubtless heard) was here a couple of years ago, I inquired particularly whether in Central Asia, or the Gobi Desert, he had ever discovered any signs of fossil mammals or reptiles, explaining that we had every reason to believe that Central Asia would prove to be the cradle of the higher mammalian groups. He replied that he could give me no hopes of such discoveries, as he had never seen a sign of fossil bones in those regions. Isn't it wonderful how blind eyes, not trained to see particular things, can be toward these things? His answer disappointed me very much, but, as it turns out, quite unnecessarily.

The Faunthorpe-Vernay Indian Expedition of 1923, which members of the American Museum were privileged to view in all its superb equipment through the motion pictures that accompanied Colonel Faunthorpe's informing lecture, has interested the press of both England and America for, in addition to its importance as an expedition, the fact that it should have been undertaken by two English gentlemen at great personal sacrifice of time and money so that an American institution might reap the benefit is an example of international good will of which both sides of the Atlantic rightly take cognizance.

Mr. Vernay on his return from India was interviewed both in England and America, and interesting accounts based on his spoken and his written word have appeared in these countries. Among the more detailed narratives was that which appeared over his name in *The Spur* for November 15, 1923, accompanied by twelve illustrations. In this article Mr. Vernay paid high tribute to Colonel Faunthorpe as "probably the finest shot in India at a running animal, and a most able organizer," adding that "organization in an expedition of this kind means half the battle." So jealously are certain of the animals in India guarded that a native who kills a rhino, for instance, is fined a thousand rupees and for a second offence is put to death, while permission to shoot an elephant is given only in extraordinary circumstances. Yet, thanks to the influence of the leaders of the expedition, groups were obtained not only of these animals but of a number of others.

Dramatic is the account which Mr. Vernay gives of the hunt of the rhinoceros and of the care which Colonel Faunthorpe and he took to study its anatomy prior to entering the field, so as to be assured of aiming the bullet at the most vulnerable spot. Equally absorbing is his narrative of elephant hunting, of ringing the tiger, and of tracking the tsine. In reading the article one cannot escape the feeling that the Museum has been singularly fortunate in enlisting the interest of two sportsmen who proved themselves such splendid organizers, such expert marksmen, and such devoted workers in the field of science.

GEOLOGY

The Geological Survey of China.—President Henry Fairfield Osborn of the American Museum brought back from the Far East not only the recent publications of the Geological Society of China but also those of the Geological Survey. In order to avoid duplication of work and assure the most useful coöperation between these organizations and the American Museum's Third Asiatic Expedition, Mr. Roy Chapman Andrews acceded to the wishes of Director V. K. Ting and Dr. J. G. Andersson of the Survey to a regional division of the field of research. Thus the Museum's expedition, equipped with rapid motor transport, agreed to work in the outlying areas which cannot be readily reached by the Chinese Survey.

We note that the Survey and the Society have not only accomplished much in recent years but that they have outlined a very extensive program. To Dr. H. C. T'an has been confided the important task of the new topographical survey of China. He has mapped the entire province of Shantung and most of that of Shansi, scale 1:100,000, and is pursuing this work with vigor. Dr. V. K. Ting has just returned from a study of Yunnan, where he has made detailed cross sections that throw much needed light upon the structure of that most complex region. Mr. George B. Barbour reports a study of the intrusive of Tsinan Fu. This is a great mass of dark-colored volcanic rock that has cut through thick beds of limestone, and now lies exposed by erosion north of the town of Tsinan Fu in Shantung. The molten rock and the volatile matters that rose from it have attacked the limestone, changing it to a series of rare and interesting minerals.

Of special importance is an analysis of recent earthquake records in China by Dr. W. H. Wong. He has plotted the centra and isoseismic lines from all the data available. It will interest readers of Natural History to learn through his research that the terrible Kansu earthquake of 1921, in which more than 100,000 lives were lost, was on a wholly different geologic structure from that which conditioned the recent earthquake in Japan.

The Survey has also published papers by Dr. J. G. Andersson, notably, "The Cave Deposit at Sha Kuo T'un," "An Early Chinese Culture," and "Essays on the Cenozoic of Northern China." In the last paper Doctor Andersson discusses eighteen fossil eggs of the extinct ostrich, *Struthiolithus chersonensis*. All of these eggs were found at various localities in the loess of China. Find No. 15 is in the American Museum. These eggs are somewhat larger than those of the living ostrich, *Struthio camelus*. Some eggs have been found as broken shells in association with the culture of early man, others in pairs in a nest which the loess covered up and preserved for thousands of years. The conditions of entombment and preservation of these remarkable bird eggs are not unlike those of the much older dinosaur eggs which the Third Asiatic Expedition found in the desert plains of Mongolia and brought back to the American Museum.

It has been arranged that Prof. A. W. Grabau, who serves China in the joint capacity of palæontologist to the Geological Survey and professor of palæontology in the National University of Peking, will report upon the invertebrate fossils, collected by the Museum's expedition to Mongolia. In 1922 the Survey published Professor Grabau's paper on "The Sinian System," a review of the second volume of the monumental work of Ferdinand von Richthofen on the Geology of China (Berlin, 1882), as well as "The Ordovician Fossils from North China" and "The Paleozoic Corals of China." At present Professor Grabau is engaged upon a very large work, *The Palæogeography of Asia*. In his opinion the greatest discovery that the Third Asiatic Expedition has made in Mongolia is that of the Permian geosyncline.

The directors of the Geological Survey of China, Dr. V. K. Ting and Dr. W. H. Wong, are to be congratulated on the splendid work that they and their staff are accomplishing for the Republic of China.—C. A. R.

OTHER MUSEUMS

Port Elizabeth Museum.—To Mr. F. W. FitzSimons, director of the Port Elizabeth Museum, South Africa, Natural History is indebted for the two Notes printed below recording recent palæontological discoveries in Africa:

The mineralized skullcap and part of a jaw that were discovered at Boskop in the Transvaal some years ago and that are now in the Port Elizabeth Museum, baffle anthropologists because the find stands alone as a type, no other ancient skulls being comparable with it. I have now found two very important links to support the theory that the Boskop man typified the race which originally inhabited South Africa, and made the bouchers and other large, roughly chipped stone implements scattered so profusely over the country.

In digging out some rock shelters in the cliffs at Zitzikama on the seacoast, I found the remains of two men with palæolithic implements that had been buried with them. These were fourteen feet below in the midden of ash, sea shells, and remains with which the rock shelter was filled from the floor to within a few feet of the roof. From the area extending from the surface to a depth of about twelve feet there were taken out large numbers of skeletons of an altogether different race, closely related to the Pygmy Bushmen of the interior rock shelters. The two skullcaps are those of men with exceptionally big brains. The Boskop man possessed a phenomenally large brain, and it is significant to find two palæolithic men, deep down in a rock-shelter midden, with similarly large skulls. It would seem that there was a very early type of man with a brain as large and even larger than that possessed by modern men of genius. It is worthy of note, however, that the bulk of brain in the skulls of these ancient men was located at the base, back, and sides, and that in modern men of exceptional mental attainments the brain is massed in the forehead and temple regions.

In times far remote there roamed over the karoo and high veld a buffalo that was of enormous proportions compared with the living species of today. Remains of this animal were first discovered forty feet below the surface on the banks of the Modder River in the Orange Free State and were described as *Bubalus bainii* by Prof. H. G. Seeley in the *Geological Magazine*, New Series, Decade III, Vol. VIII, page 199, 1891. The specimen in question is remarkable for the enormous length of the horn cores, each of which measures 5 feet, 2 inches in length. It is now in the possession of the South African Museum. Another specimen has just come to light. Mr. Herman Bekker discovered the head of a huge animal and notified me of the fact. Later he sent the remains to me, and on examination they proved to be those of the large buffalo. The skull is fragmentary, but one horn core is sufficiently intact to make possible a measurement of the length, which is 5 feet, 3 inches. The forehead between the horns is 8 inches. This means that, when alive, the beast had a pair of horns 11 feet, 2 inches across from point to point. A buffalo with such monstrous horns could not have lived in forests or even in the bush-veld. It must have been a dweller on the open plains of the Orange Free State at a time when that country probably had a regular rainfall and many flowing rivers.

THE LAST SURVIVOR OF THE "POLARIS" EXPEDITION

A recent press report to the effect that Mr. J. W. C. Kruger, believed to be the last survivor of the "Polaris" expedition, has died, justifies a few words of comment regarding one of the most remarkable feats of adventure that the annals of exploration contain. It was on June 29, 1871, that the "Polaris," a screw propeller of only 387 tons, left the Brooklyn Navy Yard, under command of Captain C. F. Hall, on the United States North Pole Expedition. The premature death of Captain Hall, who succumbed to a mysterious illness shortly after the expedition reached Thank God Harbor, Greenland, was but the prelude of many misfortunes.

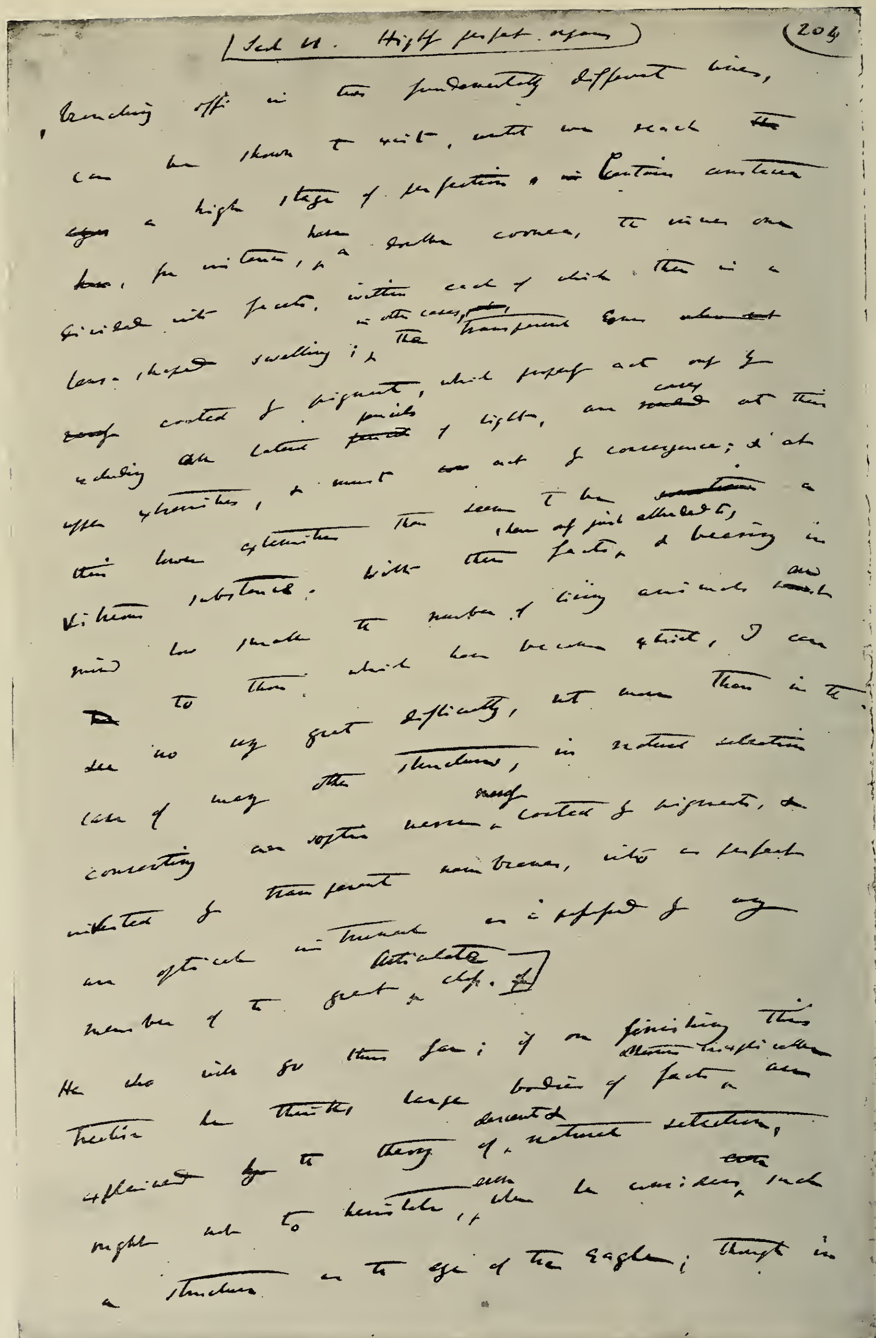
Of these the most spectacular had its inception on the night of October 15, 1872, when the "Polaris" ran into a storm and was subjected to the deadly constriction of the inpressing ice. The boat seemed to be in imminent danger and ill-advisedly orders were given to throw the provisions and other necessaries on the ice. A party under the direction of Captain George E. Tyson descended to the ice to place the salvaged articles at a safe distance from the boat, which as it rose and fell threatened to grind to pieces any luckless object that came in contact with it. While they were thus engaged, working amid the darkness and the storm, scarcely able to distinguish the things they were handling, the ice on the starboard side gave way, releasing the ship, which almost immediately lost contact with the group that had disembarked. Next day the "Polaris" was glimpsed by the men on the ice floe but instead of steering toward the desperate group, unaware of their location, she disappeared behind the land.

Now began one of the most remarkable of voyages. Here was a party of nineteen, including women and children, a party having neither compass nor chart, with inadequate food, semi-mutinous, adrift on a floating island of ice on a journey that was to consume months and cover 1500 miles. How these people endured, without warmth, in snow igloos they constructed, how they came to look even upon the frozen raw entrails of a seal as something desirable to still their hunger, how their strength ebbed, and how the taking of desperate chances was favored by the more reckless members of the party—all this is told in Captain Tyson's fascinating volume. On April 30, after more than six months of exposure, they were picked up by the "Tigress" and subsequently the party that had been left behind in the north was rescued by the "Ravenscrag."

The American Museum, the depository of so many interesting mementoes of exploration, to the inclusion of one of the sleds with which Peary made his dash to the Pole, has at least two reminders of the heroic adventure of the "Polaris,"—a whale boat abandoned at Thank God Harbor and there found by Peary, and a large painting of the "Polaris" at Thank God Harbor executed by William Bradford, justly celebrated for his vivid depiction of northern scenes.

THE HARRISON WILLIAMS GALÁPAGOS EXPEDITION

A special exhibition of paintings, collections, and other material pertaining to the Harrison Williams Galápagos Expedition was held at the American Museum December 1–14 under the auspices of the ladies' auxiliary of the New York Zoological Society (Mrs. Henry Fairfield Osborn, chairman) in coöperation with the Museum. Due to a shortage of water and the unexpected difficulties in replenishing the supply, this expedition, sent out by the department of tropical research of the New York Zoological Society under the direction of Mr. William Beebe, was able to spend only one hundred hours altogether in the archipelago; but judging by the impressive exhibit, the sojourn might well have been one of weeks. Of special interest were Miss Isabel Cooper's superb studies in water color of the animals of the region, ranging from marine forms to terrestrial forms like the spectacular giant land iguana, and Mr. Harry Hoffman's inspiring landscapes, seascapes, and skyscapes, one of the most exquisite of the pictures being an overhead view of flying frigate birds seen against the cloud-flecked blue of the sky. A sketch model for a group of marine iguanas assembled on the rocks and in the sand of a lava-rimmed patch of beach was the work of Mr. Walter G. Escherich, the background having been painted by Mr. A. A. Jansson. There were also relief models of the several islands visited, placed with the marine and



A PAGE FROM "THE ORIGIN OF SPECIES"

This sheet, written by Charles Darwin for the first edition of his epoch-making book, was recently presented to the American Museum by the author's son, Major Leonard Darwin, and has been placed on exhibition in Darwin hall land birds taken by the expedition. A collection of insects and numerous impressive photographs were other features of interest.

A PRECIOUS MANUSCRIPT

A page of the original manuscript of *The Origin of Species* was received by President Henry Fairfield Osborn under date of September 21, 1922, from Major Leonard Darwin, whom the members of the American Museum will remember as the retiring president of the Second International Congress of Eugenics. The page in question, a reproduction of which appears herewith, corresponds with the subject matter on pp. 187–88 of Volume I, Chapter 6, of the original edition of Darwin's epoch-making work. In later editions changes were introduced, altering to a large extent the wording of the upper part of the manuscript page.

This precious gift has a double significance: in the first place as an historic document of the greatest interest, and in the second because of the fact that it has been bestowed by the author's son, who through his own contributions in the field of science has added new laurels to the name of Darwin. The manuscript, as well as the copy of the original edition of *The Origin of Species*, has been mounted and placed on exhibition in Darwin hall, American Museum, beside the bust of the great naturalist.

CONSERVATION

A Necessary Step to Safeguard the Birds of Louisiana.—A tract of land 100,000 acres in extent, which because of its location ought to be a link in the chain of Louisiana wild-life sanctuaries, has recently been acquired by a group of sportsmen, who contemplate converting it into a private hunting reserve, to be known as the Louisiana Gulf Coast Club. Although those promoting the scheme were actuated not merely by the desire for sport but by the hope of developing the possibilities of the area as a wild-life center, the proposal is incongruous, and the only proper destiny of this tract is as an essential element in a larger scheme for the protection of the birds of the Gulf Coast. As visioned by Mr. T. Gilbert Pearson, president of the National Association of Audubon Societies, the existing bird reservation should be extended so that the territory embraced may stretch without a break from Cote Blanche Bay westward to the Mermentau River, a belt about eighty miles in length and from ten to fifteen miles in width. As a step toward the fulfillment of this plan the acquisition of the tract owned by the Louisiana Gulf Coast Club is essential, and it is to be hoped that public sentiment may be sufficiently emphatic and public support of Mr. Pearson's efforts sufficiently potent to assure the realization of his plan.

The Status of the Antelope.—For years the prong-horned antelope, one of the most distinctive and beautiful of American game animals, has been decreasing in numbers so rapidly that it is threatened with extinction in a comparatively brief period unless some definite steps are taken to insure its perpetuation. The decrease in these animals has been so alarming that many of those interested have expressed a desire that a meeting be called for the purpose of considering the present situation and, if possible, to formulate plans which may result in the conservation of the animals.

Such a meeting was held on December 14, 1923, at the U. S. National Museum in Washington. Representatives of all the principal conservation organizations of the eastern United States, in addition to a representative of the Canadian Government, and representatives from state game commissions in various parts of the country attended the conference, which was sponsored by the Bureau of Biological Survey. It was agreed at the meeting that conservation work in favor of the antelope could best be carried out through existing conservation organizations, aided by the Bureau of Biological Survey, which would act as a clearing house for information on the subject.

The Bureau of Biological Survey during the last two years has been conducting a census of the remaining herds of antelope and has practically all of them located and the approximate number in each herd determined. Dr. E. W. Nelson, chief of the Bureau of Biological Survey, to whom Natural History is indebted for the data contained in this Note, expects in the near future to prepare a bulletin which will set forth the information available at the present time. The bulletin will also give maps of each of the sixteen states in which antelope occur, with the location of the herds, the number in each, and other information, in order to afford a definite basis for conservation work.

A model of the three-horned American dinosaur, *Triceratops prorsus*, that, palm-embowered, greeted President Henry Fairfield Osborn on his return to the American Museum after his sojourn in Asia, the home of the ancestral ceratopsians. The model was designed and prepared by Messrs. Charles Lang and Otto Falkenbach

VERTEBRATE PALÆONTOLOGY

Welcomed Home by a Dinosaur.—A dinosaur head, life size, emerging from a bower of palms and ferns arranged in one corner of the Osborn Library greeted the eyes of Honorary Curator Henry Fairfield Osborn of the department of vertebrate palæontology, on November 7, on the occasion of his welcome home from Asia by the members of the laboratory force of the Museum.

This model of the head of *Triceratops prorsus* was designed and prepared as a surprise by two members of the laboratory force, Charles Lang and Otto Falkenbach, who discovered a new method in the use of papier-mâché materials for the frill and for the polished horns and polished horny beak. Other members of the department force, headed by Curator Matthew, had assembled in the Osborn Library just before the honorary curator was led in to witness this wonderfully lifelike reproduction. The eye of this ceratopsian was represented as quite genial, because the animal enjoys the reputation of having been entirely defensive in its habits; it did not seek trouble but went about avoiding it, with the most effective piercing horns which nature has ever invented and with a bony frill at the back of the head designed to protect all the nerve centers of the upper part of the spinal cord.

That a model of a three-horned American dinosaur of the very closing period of the Age of Reptiles was chosen with which to welcome the return of Professor Osborn from a visit to the fossil beds of Mongolia was most appropriate, because *Triceratops prorsus* is probably a direct descendant of the already famous egg-laying dinosaur *Protoceratops andrewsi* of western Mongolia, described by Dr. William K. Gregory. The head was modeled exactly after the superb skull and bony horns of the complete articulated *Triceratops* skeleton which is now on exhibition in one of the halls of vertebrate palæontology.

Replicas of Baluchitherium Distributed.—A replica of the minute tooth of *Hesperopithecus* presents the widest possible contrast to the facsimile cast of the gigantic skull of *Baluchitherium*. The story of *Baluchitherium* as described by Professor Osborn in the issue of *Asia* for September, 1923, is a romance in itself:

It took several days to work the skull out of the earth. It was transported across the desert of Mongolia and reached Peking on October 20, 1922. It reached the American Museum on December 19, 1922—a red-letter day in the Department of Vertebrate Palæontology, which received it. The scientific preparation began immediately and continued unremittingly in the hands of two, three, and sometimes four preparators, until its completion on April 6, 1923. It was then ready to be reproduced a thousand-fold in still photographs and by the moving-pictures of Mr. Shackelford, and thus distributed in this country and all over the world.

It required several months of additional work to prepare and color in facsimile this superb skull and jaws. The casting was done by Mr. Otto Falkenbach, the coloring by Miss Helen B. Cox, who made constant reference to the beautiful colors of the original. Finally the facsimile copies were finished and sent to the following institutions—the Museum of Cambridge University, the Museum of the Academy of Sciences of Petrograd, the British Museum (Natural History), the National Museum, Yale University, and the University of California—the first one going to Mr. C. Forster Cooper, the discoverer of the genus *Baluchitherium* and curator of the Museum of Cambridge University.

Fossil Birds from Nebraska.—Bird remains are exceedingly rare fossils, save in a few exceptional deposits. In certain former lake beds, such as the Christmas Lake, or Fossil Lake, of eastern Oregon, or at St. Gerand-le-Puy in France, the bones of aquatic birds are as common as those of mammals; and among the fossils of the asphalt deposit at Rancho la Brea near Los Angeles are numerous birds of prey and a few other birds which were trapped in the asphalt. In the swamps of New Zealand, Madagascar, and Australia numerous remains of extinct gigantic ground birds have been found: *Dinornis* and its relatives in New Zealand, *Æpyornis* in Madagascar, *Genyornis* in central Australia. But in most of the Tertiary formations of our West bird bones are almost unknown. The discovery of the skeleton of the giant ground bird *Diatryma* in Wyoming was a bit of rare good fortune. Aside from this, the results of fifty years' collecting in the badlands of the West by Cope and by the representatives of the American Museum are two or three trays of specimens, none of them complete, most of them consisting of single bones or parts of bones.

Expert identification and study of these scanty and fragmentary remains require a thorough knowledge of the comparative osteology of birds such as very few ornithologists possess. The American Museum has been very fortunate, therefore, in being able to place some recent finds of Tertiary birds in the hands of Mr. Alexander Wetmore of the Bureau of Biological Survey at Washington for study and description. An article by Mr. Wetmore in the *Bulletin* of this Museum has just appeared, describing the remains from the Snake Creek and Agate fossil quarries in Nebraska. Among the most interesting of these are bones of an extinct species of *Urubitinga,* a large hawk now found only in Central and South America, and of a small milvine hawk, or kite, whose nearest modern allies are the Mississippi and Everglades kites.

These, therefore, are to be added to the long list of birds, mammals, and other animals which, inhabiting North America in the Age of Mammals, were driven southward, whether by changing climate or by the competition of invading races from the north, and have left more or less modified descendants in tropical America or along our southern borders. Such are the tapirs, peccaries, and llamas, the alligators and crocodiles, certain turtles and lizards, fishes, insects, and mollusks of which we are so fortunate as to have the fossil records. Without doubt many other animals and plants will in time be added to the list.—W. D. M.

Palæontology in Russia. — American palæontologists are deeply interested in the progress of palæontology in Russia and will be gratified to learn that Mme. Marie Pavlow has for four years past held a professorship of palæontology in the University of Moscow and that at the present moment she is deeply engaged in preparing for the publication of her courses of palæontology, beginning with the invertebrates and following with the vertebrates. Under date of August 25 she writes enthusiastically of the reception in Russia of Professor Osborn's volume *The Origin and Evolution of Life*, as translated into French by M. Felix Sartiaux and now in its third printing. Her own field of work in recent years has been principally among the rich collections of proboscideans, including both the elephants and mastodons, in the more recent Quaternary formations of Russia. We owe to Mme. Pavlow the recognition of the true mastodon, very closely related to *M. americanus*, in Russia. In addition to issuing in instalments her work on the Tertiary mammals of Russia, she has from time to time published resumés of the progress of vertebrate palæontology in that country, which are invaluable to American workers to whom much of the original literature is not available.

PUBLIC EDUCATION

The New York State Federation of Workers for the Blind held its annual convention in New York City, October 23–4. Dr. G. Clyde Fisher represented the American Museum at the meetings, which were held at the Lighthouse, 111 East Fifty-ninth Street, and at Stuyvesant High School. Through the Jonathan Thorne Memorial Fund, the Museum has been able during the last fifteen years to carry on valuable work with classes of blind children and the sight conservation classes in the public schools, and with the adult blind of New York City and its vicinity.

INSECTS

The A. Cressy Morrison Prize Awarded. —At the annual dinner of the New York Academy of Sciences, held on December 17, 1923, announcement was made by Dr. Ernest Ellsworth Smith that the A. Cressy Morrison Prize had been awarded to Dr. Frank E. Lutz, curator of entomology, American Museum, for his paper entitled: *Apparently Non-Selective Characters and Combinations of Characters, including a Study of the Ultra-violet in Relation to the Flower-Visiting Habits of Insects.* The competing papers numbered fourteen and were representative of original research in several distinct branches of science. Under such circumstances a decision is necessarily difficult, for differences of opinion may readily arise as to the relative merits of studies in such varied fields as physics, astronomy, biology, and the like. It is a tribute to the intrinsic importance of Doctor Lutz's contribution that all of the judges were in accord in placing his work at the head of the list. This is the second year that the prize has been awarded, and the interest that the contests have aroused and the high standard of the essays submitted are convincing testimony of the wisdom of Mr. Morrison in establishing the prize.

Observations of the Bees of Panama.—Dr. Frank E. Lutz, curator of entomology, returned December 6 from Panama, where he spent a month studying the insects, especially the native bees, of the Canal Zone.

A part of the time was passed on Barro Colorado, the largest island in Gatun Lake. It contains about twelve square miles of dense and absolutely primitive tropical jungle. The only even partially cleared areas are several very small farms along one edge of the island. The government of the Zone has recently made Barro Colorado a biological reservation, prohibiting both hunting and any extension of agriculture. In view of the facts that, although an island and therefore readily protected, it is fairly accessible to visitors and that agriculture is rapidly destroying jungle in the Zone, this action by the government is particularly fortunate.

Through the courtesy of the U. S. Army, Doctor Lutz was able to explore the reservation from an aëroplane. He also established a camp from which he cut and fully blazed a trail across the island. This trail, the first to be blazed in this jungle, was laid out in such a way as to lead through different types of vegetation and by other points of interest, including a large settlement of leaf-cutting ants.

Doctor Lutz reports that the island, which is really the top of a mountain that became surrounded by water when Gatun Lake was flooded in the construction of the Canal, naturally contains a great variety of birds and mammals, such as parrots, monkeys, and tapirs. Almost any Panamanian animal that may be found to be lacking can be introduced. The jungle is so dense that it is practically impossible to penetrate it without first cutting a way through the vines, prickly stems, and other vegetation.

In addition to making a general collection of insects, including those bees that do not live in colonies, Doctor Lutz was successful in securing nests of several species of native social bees (Meliponidæ). These latter live in colonies, each colony having a queen and numerous workers, much as does the Asiatic honeybee that man has domesticated. They are not, however, closely related to the Asiatic bee. They do not sting but they *do* bite, and certain kinds eject a fluid that severely burns the human skin.

Bees of this group store honey in special cells about the size of grapes. There is often a considerable quantity in a nest and in some cases it has a good flavor but, depending on the species of bee that made it, the honey may be rather tasteless, or too acid, or even poisonous. Some of these bees make their nests in cavities, such as hollow trees, the walls of houses, or holes in the ground; others build large hanging nests somewhat like those of the white-and-black hornet of our northern woods; while still others establish their colonies in the large nests made in trees by white "ants."

The most populous nest of which there is an available record contained about 75,000 bees and, although they do not sting, a thousand or so of these bees covering one's face, hands, and even the inside of one's clothing, each more or less gently biting, are rather uncomfortable.

THE WHITNEY SOUTH SEA EXPEDITION

In connection with Dr. Robert Cushman Murphy's lecture on the Whitney South Sea Expedition, there was installed in memorial hall, American Museum, an exhibit epitomizing the achievements of the expedition and offering at the same time a bird's-eye view of the wealth of scientific material supplied by this interesting region of the world. Ranged in cases were examples of the bird life of Polynesia, notable not only for its diversity but on account of the restricted range of certain forms,—for instance, the warblers of the genus *Conopoderas* with twelve representatives, each confined to a single island or a small group of islands. Rare birds like Peale's petrel, of which only three specimens had been found prior to this expedition, the fruit pigeon of Rapa Island, known previously from only a single skin, and the Tuamotuan land kingfisher, interesting not only because it is new to science but because, departing from the piscatorial habits of most of its fellows, it feeds on insects and lizards, were among the prized acquisitions of the expedition. Of spectacular interest were the specimens of feral poultry,—descendants of the Asiatic jungle fowls which the Polynesian people carried to the South Pacific islands on their migrations; the red-tailed tropic bird, the long scarlet appendages of which are in some countries legitimately added to the stock of the milliner, like the down of the eider and the plume of the ostrich, seeing that they can be plucked without injury to the bird; fruit pigeons of wonderful diversity, some with white crests, others with red or purple, or red rimmed with yellow, as well as harmonious or spectacular changes of coloration in other parts of their plumage; and finally an exceptionally rich representation of interesting marine birds, such as noddies, terns, petrels, and shearwaters.

While primarily an ornithological undertaking, the Whitney South Sea Expedition secured much interesting material falling within other fields. A number of mounted specimens of identified Polynesian plants were shown in one case; examples of the land crabs, certain fish, and shells were exhibited in another; and finally the excellent photographs taken by Mr. Rollo H. Beck and his associates, selections from which were placed upon a screen in back of the cases, showed not only the bird life of the islands but their scenic attractiveness, the physique and mode of dress of the natives inhabiting them, and their ancient stone idols. A Polynesian having seven toes and six fingers was represented in one of the pictures.

It was fitting that, by way of correcting the belief that the South Sea islands have come into public cognizance only in this generation, some impression should be given of the abundant literature devoted to this area of the world in earlier decades. Among the more arresting publications displayed were one of the twelve extant volumes of the suppressed issue of Titian R. Peale's account of the mammals and birds of the United States Exploring Expedition of the forties and Lady Belcher's volume on *The Mutineers of the Bounty*. Of direct bearing on the Whitney Expedition were the Field Note Books of Mr. Beck and his major contributions to NATURAL HISTORY, the Field Journal of his associate, Mr. Ernest H. Quayle, totaling five substantial volumes of typewritten sheets, and a volume of Notes on the Geography and Fauna of Eastern Polynesia prepared by Dr. Charles W. Richmond.

BIRDS

DR. F. M. CHAPMAN'S EXPEDITION TO CHILE.—On November 29, Dr. Frank M. Chapman, curator of the department of ornithology, American Museum, sailed for Chile, accompanied by Mrs. Chapman, Mr. F. C. Walcott, and Miss Helen Walcott. Two scientific purposes will be accomplished by this trip. The sojourn in Chile will enable

Doctor Chapman to continue in a new area the field studies that he has been making in connection with his work on the origin and distribution of Andean bird life. The initial volume of this comprehensive piece of research—*The Distribution of Bird-Life in Colombia*—has already been published; a second volume, dealing with the birds of Ecuador, is well advanced; and a third volume, to be devoted to the avifauna of Chile, will take shape as a result of the present studies.

The expedition will not confine its attention to Chile. The second purpose that it has set out to accomplish is the securing of material for a habitat group representing the bird life of the Pampas of western Argentina. Miss Walcott, in the capacity of artist to the expedition, will make the field sketches for this group. Mr. Walcott will act as photographer to the expedition, and Mrs. Chapman will assist in the preparation of specimens.

ANTHROPOLOGY

Dr. William W. Graves, of St. Louis, Missouri, well known for his anatomical researches, especially on the human scapula, its form and relation to disease, represented the American Museum at the inauguration of Herbert Spencer Hadley as chancellor of Washington University, November 10, 1923.

Mr. N. C. Nelson, associate curator of archæology, returned to the American Museum after a ten weeks' field trip which took him to various states, including New Mexico, Oklahoma, Missouri, Illinois, Kentucky, and Virginia. Commencing in New Mexico in late August, he initiated Dr. Louis R. Sullivan into the art of recovering ancient Indian skeletal material from one of the Pueblo ruins, an undertaking which fortunately resulted in a considerable collection. Following this, three weeks were devoted to excavations at Jacobs Cavern, in the Ozark foothill country near Pineville, Missouri. The object here was to verify the apparent evidence (a bone with an engraved figure of a mastodon upon it) of Pleistocene man, discovered in 1921 and published in Natural History, Vol. XXI, No. 6. Expectations failed completely, inasmuch as nothing was found to indicate that man had lived in the cave in times prior to the arrival of the present fauna. Later, a remarkable Indian quarry-and-workshop of prehistoric date was examined in Ottawa County, Oklahoma, not far from the Missouri state line. Here a small representative collection was obtained.

This completed the summer's program, but Mr. Nelson took advantage of the occasion on his way home to inspect the famous Cahokia mound group near East St. Louis. As the guest of the Mammoth Cave Estate, he spent three weeks also in Kentucky, where he examined a number of caves as well as other sites reputed as showing evidence of Indian occupation. The principal discovery here was a flint quarry-and-workshop, apparently of considerable antiquity. Lastly, by invitation, the wonderful Luray and Endless caverns in the Shenandoah Valley, Virginia, were visited, but here nothing was found of archæological interest.

Incidentally, Mr. Nelson was given opportunity to see two exceptionally fine private archæological collections, viz., that of Dr. H. H. M. Whelpley in St. Louis and that of the late General Gates P. Thruston, now exhibited at Vanderbilt University, Nashville, Tennessee.

MAMMALS

J. A. Allen Memorial Fund.—This fund, established in honor of the Nestor of American mammalogists, Joel Asaph Allen, late curator of mammals in the American Museum, has now reached a total of nearly $5200 toward the $10,000 desired by the committee in charge. The income from this fund is to be used for the annual publication, as special numbers in the *Journal of Mammalogy*, of scientific papers dedicated to the memory of Joel Asaph Allen. *The Journal of Mammalogy* is the only periodical in the world devoted solely to this branch of natural history. The remaining $4800 necessary to complete the fund will be secured, it is hoped, through invitation to all the mammalogists of the world and to members of the American Museum and the New York Zoological Society.[1]

Among the first contributors to the fund were the President of the American Museum, Prof. Henry Fairfield Osborn, and several members of the Board of Trustees, including Messrs. Cleveland H. Dodge, Childs Frick, and Madison Grant, the last-mentioned being

[1]Checks should be made payable to the J. A. Allen Memorial Fund. They may be addressed care of H. E. Anthony, Secretary and Treasurer, American Museum of Natural History, New York City.

also chairman of the central committee for the J. A. Allen Memorial Fund. Among the members of the American Society of Mammalogists, the chief contributors, in addition to those just mentioned, were Miss Annie M. Alexander, Messrs. S. Prentiss Baldwin, Thomas Barbour, George B. Grinnell, Ernest Thompson Seton, and the Hon. George Shiras, 3rd. Among the non-members of the Society, Mr. James B. Ford was most generous in his support.

The largest single contributions were three of $500; next came one of $200; one of $125; nine of $100; thirteen of $50; one of $40; twenty-nine of $25; six of $20; one of $15; thirty-nine of $10; one of $7; fifty-seven of $5; and twenty-seven of less than this amount. Interested friends and admirers of Doctor Allen who are not members of the Society contributed $1250, which represents approximately one-fourth of the present sum subscribed.

Mr. H. E. Anthony, associate curator of mammals of the Western Hemisphere, returned to the American Museum early in December from field work in Ecuador. About four and a half months were spent in that country with Mr. G. H. H. Tate, field collector of the department of mammalogy, who remained in Ecuador to carry on the work after Mr. Anthony's departure. The material brought back by Mr. Anthony included about 1450 mammals, 450 botanical specimens, as well as small collections of birds, reptiles, fossil mammals, and about 250 photographic negatives. The collection of mammals comprises about 150 specimens of the rare genus *Cænolestes*, an animal formerly regarded as so rare that the taking of a single specimen was considered an achievement. The mammals collected range in size from a mouse up to a large deer, and were taken for the most part in the high mountain region about Quito.

The fossil mammals were obtained from beds of volcanic ash near Riobamba and represent the fauna of the Pleistocene. This part of the collection includes the one-toed horse, camel, deer, mastodon, wolf, possibly bear, and small forms such as rabbits, rats, and mice. Perhaps the most interesting specimen among the fossil material is the human skull that was found associated with the remains of the Pleistocene mammals. Whether this skull should be considered as contemporaneous with the Pleistocene fauna is a point to be determined by careful comparisons after the skull has been cleaned and prepared for study. At any rate, the specimen is a very interesting one and is bound to bring forth a great deal of suggestive speculation.

Mr. Tate is now collecting along the line of the old mountain trail from Guayaquil to Quito, which has been little used ever since the railroad was built.

REVIEWS

"Birds in Legend, Fable and Folklore."—A volume thus entitled by Ernest Ingersoll, published by Longmans, Green and Co., is entertaining as well as informing. We are all familiar with the time-honored fiction that the ostrich hides its head in the sand, but to get a proper conception of the perverse ingenuity of the human mind in explaining nature not by observation and legitimate inference but by letting the fancy run wild, one must turn to the pages of this book, in which are presented a large number of curious misconceptions about birds, ranging from accounts engraved on the clay tablets of Babylon to the superstitions of the Southern darkey. That geese grow on trees, bursting fully fledged from fruit resembling apples; that the stork and other "season-observing birds" winter in the moon; that the ostrich hatches its eggs not through the warmth of its body but by the concentrated gaze of its eyes; that rooks are the ghosts of bad old landlords,—these are but a few of the quaint beliefs cited by the author, some of which enjoyed a wide vogue and were honored by picturesque variants.

Observations of a Bird Photographer.—To secure a good picture of some little creature in the wild requires so much more skill and patience than to lodge a bullet in the broad target offered by some unsuspecting moose or deer that, taking into account man's joy in overcoming difficulties, it is surprising that the camera is not replacing the gun more rapidly. But after all, the exercise of skill is not the only consideration. The more intimate contact with nature enjoyed by one who *records* in contrast with one who *destroys* weighs overwhelmingly in favor of hunting with the camera.

What the bird photographer may glean from his close approaches to the nest is indicated in a volume by Dr. A. H. Cordier recently published by Dorrance under the title of *Birds—Their Photographs and Home Life.* The author has included in it brief sketches of a great number of birds that he has observed in the course of his field trips, extending from the Aleutian Peninsula to the Gulf of Mexico, and near his home at Kansas City. While only incidentally a guide to the birds, the primary function of the book being to present a readable record of the habits of different species, the descriptions given of birds, their nests, and their eggs should be helpful in making identifications. Chapters on the principles involved in photographing birds and the equipment that is essential or desirable will be of advantage to the prospective nature photographer, for, as Doctor Cordier's pictures give evidence, the information he now imparts to others he has himself applied with singular success. The author's love for the birds is bound to kindle the reader's sympathetic interest, for it finds expression not merely in an abstention from injury but in repairing injury done, witness his surgical operation upon a white ibis that had broken its leg and that was anæsthetized before the knife was applied.

A New Popular Book on Minerals.—One of the most significant tendencies in our present-day life is the urge to get out of doors and learn about the things we see in the woods and on the hillside. A number of popular books have appeared from time to time which have met, or in part have met, this need for non-technical information about the plants, the birds, and the animals. Prof. Frederick Brewster Loomis, of Amherst College, has added to this rapidly increasing book shelf a really practical and very understandable little book on minerals and rocks, entitled *Field Book of Common Rocks and Minerals,* published by G. P. Putnam's Sons.

One of the first requisites of such a field book is that it should be small in compass, and Professor Loomis has succeeded admirably in producing a volume to fit the pocket, and incidentally the pocket-book, of the Boy Scout, which tells him in language that he can understand what he wants to know about the rocks and the minerals that make them. A very attractive feature of the *Field Book* are the many reproductions in color of minerals, which are for the most part admirably executed. The book contains 271 pages, of which 169 are devoted to the minerals and the remainder to the rocks. The minerals are grouped on the basis of their chief metals, bringing together the silver minerals, the lead minerals, and so on.—H. P. W.

Wood's "Illustrated Natural History."—That a volume of systematic zoölogy, issued somewhat less than a decade before the publication of Darwin's *Origin of Species,* should still be read, not flippantly, with the thought of discovering quaint misinformation, but respectfully, for the substantial amount of fact it contains, is rather remarkable. Yet such is the distinction that attaches to the Rev. J. G. Wood's *Illustrated Natural History,* which, first issued in the early fifties of the last century and subsequently expanded into a series of volumes, has recently appeared in a handsome new edition under the imprint of E. P. Dutton and Company. In the preparation of the new edition, which consists of a single volume, there has been necessarily extensive elimination of material, both text and illustrations, but by way of compensation there have been added eight colored plates.

An unfortunate error has resulted through the introduction of division titles in the section on insects. The Neuroptera, already burdened by the inclusion of several groups of insects that have since Wood's day been placed in distinct orders, has by error taken into its fold also the Hymenoptera, which even in Wood's time was a well recognized independent order; while the important order of beetles, like that of the bees, wasps, ants, and sawflies, appears without an introductory heading.

One of the reasons doubtless for the great vitality of Wood's work is the fact that it is presented in so simple and readable a form that it has won its way among circles of readers that are repelled by the heavier language of the technical writer; but its substance too, though necessarily in many details out of date, entitles it to respectful consideration.

HONORARY LIFE MEMBERS OF THE AMERICAN MUSEUM

In the March-April issue of Natural History the exploits and achievements of the various expeditions working in different parts of Asia on behalf of the American Museum will receive emphasis. Honorary life membership has recently been conferred by the Board of Trustees of the Museum upon several individuals who, because of their services in the field or because of their invaluable aid in facilitating the work of exploration, were selected for this distinction. To the reader of the Asiatic number it will be of interest to know in advance something of these individuals, who have contributed so much to the success of the Museum's undertakings in that continent:

Col. J. C. Faunthorpe first visited the American Museum in 1919, and was so delighted with the manner in which the mammals were shown in the exhibition halls that he conceived the idea of sending some of the game mammals of India to the American Museum. This initial resolve led step by step to the coöperation of his friend, Mr. Arthur S. Vernay, and to the plans for the Faunthorpe-Vernay Indian Expedition of 1923, which has brought such splendid results to the Museum. An account of this expedition, written by Colonel Faunthorpe, will be one of the notable features of the March-April issue of Natural History.

In the intervals of his long service in India Colonel Faunthorpe has become famous as a sportsman, especially through his success in tiger shooting, and many a fine specimen sent to the Museum is a tribute to his marksmanship. In unanimously electing him an honorary life member the Trustees considered his record of service, some of the principal features of which are here briefly indicated:

Subsequent to his graduation from Balliol College, Oxford, he became connected in 1892 with the Indian Civil Service. In 1914, at the call of his country, he joined the Army, having previously served in the United Provinces Horse. He was on duty in France and Belgium until 1918, when he went to America on the War Mission. During 1919 and part of 1920 he was attached to the British Embassy at Washington, D. C. Since 1920 he has been ably administering his office as Commissioner of Lucknow.

Mr. Arthur S. Vernay was elected to the rank of honorary life member at the same time as his friend and fellow sportsman, Colonel Faunthorpe. A great lover of sports, Mr. Vernay has traveled widely in search of big game, including in his field trips certain of the wilder parts of North America and various areas of Asia. Mr. Vernay has spread the knowledge of wild life in Asia through the interviews which he has accorded representatives of the press and through spirited articles descriptive of his remarkable six months' hunt with Colonel Faunthorpe. The splendid qualifications of Mr. Vernay not only as a sportsman but as a naturalist are evidenced in his writings; his article on "Stalking Tsine in Burma," which will appear in the March-April issue of Natural History, may be cited as an instance in point. By his own request the expedition in which he was one of the joint leaders is known as the Faunthorpe-Vernay Indian Expedition, but in the case of the photographs and films of the undertaking, the copyright is held in the name of the Vernay-Faunthorpe Expedition to India and Burma. Beautiful examples of the pictures obtained by the expedition have been published in *The Illustrated London News* (August 18, 1923) and *The Illustrated Sporting and Dramatic News* (August 11, 1923 and August 18, 1923) as well as in periodicals in this country.

Mr. Vernay is at present on his way from Moulmain to Bangkok. He has been spending several months in that area, collecting additional specimens for the American Museum.

Mr. Roy Chapman Andrews.—Seventeen years ago, after graduation from Beloit College, Wisconsin, Mr. Andrews approached the front of the American Museum as an unknown young naturalist, wondering how he would be received and whether he could find work within its doors. He was fortunate in entering immediately into the service of the venerated curator of mammalogy, Dr. Joel Asaph Allen. Early in his scientific career Mr. Andrews became interested in whales through the acquisition by the Museum of the large whale killed off the Long Island coast at Amagansett, and of the smaller specimen obtained at Wainscott. The two skeletons were collected by Mr. Andrews with the aid of Messrs. James L. Clark and John T. Nichols. During eight years subsequent to this experience Mr. Andrews gave much attention to whales, a group of mammals that will receive emphasis in the proposed hall of ocean life. The work of collecting and studying the cetaceans carried Mr. Andrews "twice around the world, as well as northward on two expeditions to Alaska, and southward to the tropic waters of Borneo and Dutch East Indies." The last-mentioned places were visited during 1909–10 when Mr. Andrews was cruising in the Far East on the U. S. Fish Commission steamer, *Albatross*. In 1911–12 Mr. Andrews continued his studies in the East by exploring northern Corea, but in 1913 returned to Alaska to secure northern species of whales. The next two years were devoted to working up the whale collections, the year 1914 being signalized also by his marriage to Miss Yvette Borup, sister of Mr. George Borup of Arctic fame. In March, 1916, he organized what has come to be known as the First Asiatic Expedition, and spent nineteen months in conducting it through southern and western China, Fukien, and Yunnan, and thence into western Burma, to proceed down the Irrawaddy River from Bhamo to Rangoon. In 1919, Mr. Andrews headed the Second Asiatic Expedition to northern China and outer Mongolia, and this undertaking led in turn to the highly successful Third Asiatic Expedition, with the progress of which readers of NATURAL HISTORY are familiar through articles contributed by Professor Osborn and Mr. Andrews and through numerous Notes. Mr. Andrews is the author of a number of works dealing with his field experiences and scientific studies. Among these are: *The California Gray Whale, The Sei Whale, Whale Hunting with Gun and Camera, Camps and Trails in China,* and *Across Mongolian Plains.*

HIS EXCELLENCY The EARL OF READING, G.C.B., VICEROY OF INDIA is too well known for his statesmanship and the potent rôle he has played in the political life of the British Empire to require an introduction to our readers. As president of the Anglo-French Loan Mission to the United States in 1915, as special envoy in 1917, and finally as high commissioner and special ambassador to our country in 1918, he is especially well remembered, although these offices were but a few of the posts of responsibility that he has held in the course of his eventful career. As viceroy and governor-general of India he gave the Faunthorpe-Vernay Expedition invaluable support, and the tiger group is to be presented to the American Museum in his name as a constant reminder to the public of his part in making the expedition a success.

HIS EXCELLENCY SIR HARCOURT BUTLER, G.C.I.E., is governor of Burma, and the practical assistance which he gave to the Faunthorpe-Vernay Expedition will be commemorated through the association of his name with the specimens obtained in Burma. It was he who gave the expedition his sanction to shoot any animals necessary to the collection and who deputed Mr. D. F. Hopwood, M.C., to arrange all the bandobust. He showed the greatest interest in the work generally and his helpfulness has extended to the expedition of Mr. Vernay that is now in progress, to which he has given every encouragement and support.

TO GENERAL HIS HIGHNESS MAHARAJA SIR CHANDRA SHUMSHERE JUNG, prime minister and marshall of Nepal, the Faunthorpe-Vernay Expedition is under special obligations for the invaluable assistance he gave in the collecting of the rhinoceros specimens. In India the rhinoceros is royal game and the privilege to hunt it is one of the most difficult to obtain. The Maharaja not only accorded this permission but with regal generosity supplied the expedition with Nepalese officials, coolies, elephants, and food supplies, indispensable to the carrying out of the project. The group of the great one-horned rhinoceros will, with the Maharaja's permission, be presented in his name.

MR. A. P. KINLOCH, a coffee planter of India, has been of great aid to the Faunthorpe-Vernay Indian Expedition, to the collected fauna of which he contributed certain rare birds that he obtained in the Kollengode Division. Mr. Kinloch is a keen ornithologist and the fact that the material he collected was accompanied by field notes adds to its value. He is particularly interested in the avifauna of the Nelliampathy Hills, to the literature of which he has been a contributor.

MR. FRANZ A. LARSEN went to Mongolia as a missionary more than thirty years ago. The country and its people appealed to him so greatly that he decided to make his home there. Mr. Larsen eventually gave up his missionary work and entered business, becoming manager of the Anderson and Meyer Company. He organized a branch office in Urga and carried on the work of the company successfully under the most disadvantageous conditions. Leaving the employ of the company in 1922, he organized the firm of F. A. Larsen and Company for the export of furs, ponies, and other Mongolian products. During Mr. Larsen's long residence in Mongolia he has taken part in almost every political event of importance in that country. He has enjoyed the entire confidence of the Mongolian government and has acted as an intermediary in settling many political questions between the Mongols and Chinese. In 1922, Mr. Larsen accompanied the Third Asiatic Expedition for a part of the time it sojourned in Mongolia, and it was largely through his active work on behalf of the expedition that permission to carry on its investigations was granted by the Mongolian government.

Mr. C. Badmajapoff, who is Mongolian minister of justice, accompanied the famous Russian explorer, Colonel Kozloff, on a three-year tour of exploration in Mongolia and Tibet. He was a member of the Third Asiatic Expedition during part of the summer of 1922. Occupying an important position in the Mongolian government, he assisted the members of the expedition very greatly by obtaining permission for them to work in Mongolia both during the seasons of 1922 and 1923.

Since the last issue of Natural History the following persons have been elected members of the American Museum, making the total membership 7260:

Patron: Mr. Arthur S. Vernay.

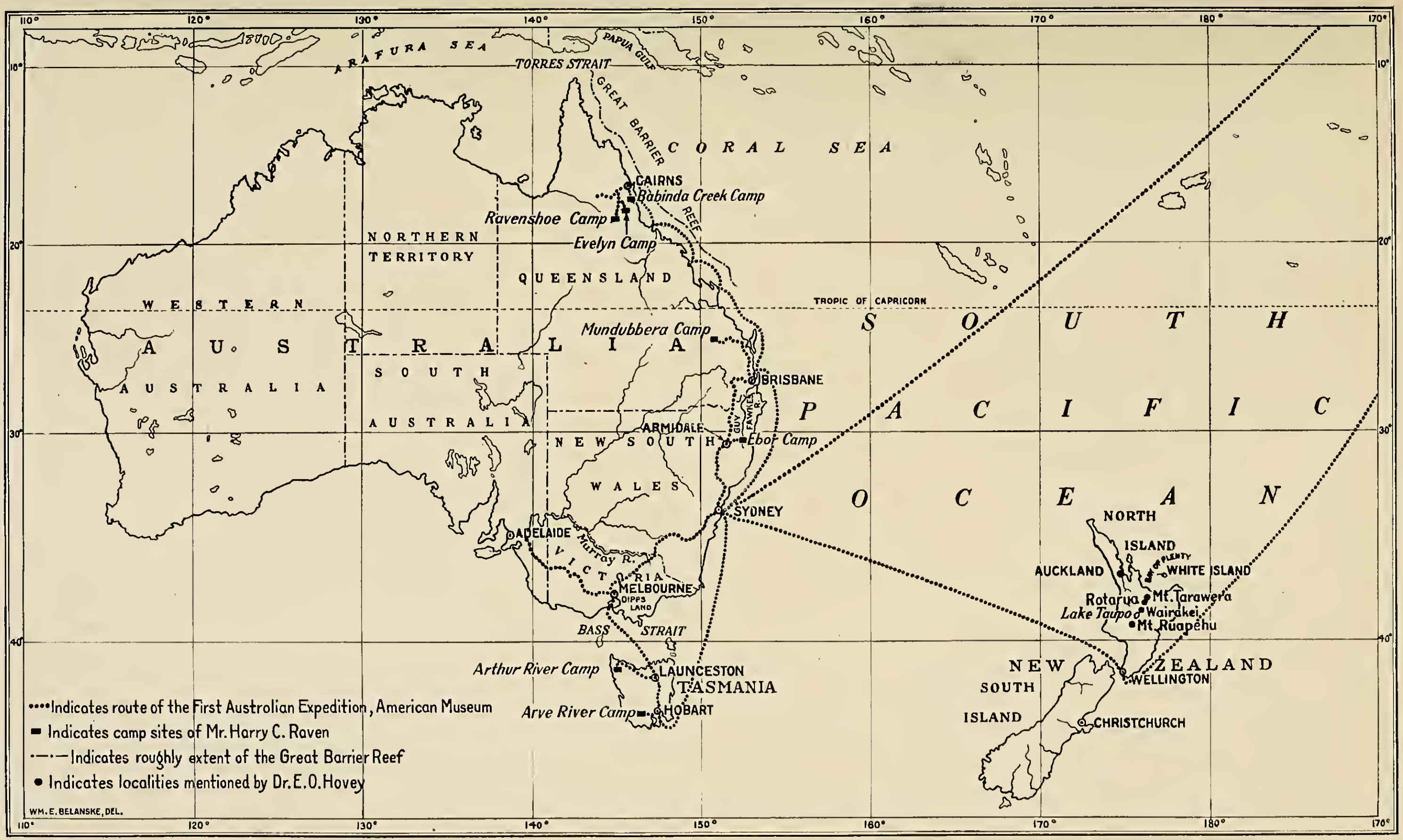
Honorary Life Members: Mrs. Mary White Tsipouras; General His Highness Maharaja Sir Chandra Shumshere Jung; His Excellency the Earl of Reading, G.C.B. and His Excellency Sir Harcourt Butler, G.C.I.E.; Dr. Joseph Bequaert; Messrs. Roy Chapman Andrews, C. Badmajapoff, A. P. Kinloch, and Franz A. Larsen.

Life Members: Prof. Alice Wilson Wilcox; Mesdames George Temple Bowdoin, E. L. Dickerson, George F. Kunz, Carson C. Peck, F. Sullivan Smith; Dr. Henry H. Covell; Messrs. Beecher S. Bowdish, George T. Brokaw, Walter W. Holmes, Mason M. Phelps, and Albert T. Stewart.

Sustaining Members: Mesdames Hanna E. Belden and Henry W. J. Bucknall; Miss Elizabeth D. Bowen; Messrs. Wm. W. Carman and Charles E. F. McCann.

Annual Members: Mesdames Phineas Hillhouse Adams, Barrett Andrews, W. D. Baldwin, John E. Bates, Joseph Bates, F. Wilder Bellamy, W. W. Benjamin, I. Block, William M. Bradshaw, Mary O. M. P. Brown, Durant Campbell, Ernest T. Carter, John McClure Chase, Percival W. Cowles, Henry E. Crampton, Arthur Friend, Alfred J. Frueh, John I. Hart, James Mott Hartshorne, Elizabeth Herb, Nancy C. Lange, M. A. Litwin, Mabel P. Miller, Charles D. Norton, Wm. R. Pitt, S. T. Shoneman, and Hutton Williams; Sister M. Thomasina; the Misses M. A. Aspinwall, H. Broadbent, B. G. Brooks, Sarah E. Bruce, Angela Diller, Julia R. Hall, Mary E. P. Haynes, M. T. Lippincott, and Mary T. Tower; Doctors Theodore J. Abbott, James W. Babcock, Ernest S. Bishop, Richard Blum, Henry Brodman, Eleanor A. Campbell, Albro R. Carman, Arthur F. Chace, Solomon De Sola, Martin Dewey, William H. Dieffenbach, Jacob Heiman, A. B. Jamison, Edmund R. P. Janvrin, Howard Lilienthal, and Wm. H. Woglom; Prof. Herbert R. Moody; the Reverend Winfred Douglas; Messrs. B. Abbot, Samuel N. Abbott, Paul Strong Achilles, H. M. Addinsell, Albert J. Appell, Charles F. Ayer, John V. Bacot, Jr., Sydney H. Ball, Edwin De T. Bechtel, E. S. Beck, Pope B. Pillups, D. Borgia, J. A. Bower, Otho S. Bowling, John Hall Bowman, Leo Brecher, Hiram Burlingham, Robert E. Carrick, Norman Wilmer Chandler, C. L. Chester, Hawley T. Chester, Charles S. Clausen, Arthur J. Cohen, L. W. T. Coleman, P. D. Collins, Dudley N. Condit, James Bliss Coombs, J. E. Coonan, Mark Douglas Currie, De Witt A. Davidson, Samuel D. Davis, Clarence M. Day, David B. Dearborn, Jr., R. E. Deeks, Paul A. Degener, Wm. R. Delehanty, Edwin H. Denby, Benjamin P. DeWitt, Fred'k E. Donaldson, Arthur Simeon Doying, Mansfield Ferry, John R. Flanagan, W. A. Gardner, Carleton Greene, William Hare, A. Abbott Hastings, Karl Heisenberg, Charles E. Heydt, Leo H. Hirsch, Louis L. Horch, Henry T. Hunt, George B. Huron, George W. Jacoby, Leeds Johnson, Ralph Jonas, Bassett Jones, Edwin Artimus Jones, W. Strother Jones, Philip Kachurin, Saml. M. Kaplan, Bernard Karsch, Max Kaskel, Adolph Kastor, Charles B. Kaufmann, Charles G. Keller, James J. Kennedy, John N. Kenyon, Alphonse Kloh. Julius Klugman, Emil W. Kohn, Jacques Krakeur, John F. Krauser, Michael Lerner, Samuel A. Lerner, Harrison Lillibridge, Oscar Lion, C. C. Loomis, Amos Morrill, Frank J. Muhlfeld, William C. Mumford, Charles J. Paine, Geo. W. Phillips, Jr., Edward R. Rayher, Stanley M. Rumbough, Ludwig Stern, W. H. Stevens, H. E. Stump, Walter S. Sullivan, Frank E. Thompson, Oscar von Passavant, W. M. Wadsworth, Ralph Wolf, Ernest Wolkwitz, and Fifield Workum.

Associate Members: Mesdames Florence M. Dow, Wm. Preston Johnston, Alphonse Le Duc, Helen J. Lee, Caroline B. Shoemaker, and Grace E. Valentine; the Misses Matilda Geddings Gray, Clara H. Many, Katherine McEwen, E. Virginia Smith, and Mary B. Whiting; Judge De Witt H. Merriam; Doctors James L. Gamble, William E. Gamble, R. S. Manley, Rudolph Matas, Arthur B. McGraw, E. Lawrence Oliver, Graham Renshaw, F.R.S.E., R. M. Van Wart, and Richard B. Wetherill; Prof. H. W. Straley, 3d; the Reverend W. D. Westervelt; Messrs. Vernon Bailey, Charles Baker, P. L. Barter, Hugh J. L. Beadnell, Dana E. Brinck, William W. F. Brinley, Chandler M. Brooks, Chester K. Brooks, E. H. Brooks, Frank L. Connard, S. B. Copeland, H. N. Davock, C. W. de Rekowski, B. H. Dibblee, Alex Dow, Harold Hunter Emmons, Horace H. Esselstyn, E. G. Ewing, Calvin Fisher Fencil, William S. Green, Guy S. Greene, Rae T. Hadzor, Samuel H. T. Hayes, J. M. Heiser, Jr., George M. Hendrie, Charles E. Hilton, Joseph H. Hunter, Robert L. Kemp, Robert Kent King, Clarence H. Knowlton, John M. Lazear, Roy C. Manson, Clifford Marburger, Robert R. McMath, Arthur McMullen, III, Robert A. Morton, W. Howie Muir, Hashime Murayama, Jerome Newman, C. M. O'Donel, E. W. Parker, C. E. Rose, L. S. Russell, Wm. N. Simons, Roger A. Simonson, J. Zach. Spearing, S. B. Dick Speer, A. L. Stephens, Charles M. Sternberg, J. I. Stoddard, F. D. Whitall, Lawrence W. Whitall, Carrel Wiest, S. P. Williams, Jr., and George W. Woolsey.


ARAFURA SEA
TORRES STRAIT
PAPUA GULF
GREAT BARRIER REEF
CORAL SEA
CAIRNS
Babinda Creek Camp
Ravenshoe Camp
Evelyn Camp
NORTHERN TERRITORY
QUEENSLAND
WESTERN AUSTRALIA
AUSTRALIA
SOUTH AUSTRALIA
Mundubbera Camp
BRISBANE
ARMIDALE
GUY FAWKES R.
Ebor Camp
NEW SOUTH WALES
SYDNEY
ADELAIDE
Murray R.
VICTORIA
MELBOURNE
GIPPS LAND
BASS STRAIT
Arthur River Camp
LAUNCESTON
TASMANIA
Arve River Camp
HOBART
TROPIC OF CAPRICORN
SOUTH PACIFIC OCEAN
NORTH ISLAND
AUCKLAND
PLENTY
WHITE ISLAND
Rotarua
Mt. Tarawera
Lake Taupo
Wairakei
Mt. Ruapehu
NEW ZEALAND
WELLINGTON
SOUTH ISLAND
CHRISTCHURCH
110° 120° 130° 140° 150° 160° 170° 180° 170°
10° 20° 30° 40°
••••Indicates route of the First Australian Expedition, American Museum
■ Indicates camp sites of Mr. Harry C. Raven
·—·— Indicates roughly extent of the Great Barrier Reef
● Indicates localities mentioned by Dr. E. O. Hovey
WM. E. BELANSKE, DEL.

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FOUNDED IN 1868

MEMBERSHIP MORE THAN SEVEN THOUSAND

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

Illustrated stories for the children of members are told on alternate Saturday mornings in the fall and in the spring.

MEMBERS' CLUB ROOM AND GUIDE SERVICE

A room on the third floor of the Museum, equipped with every convenience for rest, reading, and correspondence, is set apart during Museum hours for the exclusive use of members. When visiting the Museum, members are also privileged to avail themselves of the services of an instructor for guidance.

THE AMERICAN MUSEUM OF NATURAL HISTORY has a record of more than fifty years of public usefulness, during which its activities have grown and broadened, until today it occupies a position of recognized importance not only in the community it immediately serves but in the educational life of the nation. Every year brings evidence—in the growth of the Museum membership, in the ever-larger number of individuals visiting its exhibits for study and recreation, in the rapidly expanding activities of its school service, in the wealth of scientific information gathered by its expeditions and disseminated through its publications—of the increasing influence exercised by the institution.

In 1923 no fewer than 1,440,726 individuals visited the Museum as against 1,309,856 in 1922 and 1,174,397 in 1921. All of these people had access to the exhibition halls without the payment of any admission fee whatsoever. The EXPEDITIONS of the American Museum have yielded during the past year results of far-reaching importance. The fossil discoveries in Mongolia made by the Third Asiatic Expedition, the representative big-game animals of India obtained by the Faunthorpe-Vernay Expedition, the collections of fossil vertebrates made in the Siwalik Hills by Mr. Barnum Brown, the achievements of the Whitney South Sea Expedition, and of other expeditions working in selected areas of South America, in the United States, in the West Indies, and in Panama, are representative of the field activities of the Museum during 1923. Many habitat groups, exhibiting specimens secured by these expeditions, are planned for the new buildings of the Museum.

The SCHOOL SERVICE of the Museum reaches annually more than 5,000,000 boys and girls, through the opportunities if affords classes of students to visit the Museum; through lectures on natural history especially designed for pupils and delivered both in the Museum and in many school centers; through its loan collections, or "traveling museums," which during the past year circulated among 472 schools, with a total attendance of 1,491,021 pupils. During the same period 440,315 lantern slides were loaned by the Museum for use in the schools as against 330,298 in 1922, the total number of children reached being 3,839,283.

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

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

The POPULAR PUBLICATIONS of the Museum, in addition to NATURAL HISTORY, include Handbooks, which deal with the subjects illustrated by the collections, and *Guide Leaflets*, which describe some exhibit or series of exhibits of special interest or importance, or the contents of some hall or some branch of Museum activity.

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

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

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NATURAL HISTORY

ASIA

THE DISCOVERY OF AN UNKNOWN CONTINENT BY HENRY FAIRFIELD OSBORN—LIVING ANIMALS OF THE GOBI DESERT BY ROY CHAPMAN ANDREWS—GEOLOGICAL RECONNAISSANCE IN CENTRAL MONGOLIA BY CHARLES P. BERKEY—JUNGLE LIFE IN INDIA BY COLONEL J. C. FAUNTHORPE—STALKING TSINE IN BURMA BY ARTHUR S. VERNAY—THE DISAPPEARANCE OF THE WILD LIFE OF INDIA BY COLONEL J. C. FAUNTHORPE—EXTINCT ANIMALS OF INDIA BY WILLIAM D. MATTHEW—HAINAN—AN ISLAND OF FORBIDDING REPUTATION BY CLIFFORD H. POPE—THROUGH THE YANGTZE GORGES TO WAN HSIEN BY ANNA G. GRANGER—IN THE REALM OF THE KAMCHATKA BLACK BEAR BY WALDEMAR JOCHELSON

The American Museum is greatly indebted to naturalists and officials of India, China, and Mongolia for their coöperation in assembling materials representative of the great continent of Asia

JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

EXPLORATION · RESEARCH · EDUCATION

美國天產博物院

B.

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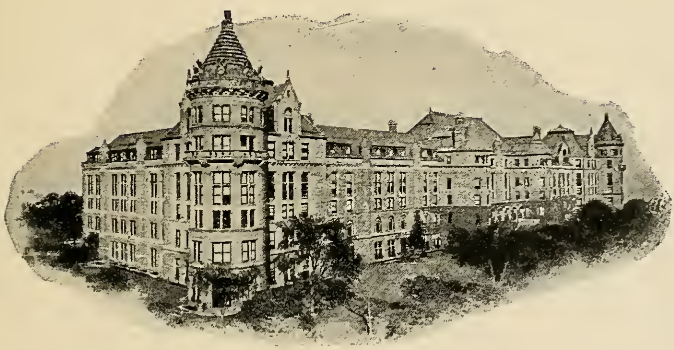
NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

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



MARCH–APRIL, 1924

[Published April, 1924]

VOLUME XXIV, NUMBER 2

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VOLUME XXIV CONTENTS FOR MARCH-APRIL NUMBER 2

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The Cover Design Explained

The cover design of Natural History, fittingly commemorating by its Chinese character the important discoveries made in that general area of the East by the Third Asiatic Expedition, requires, in order that it may be properly appreciated, a word of explanation. This has been supplied by Prof. Frederick K. Morris, of the Third Asiatic Expedition, to whom the editor is under obligations not only for his helpfulness in connection with the cover design but for valued counsel throughout the preparation of the issue.

Below the panel at the base of the cover appear the Chinese words for "American Museum of Natural History," between the handsome circular symbols expressing "long life." The undulations that extend just above the Chinese characters and between the long-life symbols are the conventional sea waves of Chinese design. Along the upper border of the basal panel clouds are shown, these being invariably introduced in association with the wave motive. The royal dragons, rising, as they should, from the waves through the clouds, enclose at the top of the cover the Chinese word Asia, the continent to which the subject matter of the issue is predominantly devoted. Read symbolically, the cover may be interpreted as denoting "Long life to the work of the American Museum of Natural History in Asia!"

The elements of the design were suggested by Prof. Henry Fairfield Osborn. Their assemblage into an attractive ensemble and artistic embellishment is the work of Mr. William E. Belanske. To Dr. Lucius C. Porter the magazine is indebted for valuable help in preparing the Chinese symbols. Doctor Porter is dean of Yen Ching University, Peking, and during the present year is exchange professor of Chinese at Columbia University.

Africa

Africa has been the objective of a number of expeditions sent out by the American Museum, some of them consuming years. The experiences and observations of those participating in these expeditions might fill volumes, but from the generality of memories have been culled a few of outstanding interest for inclusion in the May–June issue of Natural History.

RESTORATION BY E. RUNGIUS FULDA OF *PROTOCERATOPS ANDREWSI*, ONE OF THE EGG-LAYING DINOSAURS

The name "*Protoceratops*" signifies "ancestor of the dinosaur with horns on its face." As restored by the artist, these animals show a broad bony frill protecting the nerve centers at the back of the neck from attacks of carnivorous dinosaurs. The horns above the eyes, which give the name ceratopsians to this family, are too rudimentary to appear in this drawing, although they can be seen on the bony surface above the eyes in the fossil specimens. The landscape is that of a desert, in which the wind-blown sand, it is believed, buried the nests of dinosaur eggs

NATURAL HISTORY

Volume XXIV MARCH-APRIL Number 2

The Discovery of an Unknown Continent

By HENRY FAIRFIELD OSBORN

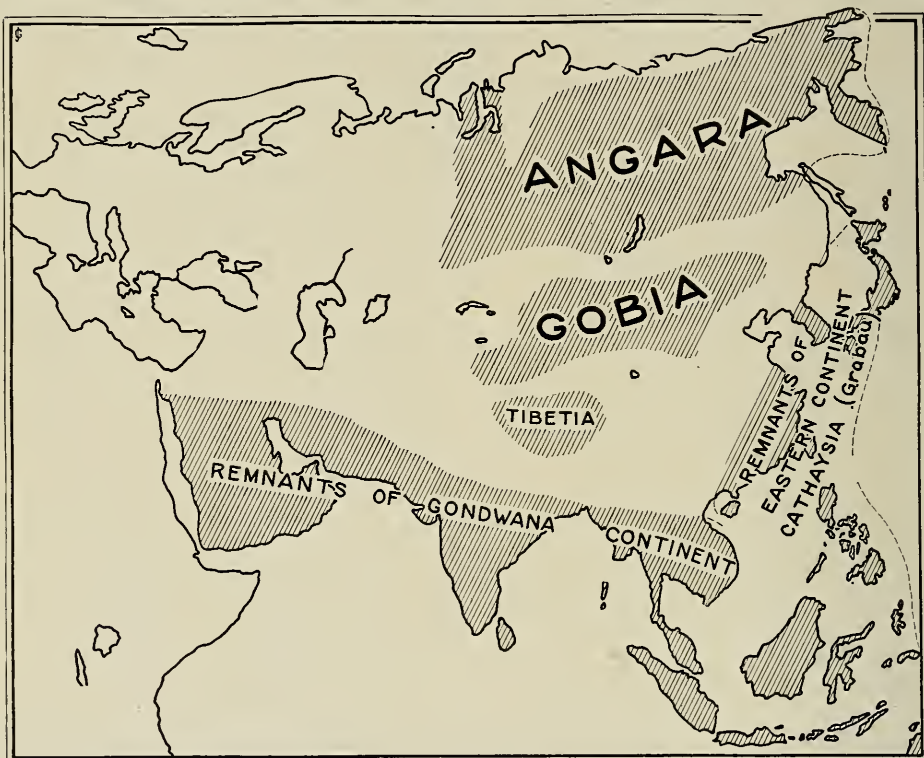
Honorary Curator of Vertebrate Palæontology, American Museum

The name Gobia, alluding to the Gobi Desert of southern Mongolia, is given by geologists to a hitherto unknown continental surface in the heart of Asia, the history and life of which is being made known by the explorers of the Third Asiatic Expedition. The present article is a summary of the outstanding discoveries already made and of their significance in elucidating the past history of the earth. It is also a forecast of discoveries which may still be made in the projected five-years' work of the expedition.

THE ancient continent of Asia in the early part of the Age of Dinosaurs was so entirely different, both in geography and in climate, from the present continent of Asia that the familiar modern geographic names would have no significance. Consequently, the palæogeographer forms a league with the palæontologist to describe the animal life; with the palæobotanist to describe the plant life; with the palæometeorologist to deduce the climate from the plant and animal life; and together they give all the information they can to the geologist, on whose rugged shoulders falls the final responsibility of describing the past history of Asia, the "mother of continents." It is this friendly conspiracy of the scientists which is surveying Asia as it were from a very lofty aëroplane, visualizing it as it was long before there were any such mountain ranges as the Altai or the Himalaya, when the seas flowed over the areas of the present mountain tops, when the present great plains, steppes, and table-lands were nonexistent, when not a single form of animal life known today existed, even before what seems to us the far-distant Age of Dinosaurs. It is most interesting to note that such a period "before the mountains were brought forth or ever Thou didst form the earth and the world" was also in the mind of Shakespeare, for in *Henry IV* occurs the remarkable passage.

King Henry. O heaven! that one might read
the book of fate;
And see the revolution of the times
Make mountains level, and the continent
Weary of solid firmness, melt itself
Into the sea! and, other times, to see
The beachy girdle of the ocean
Too wide for Neptune's hips; how chances
mock,
And changes fill the cup of alteration
With divers liquors!

The period we are interested in is that in which the previously unknown continental surface of Mongolia emerged from sea level. The palæogeographers Edouard Suess of Vienna, Bailey Willis of the United States Geological Survey, and Amadeus Grabau, formerly of Columbia University and now of the Geological Survey of China, have named the elements of a titanic archipelago which preceded the present continent of Asia. To the north of Gobia was the solid land of the Angara of Suess, taking in a large part of Siberia; to the west was the Mongolian insular plateau, embracing the Gobi, the Tarim, and Dzungaria; to the southeast was a great plateau corresponding with existing Tibet; occupying a large part of the present peninsula of India was the hypothetical Gondwana land mass of Suess, which, according to the hypothesis of this distinguished author of *The Face of the Earth*, extended around the southern hemisphere like a great girdle, bridging both the South Atlantic and the Pacific oceans. Between these ancient land masses were areas of shallow seas, known to geologists as geosynclines, and finally destined to emerge as great mountain ranges. It remained for Grabau to give the name Gobia, derived from the present Gobi Desert, to the great land mass which rose in the heart of Asia during the early period of the Age of Reptiles and has persistently been rising despite the erosion of the mountain summits bordering its sides, rather than sinking back to sea level. Gobia, therefore, hitherto a reputed but historically unknown continental surface, is that portion of the heart of Asia of which the Third Asiatic Expedition is writing the history.



Palæogeography of Asia.—To the north, are the remnants of the granitic continent named Angara by Suess ; to the south, the remnants of the continent named Gondwana by Suess, who believed that it encircled the Southern Hemisphere; in the center, the continent of Gobia, which corresponds with modern Mongolia. Between these ancient land masses there flowed the tides of epi-continental seas directly over regions which are now the mountain summits of the Himalaya, the Altai, and other great mountain ranges. These mountain ranges are relatively youthful; they arose during the Age of Mammals. (See the pictorial table on p. 139.)

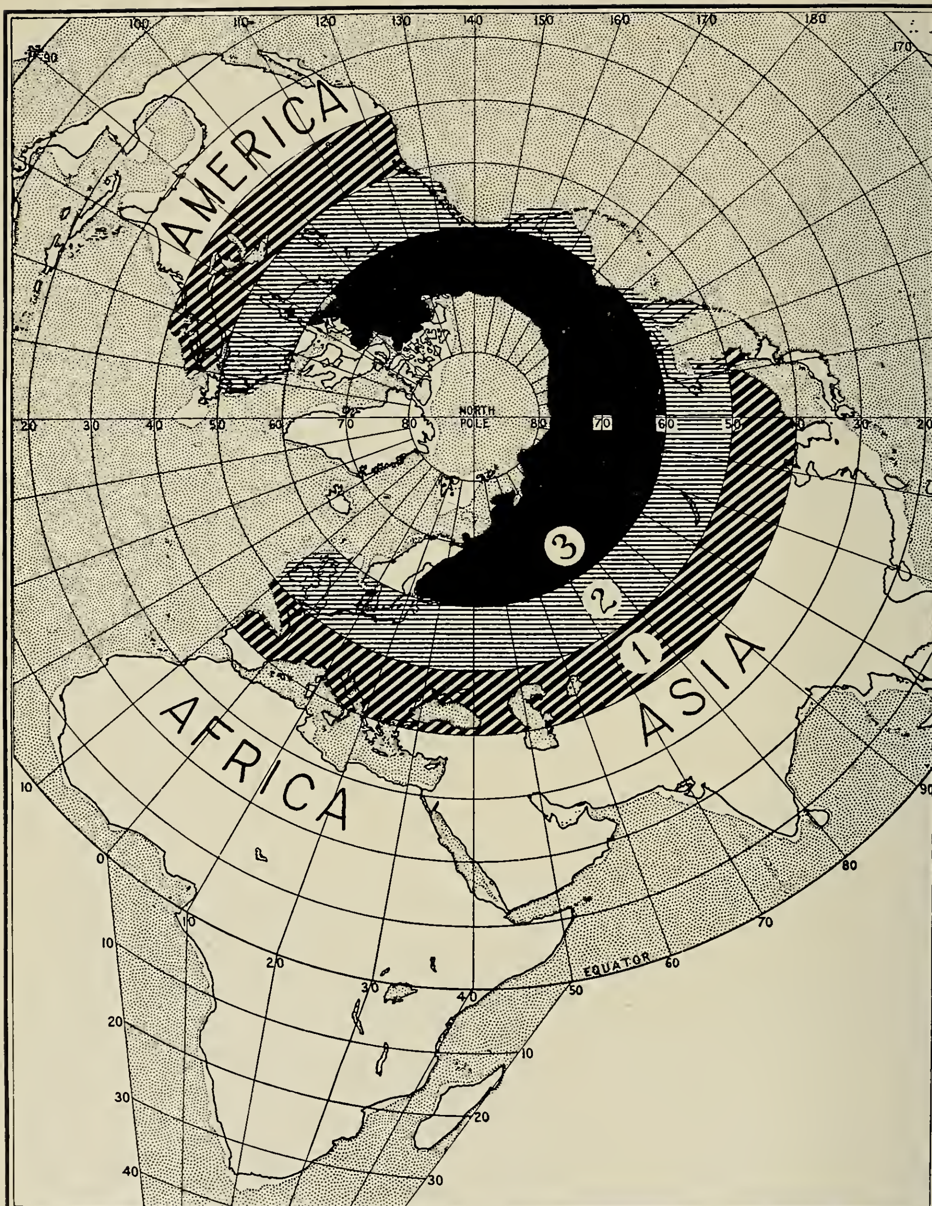
It requires constructive imagination tempered by cold facts, as well as some moral courage, to put forward a map of Gobia at the present time. "Fantastic and useless" will be the first criticism of many scientists, while others will regard it more truthfully as a tentative or working hypothesis that will be very materially altered by the time the Third Asiatic Expedition has completed its thorough survey of Mongolia. In the meantime, let us imagine that such an unknown continental land mass existed, raised three or four thousand feet above sea level, thus enjoying a relatively dry and stimulating climate. The mountains which bordered it on the north and south furnished a double shelter, serving to give it a relatively temperate climate and a moderate rain supply. One of the most interesting conclusions already reached by the geologists is that this great plateau had only a very moderate rain supply from the very beginning of its history and even passed through certain long periods of aridity.

FORMATIONS AND LIFE ZONES

These secular cycles of moisture and drought are recorded in the kinds of rocks scattered in very broad but relatively thin layers or *formations* over the borders of this great upland country. These formations are known as epi-continental because they are laid on the surface of the continent and contain land fossils, as distinguished from those laid along the sea borders of the continent, which invariably contain marine shells. A formation is local; it may be one hundred miles or several hundred miles in extent, whereas the 'life zone' may extend around the world.

In the list of popular and scientific papers which have already been written about the Third Asiatic Expedition, as shown at the end of this article, are included those containing preliminary descriptions of the various assemblages of life to which we give the collective name *life zones*, the meaning of which may be indicated by reference to present life conditions, or rather to conditions which prevailed before civilized man destroyed the life zones which he found encircling the Northern Hemisphere. For example, (2) the life zone of the stag of the genus *Cervus* (see zonal map p. 136) extends between the fiftieth and sixtieth parallel of latitude, from Great Britain directly across northern Europe, central Asia, and North America as far east as New York and New England. Similarly, just north is (3) the life zone of the moose of the genus *Alces*, which extends from Maine through northern United States and southern Canada directly across to Scandinavia. Also in (3) to the north is the life zone of the reindeer of the genus *Rangifer*, extending from Scandinavia across northern Europe, Asia, and North America. South of the natural zone of the stag and practically parallel with it is (1) the life zone of the bison, a typical animal of the plains. The reason each of these animals keeps to its own life zone is that each seeks forms of plants and degrees of temperature which it most enjoys. All animals have their pleasures in life, their likes and dislikes in food and in climate. As humorously expressed in the Munich adage: *Ein jedes Tierchen hat sein Plaisirchen;* that is, each little beast has its feast. This natural principle of the enjoyment of life—that like seeks like—is of very great aid to the geologist and palæontologist because it applies not only in recent time but far back into the most remote periods of geologic time.

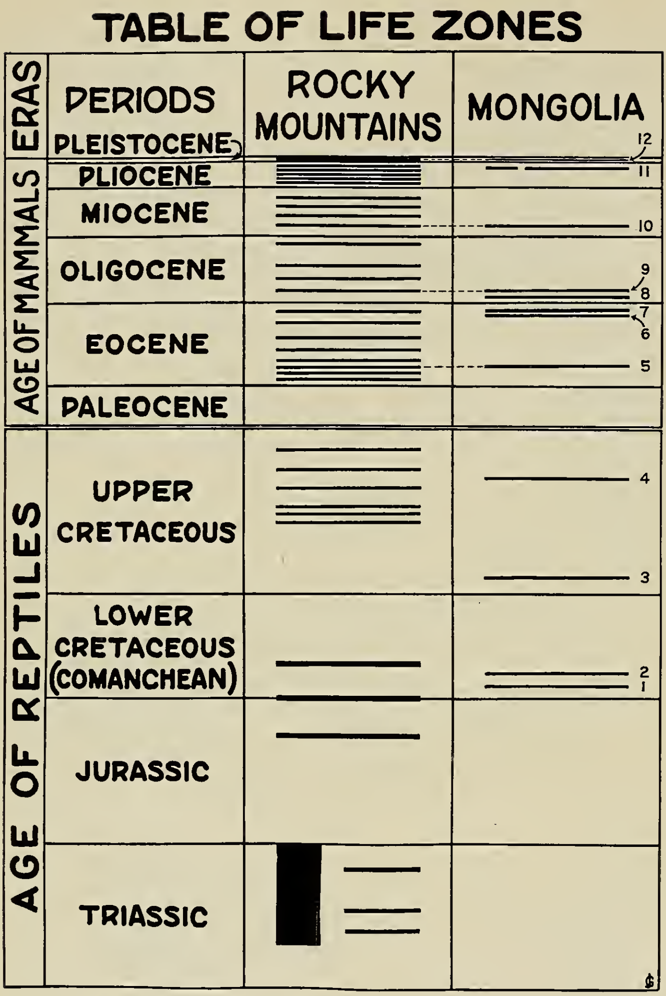
As "birds of a feather flock together," and mammals of the same species migrate together, so dinosaurs of similar forms and habits of life found their way into similar environments around the whole Northern Hemi-



The Northern Hemisphere, showing the three great life zones which encircled the polar regions. (1) Fortieth to fiftieth parallel: favorite zone of the dinosaurs during the Age of Reptiles and of the hardy bison, or northern cattle, during the Age of Mammals. (2) Fiftieth to sixtieth parallel: zone near the southern border of which dinosaurs have been discovered; zone of the *Cervus*, the hardy northern stag, and the wapiti in the Age of Mammals. (3) Area north of the sixtieth parallel; zone in which Cretaceous terrestrial life is still unknown; zone of the reindeer, *Rangifer*, and of the moose, *Alces*, in recent times

Map of Mongolia (heavy black lines) superimposed upon map of the United States.—Both regions are drawn to the same scale, and their latitudes, fortieth to fiftieth parallel, coincide. Dotted lines show the route of the expedition. The chief fossil dinosaur localities of the United States are indicated by solid black triangles and the chief fossil mammal localities by solid black circles; those of Mongolia appear as open triangles and open circles, with index numbers signifying: (1) Ashile, (2) Ondai Sair, (3) Djadochta, (4) Iren Dabasu, (5) Gashato, (6) Irdin Manha and Arshanto, (7) Shara Murun, (8) Ardyn Obo, (9) Hsanda Gol (west) and Houldjin (east), (10) Loh, (11) Hung Kureh, (12) Olan Diske

sphere. They may have wandered out of their favorite life zone—they probably did—but their remains are found in greatest number between the parallels of latitude and along the ancient isotherms of climate where life was most agreeable to them. This very interesting observation of the general likeness of past life zones with existing life zones is made clear when we project an outline map of Mongolia upon an outline map of the United States as indicated in the map figured above. Taking the line of the fortieth parallel as a key, we observe that the very richest dinosaur beds of the close of the Age of Reptiles that have been discovered in the United States and Canada during the past half century are not far distant in latitude from those we have found recently in Gobia. Thus the great life-zone belt of the horned dinosaurs lies chiefly between the fortieth and forty-fifth parallels and extends like a broad ribbon of dinosaur dominance over the ancient continent of Gobia eastward and westward. The reason why this belt of dinosaur life is broken is that most of the formations that contained these fossils at intermediate points have all been washed away and destroyed by water erosion or by the great glaciers of the Ice Age. We know that dinosaurs closely related to those found in Mongolia in the Upper Cretaceous occur as far west as Great Britain and as far east as the New Jersey coast in the United States. These remnants of the dinosaur belt do not prove by any means that these reptiles lived in colonies or in isolated patches; on the contrary, it is highly



The chief life zones thus far discovered by the Third Asiatic Expedition in Mongolia (right-hand column 12–1) as compared with life zones known in the Rocky Mountain region (center column).

In descending order these life zones of Mongolia are: Olan Diske (12), Pleistocene; Hung Kureh (11), Upper Pliocene, *Cervus* zone; Loh (10), Lower Miocene, primitive mastodon zone; Hsanda Gol and Houldjin (9), Oligocene, *Baluchitherium* zone; Ardyn Obo (8), Lower Oligocene; Shara Murun (7), Upper Eocene, protitanothere zone; Irdin Manha—Arshanto and Pang Kiang (6), Upper Eocene; Gashato (5), Lower Eocene. The precise positions of these life zones remain to be determined by more thorough investigation. Iren Dabasu (4), Upper Cretaceous zone; Djadochta (3), *Protoceratops* zone; Ondai Sair (2). *Protiguanodon* zone; Ashile (1) *Psittacosaurus* zone.

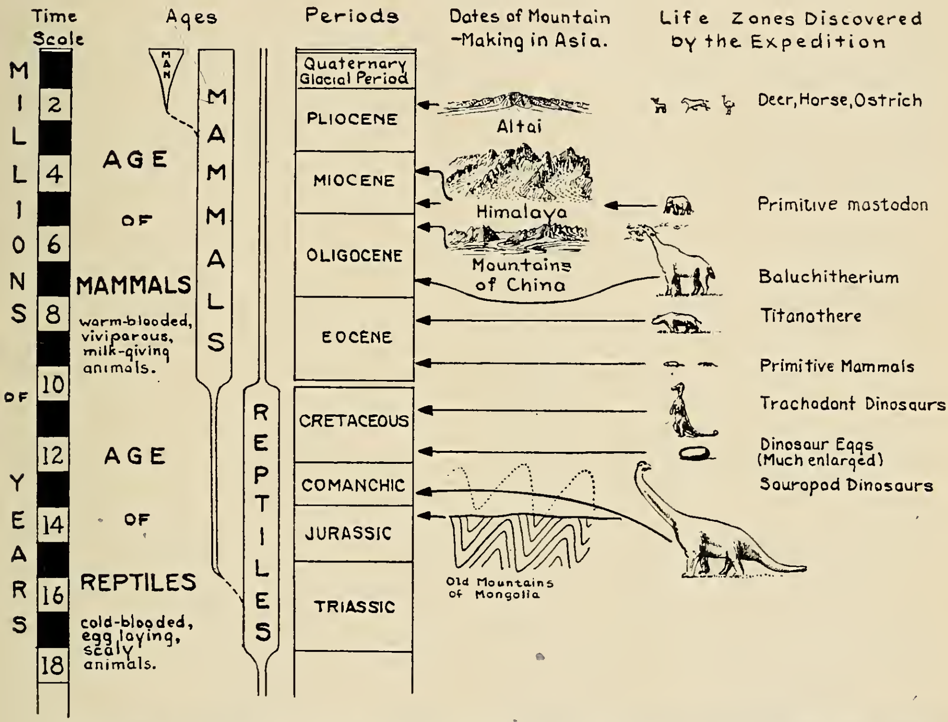
Mr. Walter Granger, palæontologist of the expedition, is preparing a paper for the *Bulletin* describing each of these life zones

probable that, like the stag, the reindeer, the moose, and the bison, these remnants represent formerly continuous life zones.

We thus reach the broad significance of the two outstanding discoveries of the Third Asiatic Expedition: first, the discovery of a hitherto unknown and extremely ancient continental surface of Gobia right in the heart of Asia, where the conditions were highly favorable for the origin and evolution of all forms of continental life over a period of time variously estimated as from ten millions to sixty millions of years in duration; second, the discovery that this inland continent lay at the very center of a series of great life-zone belts which extended around the Eastern and Western Hemispheres, along the lines of the fortieth and forty-fifth parallels. Hitherto we have known only the eastern and western ends of these great broad bands of life; now we are exploring in the very center of these life zones.

The animals and plants of these life zones enable us to reckon the steps or stages in the passage of geologic time —not the length of time but the successive divisions of time. For example, dinosaur time in Mongolia is also dinosaur time to the far east in New Jersey and to the far west in Great Britain. The Age of Dinosaurs is succeeded by the Age of Mammals, when we find zones represents a very long period of time in which it is possible for a community of mammal life to be established by eastern and western migration.

In the diagram on the opposing page these life zones are indicated by black



Popularized summary by Prof. Frederick K. Morris of the chief palæontologic discoveries of the Third Asiatic Expedition during the seasons of 1922–23. The reader is referred to the map on p. 134 for comparative study

closely similar species of mammals occupying these broad east and west life zones along similar climatic isotherms. By means of this great palæontologic clock we are able to subdivide the ages more closely. For example, the dawn period of the Age of Mammals is known as Eocene time, derived from Greek ἠώς (dawn) and καινός (recent). In the Rocky Mountain Eocene we have discovered during the past thirty years no less than sixteen distinct mammal life zones, one above the other; each of these life bands placed in a Rocky Mountain column and a Mongolia column. Bands across both columns indicate those life zones already discovered in both Mongolia and North America. It will be seen that there are still a great many gaps in the Mongolia column; to fill these gaps is one of the main objects of the continuation of the Third Asiatic Expedition for the next five years.

THE NEW CONTINENT OF ANCESTRAL DINOSAUR LIFE

In the lower half of the table on p. 138 the reader will see a series of entirely new epi-continental life zones, which are of Lower Cretaceous age—new, because upland formations of this age have never before been discovered and the upland life has not been known before. This part of the column corresponds in time with rocks deposited near sea level in North America to which the name Comanchean has been applied because they are now best known in lands formerly inhabited by the Comanche Indians. Gobia is not only a new continent; it is a new world of ancestral dinosaur life. Here we are in the halfway period of dinosaur evolution—the great amphibious dinosaurs of the preceding Jurassic Period are dying out; we are now in the beginning of the reign of land dinosaurs and especially of the upland dinosaurs living away from the sea. Among the hitherto unknown dinosaurs of various kinds are those listed in the table on the opposing page.

The first four dinosaurs listed in this table are the only ones thus far described from the wonderful collection of seventy-two skulls and eleven complete skeletons found in the life zone of *Protoceratops andrewsi*, which is destined to become one of the classic life zones of the world.

ANCIENT DINOSAUR LIFE ZONES OF THE LOWER CRETACEOUS

Below this classic *Protoceratops* life zone are the two dinosaurs named at the bottom of the list on p. 141; they may prove to be of similar geologic age, probably Upper Jurassic or Lower Cretaceous. The little animal *Psittacosaurus*, about a yard's length, is superbly preserved exactly as it coiled up before being overtaken by sudden death. A really remarkable feature is the presence of two bony horns bristling out at the side of the head as a warning to hungry carnivores; there is also evidence of skin armature to protect the side of the jaw and the sensitive throat, which leads to the belief that this little leaf-eating animal was developing in the direction of defense by means of dermal armature rather than of escape from its enemies by speed. In contrast, there is the *Protiguanodon*, also a leaf-eater, which was apparently developing rapid powers of locomotion upon its hind limbs; this animal was found eighty-five miles distant from *Psittacosaurus*, but may be of the same geologic age. *Psittacosaurus* was discovered in the year 1922 in a formation 1500 feet in thickness. Among these beds were deposits of fine paper shales containing insects which will give us an insight into the climate; this was probably humid. Evidence of humidity is found in the presence in the same life zone of giant amphibious dinosaurs, surviving from Jurassic time and known as Sauropoda, which could have lived only in great swamps or shallow lakes.

A wet period is indicated also in the Ondai Sair beds, 500 feet in thickness, in which the leaf-eating *Protiguanodon* is found. This superb skeleton occurred in deposits of gray sands and gravels, overlying which were paper shales containing remains of both the insect and fish fauna of the time. The animal most nearly allied to the *Protiguanodon* is the dinosaur known as *Hypsilophodon foxi*, found in the Lower Cretaceous or Wealden, named after the "weald" of Sussex, England. This dinosaur has teeth adapted to leaf-eating like those of certain iguanid lizards.

THE ANCESTORS OF THE HORNED DINOSAURS

The overlying Djadochta beds, which contain in such abundance the *Protoceratops andrewsi* and the three

PERIOD	SCIENTIFIC NAME	SIGNIFICANCE	LIFE AND HABITS
Beginning of Upper Cretaceous Time	*Protoceratops andrewsi*	Ancestor of the great American dinosaur *Triceratops*, with horns above its eyes. This is one of the animals which laid the now famous dinosaur eggs that in turn have made "dinosaur" a household word all over the civilized world.	An herbivorous dinosaur.
	Fenestrosaurus philoceratops	A small birdlike dinosaur, remains of which were found resting on top of one of the nests of dinosaur eggs; hence the specific name *philoceratops*, signifying "ceratops lover."	Egg-eating or ovivorous. This dinosaur was without teeth.
	Ornithoides oshiensis	A name given in allusion to the fact that the reptile was found in the basin Oshih, with numerous teeth.	A dinosaur birdlike in its skull form.
	Ovoraptor djadochtari	A wonderfully alert little egg-snatcher, hence Ovoraptor of the Djadochta formation.	Swift-moving, carnivorous dinosaur.
Lower Cretaceous Time	*Psittacosaurus mongoliensis*	A parrot-beaked little dinosaur of Mongolia, found in the formation known as Ashile.	Leaf-eating dinosaur.
	Protiguanodon mongoliense	A possible ancestor of the great iguanodonts of the Upper Cretaceous, leaf-eating dinosaurs which extended over the whole Northern Hemisphere, the name iguanodont referring to the fact that these reptiles had teeth resembling those of some iguanid lizards which are herbivorous.	Leaf-eating dinosaur.

raptorial dinosaurs *Fenestrosaurus*, *Ornithoides*, and *Ovoraptor*, indicate an entire change of climate into a semi-arid condition, which is demonstrated by the manner in which the fossilized remains are found, namely, in a fine reddish sand partly of wind origin, partly deposited in shallow lakes or flood plains. Much of this sand is noncohesive and can readily be removed with the tool. Probably at this time Gobia was assuming the appearance of a savanna country, partly open, partly forested, with evaporating or

The American Museum camp on top of the Lower Cretaceous formation of Ashile.—The elevation extending along the back is Oshih Mesa, which gives the region its name. It was here that the Third Asiatic Expedition discovered remnants of a giant amphibious dinosaur representing the order Sauropoda

playa lakes such as we now observe in Nevada. The Djadochta formation, which was deposited in this way, is 500 feet in thickness and is now eroded into cliffs of glorious flame-color, at the foot of which dinosaur remains were found. This will become one of the classic formations of the world, because of the extreme richness and variety of the fossils found there, giving us an insight into the entire life of the unknown period. Absolutely unique in the records of palæontologic discovery are the stages of development of the frill-necked *Protoceratops andrewsi*, the species named for the leader of the Third Asiatic Expedition, because it gives us all stages, from the little skeleton contained in the egg up to the fully matured animal, which had the general appearance shown in the frontispiece of this article. Only the very closest examination of the skull above the orbits and above the nostrils reveals the minute rudiments of horns above the eyes to which the family name Ceratopsidæ refers. In life these were covered with dermal horns serving as defense against the carnivorous dinosaurs. The bony frill at the back of the skull protects the most sensitive part of the neck, that which was most exposed to attack among the reptiles and among the mammals. The three kinds of carnivorous dinosaurs already found were incapable of attacking the *Protoceratops*. Doubtless in time we shall discover carnivorous dinosaurs of larger size.

DINOSAUR LIFE ZONES OF UPPER CRETACEOUS AGE

The animals described above are all new to science; they are doubtless ancestral to the great dinosaurs of the Upper Cretaceous, which extended their sway over the whole Northern Hemisphere, chiefly in traveling eastward and westward between the fortieth and forty-fifth parallels of latitude. Fortunately we discovered at

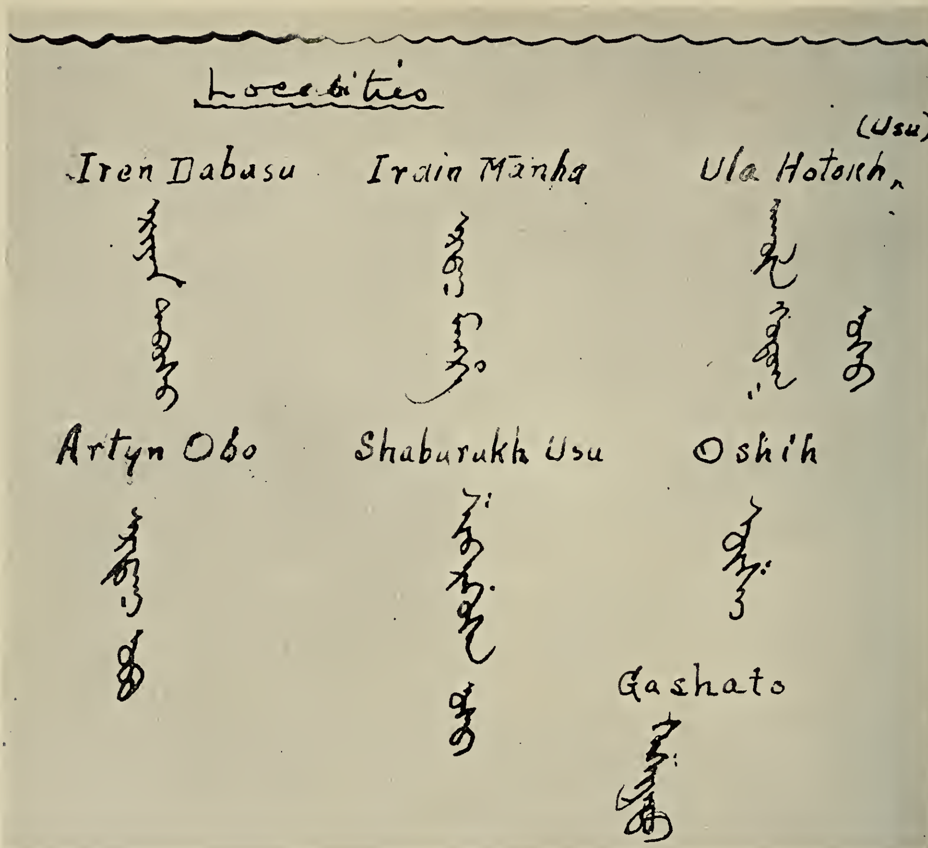
American Museum of Natural History and Asia Magazine

This locality yielded the ancestor of the iguanodont family known as *Psittacosaurus*. The superbly preserved skeleton of this animal, which is about seven feet in length from head to tail, was found somewhat to the right of the picture, in the deep cut that extends in that direction. Photograph by Roy Chapman Andrews

Iren Dabasu an Upper Cretaceous dinosaur bed containing at least three kinds of carnivorous and herbivorous dinosaurs, the remains of which were excavated from several great quarries near the salt playa lake, which gives the Mongol name "Iren Dabasu." We have not yet had time to study these animals with care but in size and proportions they remind us strongly of the Upper Cretaceous iguanodonts and carnivores of Wyoming and Montana, belonging to at least three types—the iguanodont, the large carnivore, and the ostrich-mimic type. Singularly enough, we have not thus far found the ceratopsian dinosaurs in this bed, probably because it represents a shore level deposit rather than the upland deposit in which the horned herbivorous dinosaurs would naturally occur.

SCIENTIFIC NAME	SIGNIFICANCE	LIFE AND HABITS
Iguanodontia	Bipedal dinosaurs living along shore lines and having teeth like those of some of the iguanid lizards.	Large leaf-eating dinosaurs.
Ornithomimidæ	Ostrich-mimicking dinosaurs.	Slender, browsing dinosaurs, toothless.
Theropoda	Having three-toed clawed feet like the birds.	Large flesh-eating dinosaurs.

The difference between the Iren Dabasu beds and the more ancient *Protoceratops* beds is that, in the interval of time separating the two, broad land connections were formed with Europe on the west and with North America on the east, and the dinosaurs had begun to migrate in large numbers in both directions but especially, it is believed, into North America. Consequently, we expect to find that the



Page from the diary of Mr. Walter Granger.—In all Mongolia Urga, the capital, with 20,000 inhabitants, is the only city. Two towns, Uliassutai and Kobdo, correspond in size with our villages. Other localities indicated on maps as towns are merely wells or springs of salt deposits—stopping places for caravans. These localities have picturesque names; for example, Iren Dabasu, "Valley of the Salt Lake," Irdin Manha, "Valley of the Jewels."

dinosaurs of Iren Dabasu have close relatives among the dinosaurs of Wyoming and Montana. When dinosaurs migrated, they did not change their characteristics; it is possible that we may discover either identical or very closely related species in Mongolia and in Montana, as we did among the mammals of more recent age. In Iren Dabasu also there will be found dinosaurs of less adventurous spirit, which did not migrate to America at all but preferred to travel in the direction of Europe. The result of these differences in migrating habit is that in western Europe we find large shore-living, leaf-eating iguanodonts very different in details of structure from their contemporaries in America.

In Upper Cretaceous time the land dinosaurs were absolutely dominant in the great life zone encircling two-thirds of the Northern Hemisphere. Remnants of this dinosaur empire have been discovered in Great Britain, France, Belgium, Austria Hungary, and Mongolia. It is highly probable that when the whole high plateau region of Asia is known, the geographic gaps in this great life zone will be filled; at present we depend chiefly upon the extraordinary yield of the Cretaceous dinosaur beds of Alberta, Montana, Wyoming, Colorado and northern New Mexico for our knowledge of the entire dinosaur world. In its majestic forms—such as the great carnivore *Tyrannosaurus*, the three-horned herbivore *Triceratops*, the slow-moving and heavily-armored *Ankylosaurus*, the stately shore-living and amphibious trachodonts, the fleet-footed, bird-mimicking *Ornithomimus* and the ostrich-mimicking *Struthiomimus*—it presents an assemblage of life not paralleled before or since in the whole history of the earth. The only life period approaching it is that which marked the close of the Age of Mammals, when the horses, giraffes, elephants, hippopotami, and other quadrupeds reached the acme of their evolution.

At the very moment of this great life climax, which had been in the process of evolution during the entire Age of Reptiles, namely, during Triassic, Jurassic, and Cretaceous times, the whole dinosaur world became extinct. Among the many theories as to the cause of this extinction not the least probable are that the dinosaurs failed to protect their young, either during the nesting stage or immediately after hatching, or that some new marauder (such as we named *Ovoraptor*) of the dinosaur nests arose which sought out the eggs and fed upon their rich food supply. In this connection the discovery of three kinds of dinosaur eggs in three separate nests is extraordinarily interesting, and of this we shall speak more fully in another number of NATURAL HISTORY.

CHIEF LIFE ZONES OF THE AGE OF MAMMALS THAT HAVE BEEN DISCOVERED

The extinction period of the dinosaurs marked the dawn of the Age of Mammals. The life conditions in Gobia, wonderfully favorable to the production of a great variety of dinosaurs, were no less favorable to the origin and development of highly varied mammalian life, and especially does this apply to the five-toed ancestors of the hoofed animals. Discovery of the ancestral five-toed horses, tapirs, rhinoceroses, and titanotheres, which we are confident will be found on the border line between the Age of Reptiles and the Age of Mammals, is another of the main reasons for the continuation of the Third Asiatic Expedition.

The chief fossil sites thus far discovered have been enumerated in descending geologic order in the following list. The localities (1) to (4) have been omitted in this connection as they are treated elsewhere in the text. The geographic position of these several sites is indicated in the map of Mongolia that has been superimposed upon the map of the United States (see p. 137).

OLAN-DISKE [or Disek] (12). These beds were investigated by J. G. Andersson and are reported in his "Essays on the Cenozoic of Northern China" (*Memoirs of Geological Survey of China*, Ser. A, No. 3, March, 1923). The localities are in southern Mongolia, not far from Tabul, in the level country south of the American Museum camp No. 1. At OLAN are sands, well stratified, and exposed to a depth of 50 feet; with clay intercalations, and, at the base, layers and lenses of angular gravel. Large bones, which, it was inferred, belonged to an elephant or mammoth, were collected here. A rhinoceros skull was brought in from DISKE. So far these are the only undoubted Pleistocene fossils of which we have record in Mongolia.

HUNG KUREH (11). The fauna of this formation is scanty. The most notable of its animals is a fine stag related to the wapiti

This restoration by Mr. Charles R. Knight shows a *Mesonyx* preying upon the skull of a *Loxolophodon*. The *Mesonyx* is a Rocky Mountain relative of the giant carnivorous mammal *Andrewsarchus*, named after Leader Roy Chapman Andrews (see p. 147)

or "elk," but fragmentary remains of two or more antelopes, a small horse, perhaps three-toed, a large camel, a proboscidean of some kind, and a beaver show that the animals of Mongolia at that time were related to the faunas of the late Pliocene of Europe and early Pleistocene of North America. To decide how close the relationship may be, more complete specimens are needed.

Loh (10). In these beds have been found remains of a primitive mastodont which may be related to the *Trilophodon* of France; also of a rhinoceros whose particular relationships are not yet known. It has been proved that this animal is a small *Baluchitherium*, of Middle Miocene Age.

Hsanda Gol and Houldjin (9). This is the life zone of *Baluchitherium grangeri*, the giant tree-browsing, hornless rhinoceros. From this zone Matthew and Granger have described eight genera of carnivores resembling those in France and in our Rocky Mountain region; nine genera of rodents, including an African family; two genera of insectivores; a small hornless rhinoceros, companion of the giant *Baluchitherium;* the ancestral type of the deer family; a member of the giant pig family.

Ardyn Obo (8). These beds are 500 feet in thickness, consisting of sands, gravels, and clays. The life zone resembles that of the Phosphorites beds of France, containing especially the amphibious type of rhinoceros known as *Cadurcotherium.* Here too are found the first of the chalicothere family with split hoofs, known as *Schizotherium;* also many primitive wolves, *Cynodictis,* and the type of deer, *Eumeryx,* important because it may be the ancestor of the deer family, which undoubtedly arose in Asia. These beds are regarded as of Oligocene age.

Shara Murun (7). This horizon is 150 feet in thickness, consisting of sandy clays and moulding clays, with sandstone beds at the top. The clays are rich in fossils, especially titanotheres, which resemble those of Lower Oligocene age in northern Wyoming and South Dakota. This seems to be the climax of the titanothere period in Mongolia. The species *Protitanotherium mongoliense* is almost identical in tooth structure

A restoration by Mr. Knight of *Loxolophodon*, from the Rocky Mountain region. The presence in Mongolia of an animal belonging to the same order was established through the discovery of two of its upper teeth, one by Leader Andrews and the other by Professor Osborn

with *Protitanotherium superbum* of northern Utah. There are also extremely long-limbed rhinoceroses in this formation, possibly ancestral to the long-limbed *Baluchitherium*.

Irdin Manha—Arshanto, and Pang Kiang (6). The Irdin Manha is the most majestic Upper Eocene formation thus far discovered, probably of flood-plain origin, extending for a hundred miles north and south like a gigantic platform. Its life zone is extremely rich and bears very close resemblance to a similar Upper Eocene life zone of northern Utah, due to the presence of primitive carnivores, insectivores, and two kinds of primitive even-toed ungulates. The two kinds of odd-toed ungulates which dominate are the large titanothere known as *Sphenocœlus* and the diminutive cursorial *Desmatotherium*—these little animals are extremely numerous. In this fauna occurs the giant carnivorous animal named *Andrewsarchus* after the leader of the expedition, far surpassing in size the largest of its American relatives, *Mesonyx*. Even more surprising is the discovery in these beds of two teeth, undoubtedly belonging to one of the giant uintatheres of the Rocky Mountain region. One of the teeth was found by Leader Andrews, the other by the present writer. The American tooth strongly reminds us of the genus *Loxolophodon*, named from its yoke-crested teeth. The Arshanto beds consist of reddish clays, lying at the base of the Irdin Manha, and have thus far yielded only the remains of small odd-toed ungulates, probably ancestral to those which occur in such vast herds in the Irdin Manha formation. The Pang Kiang beds are probably older than the Irdin Manha beds, and are not at all rich in fossils. They have thus far yielded only the small jaw of a rodent, not improbably of Middle Eocene age.

Gashato (5). This formation, 200 feet in thickness, of brown and red sandy clays, lies above the *Protoceratops* zone of Djadochta. To the keen eye of Mr. Walter Granger it disclosed a number of small fossil jaws, from four inches to less than one inch in length, found only in small pockets. So far as examined, these animals are of archaic type and we hope to prove that they are the long-sought mammals of either Upper Cretaceous or Lower Eocene age. If we find hoofed animals at this period, we may surely anticipate that they will have five digits on both the front and hind foot and we shall be in the presence of the greatly desired life zone of the five-toed ungulates.

MAMMALS STILL TO BE DISCOVERED

It is possible that a five-toed period in the evolution of the higher type of hoofed mammals may be recognized in the Gashato formation (5); it is also possible that this cradle of the five-toed hoofed race may be in some other more northerly part of the plateau region of Asia. All that we can feel sure of today is that these long-sought five-toed horses were evolving somewhere in a dry upland country, because it is only in such a country that the loss of the first digit of the hand and foot would occur. Thus we are seeking in Gobia or to the north a country where the thumb on the hand and the big toe of the foot were lost, because when these quadrupeds arrived in America, in Lower Eocene time, they had without exception left their thumb and big toe behind them.

Surprising as is the great list of mammals already discovered, a list which includes representatives of upwards of thirty genera and forty species of many different families, the long list of *undiscovered* mammals is no less surprising. We had confidently expected to find ancestral four-toed horses in some of these formations; not a single horse has thus far been found. This leads us to suspect that the great horse-breeding country may have been farther north, on the continental mass of Angara. Surprising also is the absence of proboscideans,—of mastodons or ancestors of the elephant family,—which first appear in the Loh formation of Lower Miocene age.

Surprising too is the fact that many of the mammals thus far discovered are not new to science, but are more or less closely related to mammals previously known either in the Rocky Mountains or in France. It is not surprising that we have thus far found no primates, because these animals are always the most difficult to discover. We might expect to find them in suitable environment of Lower Miocene or later age, because in some older beds of France lemuroid primates are relatively abundant.

Therefore, among the chief objects of the remaining five years of the expedition are the search for primates, especially those which may point toward human ancestry, and the search for Basal Eocene and Upper Cretaceous ancestors of the higher types of quadrupeds of the Northern Hemisphere. During the remaining period of the expedition the most diligent effort will be made and the keenest powers of observation will be devoted to filling in these two great gaps in our knowledge of the mammals of Gobia.

POPULAR AND SCIENTIFIC ARTICLES

In NATURAL HISTORY have appeared several articles from the pen of Mr. Roy Chapman Andrews dealing with the work of organization and the achievements of the Third Asiatic Expedition. Among these contributions are "The Motor Truck in Central Asia" (January–February, 1921), "Scientific Work in Unsettled China" (May–June, 1922), and "Hunting Takin in the Mountains of Shensi" (July–August, 1922). Under the title of "The Extinct Giant Rhinoceros Baluchitherium of Western and Central Asia" Prof. Henry Fairfield Osborn wrote for the issue of May–June, 1923, an account of one of the most important discoveries of the expedition, comparing the specimen with other rhinoceroses, living and extinct.

Beginning in 1922, a series of articles on the Third Asiatic Expedition appeared in *ASIA* Magazine as follows: by Mr. Andrews, in 1923, "Setting out for the Buried Treasure of Mongolia" (April), "A Paradise for Dinosaurs" (May), "Untying Red Tape in Urga" (June), "Tenting in Lama Land" (July), "A Kentucky Derby in the Gobi Desert" (August), "A Fossil Hunter's Dream Come True" (October), "Winter-cooled Ardor for Fossils" (November); in 1924, "Where the Dinosaur Hid Its Eggs" (January), "The Lure of Mongolia" (February); by Professor Osborn, in 1922, "Proving Asia the Mother of Continents" (September); in 1923, "Giant Beasts of Three Million Years Ago" (September).

In addition to these popular articles and those in the illustrated weeklies of England and France, the Third Asiatic Expedition has issued a series of twenty-two scientific papers, including the first scientific notices of important discoveries of new species of fishes, amphibians, reptiles, birds, and mammals in China, and of new genera and species of extinct animals in Mongolia. These papers by various naturalists and geologists—Nichols, Andrews, Bangs, Fowler, Granger, Berkey, Gregory, Osborn, Allen, Mook, and Matthew—have been published chiefly in the American Museum *Novitates*, of which copies may be secured from Dr. R. W. Tower, librarian of the Museum.

The geological work of the expedition has been presented also in papers read before the Geological Society of America at its thirty-sixth annual meeting in Washington, D. C. On this occasion there were presented a joint article by Prof. Charles P. Berkey and Mr. Frederick K. Morris on "Basin Structures in Mongolia" and a paper on the "Physiography of Mongolia" by the latter author.

Finally, to sum up the great results of the expedition in worthy form, there is in preparation a series of demi-quarto volumes under the title *Mongolia—Its Past History*, the first volume of which, *Geology and Geography*, will go to press during the present year.

Living Animals of the Gobi Desert[1]

By ROY CHAPMAN ANDREWS
Leader of the Third Asiatic Expedition

IN the last decade exploration has assumed a new aspect. The great geographic land areas, with the exception of certain regions surrounding the North and South Poles, have been visited by white men, and their topographic features more or less perfectly described. The new era of exploration concerns itself with intensive work in the little-known areas of the world, in order to make them known scientifically and economically. Other expeditions have done work of this character but I believe that the Third Asiatic Expedition is unique in the fact that it was composed of a group of specialists in various branches of science, *all of whom were concentrating their efforts upon a single problem.*

The great object of the Third Asiatic Expedition was to test the theory of the central Asian origin of the mammalian life of Europe and America. It was concerned with no department of science which did not bear directly upon this problem. Palæontology, geology, geography, and zoölogy were represented by the staff of specialists during 1922 and 1923.

In this issue of NATURAL HISTORY other members of the expedition are giving reports on their special lines of work, and it is left for me to present a general view of the zoölogy, which was my particular concern. Reptiles, batrachians, fish, and mammals occupied the special attention of the zoölogists of the expedition. Studies and collections in these groups were made most efficiently by Mr. Clifford Pope, who is relating in an article in this issue his experiences on little-known Hainan.

It is the purpose of the expedition to make collections of reptiles and fishes in every province of the Chinese Republic, for no correlated work has ever been done in China in these branches of zoölogy, and the wealth of new material which Mr. Pope has obtained gives abundant evidence of what remarkable opportunities await us. Mongolia and the Gobi Desert have such a limited fish and reptile fauna that Mr. Pope confined himself to China, leaving to the other members of the expedition the task of collecting the few species that exist in the desert.

The extant mammals are extremely important in relation to the palæontology of Mongolia and to the existing forms in other parts of the world. Just as the fossils show that many groups of reptiles and mammals originated in central Asia and migrated to Europe and America, so do the living mammals indicate a similar trend. The Rupricaprinæ, or goat antelopes, are an excellent example. This group in a measure stands intermediate between the true goats and the true antelopes, and comprises five distinct genera. In Europe there is the chamois; in America we have the Rocky Mountain goat; while in Asia three genera still remain,—the goral, takin, and serow. Without doubt the chamois and the Rocky Mountain goat are migrants from the central Asian stock, one going to the west and the other to the east.

The wild argali, or mountain sheep, which reaches its highest development in central Asia, has sent migrants

[1]Except where specification is made to the contrary, the pictures accompanying this article were taken by Mr. J. B. Shackelford, the official photographer of the Third Asiatic Expedition.

American Museum of Natural History and Asia Magazine

Members of the Third Asiatic Expedition in their encampment at Irden Manha in Mongolia. Those seated in the middle row are, reading from left to right, Mr. Walter Granger, palæontologist of the expedition, Prof. Henry Fairfield Osborn, Leader Roy Chapman Andrews, Prof. Frederick K. Morris, associate curator of geology and geography in the division of Asiatic exploration and research, and Mr. Peter Kaisen. The four white men in the group that is standing are, reading from left to right, Mr. C. Vance Johnson, motor expert, Mr. Albert F. Johnson, Mr. J. McKenzie Young, motor expert, and Mr. George Olsen, discoverer of the first dinosaur nest. In the foreground at the left are the three Mongol interpreters, two in skull caps and the third (at the extreme left) with his queue encircling his head. This individual, named Tcherim, was the best hunter connected with the expedition. It is interesting to note the more robust build of the Mongols in contrast to the more slender stature of the Chinese. Among the latter is Buckshot (the young man toward the center of the front row with hair brushed back), Huei (seated to the right of him), Chow (the Chinese on the left of Buckshot), and Chi (standing under the tip of the flag). These are referred to in Mrs. Granger's article in this issue. Buckshot and Liu (at the extreme right of the upper row) are now employed in the American Museum. The photograph is included by courtesy of Mr. Walter Granger

through Siberia to Alaska, and southward into the Rocky Mountains and some of the coastal ranges. The American caribou and moose are certainly migrants from Asia, being very closely related to the reindeer and moose of Europe and Asia. Our American wapiti probably came from the Asiatic stock, which may have given rise also to the red deer of Europe.

I have mentioned only a few examples of the large animals which are familiar to every sportsman, but my remarks apply also to less-known smaller forms. It is evident that if we are to understand the past life of central Asia in its relation to the rest of the world, we must know the existing mammals as well as the extinct. Only by making extensive collections which will be available for study can this knowledge be acquired. The

Although yielding preëminence in speed to the antelope, which can beat an automobile going at forty miles an hour, the wild ass is one of the speed marvels of the desert, and combines with its fleetness an endurance that would make it a coveted draft animal if its wild nature did not preclude the possibility of its being domesticated. To maintain an average speed of thirty miles an hour for sixteen miles calls for extraordinary reserves of energy, yet that was the record made by a stallion which was pursued in an automobile. The pictures reproduced herewith give an impression not only of the gaits of the animal as it exerts itself to escape the strange hobgoblin of metal that keeps relentlessly close to it, but also of the open country it inhabits, the sparse vegetation of which furnishes, one would imagine, all too little nutriment for so virile an animal. The photographs are controlled by the American Museum of Natural History and *Asia* Magazine

Asiatic expeditions have already obtained nearly 10,000 mammals, many of them representing species which are new to science. These are by far the largest collections that have ever been made in Asia, and many of the species composing them were taken in regions which have never before been visited by a zoölogist. Although the great majority of the specimens will be kept purely for scientific study, others will be mounted for exhibition in the new hall of Asiatic life. The groups to be constructed will have a geographical as well as a zoölogical value, because typical scenes in the deserts, mountains, grasslands, and forests of Asia will be selected.

The superb collections which have been presented to the American Museum by the Faunthorpe-Vernay Expedition will give us an unequalled opportunity to illustrate groups and single specimens representative of the vast area of India and southern Asia. Therefore, the Third Asiatic Expedition has concentrated its efforts on China and central and northern Asia.

One of the groups for which material is already in the Museum will be called the Gobi Desert Group. This will show the Mongolian wild ass (*Equus hemionus* and the Gobi gazelle (*Gazella subgutturosa*). Although wild asses are found also in Africa and Thibet, very little was known about the Mongolian species until our work in Asia. We found these animals in considerable numbers in the central Gobi and extended the known range of the species several hundred miles to the east.

They are splendid beasts, about the size of a Mongolian pony, standing thirteen hands in height. They represent a wonderful adaptation to life in the desert, being able to maintain themselves on the scanty vegetation of sage brush and thorn bushes, which would not seem to furnish nourishment enough to keep a wooden animal from starvation. Much of the starch in their food is converted into water in the stomach, so that they seldom have to drink. Although we camped for five weeks on the banks of the Chagan Nor, a lake of considerable size in the center of the Gobi, we saw no evidence that the wild asses were accustomed to come to the water, and, indeed, they were found in greatest abundance in parts of the desert where there is no water whatsoever. During the months of July and August, when we studied them particularly, they were in herds composed largely of females and young, with one or two adult males. Very

American Museum of Natural History and Asia Magazine

Fagged out by pursuit, the wild ass acknowledges itself beaten. Somewhat later, however, refreshed by a rest, it galloped off to join its fellows in the desert often we would find individuals living alone and almost invariably these proved to be stallions.

The young are born during the end of June and the first part of July, and are able to run with their mothers almost immediately. We captured one baby wild ass, which was only three or four days old; he was not able to keep up with the herd, so that we had no difficulty in overtaking him with the car. We kept the little fellow as a pet for six weeks, and had hoped to be able to bring him to America and place him in the New York Zoological Park, but owing to the impossibility of obtaining proper milk, he died at the end of six weeks. I have never known an animal so difficult to tame. He became really friendly only with Buckshot, the Chinese boy who fed him daily, and would have nothing to do with the other members of the expedition, although he received the greatest kindness from everybody.

A baby wild ass and the one individual toward whom the little animal was really friendly. Photograph controlled by American Museum of Natural History and *Asia* Magazine

I have been asked by many people if it would be possible to catch wild asses when they are young and use them for breeding purposes. I do not believe that this would be practicable, due to the extraordinary wildness of the animals. Certainly, it would be difficult to tame an adult wild ass.

Their speed and endurance is almost beyond belief. One fine stallion which we followed in the motor car while obtaining photographs and motion picture film, maintained an average speed of thirty miles an hour for the first sixteen miles of the race. He reached forty miles an hour in short dashes when crossing in front of the motor car.

After many experiences in chasing these animals, we came to the conclusion that all wild asses can exceed thirty-five miles an hour, but that only a few can attain a speed of forty miles even for a short distance. When the young are two or three weeks old, they can run almost as fast as the adults, but their endurance is not so great. Like all the animals of the plains, the wild asses evinced curiosity rather than fear when they saw a motor for the first time. They would invariably try to cross in front of the car, and it was only when they discovered that it was impossible to get away from their pursuer that they became thoroughly frightened. We usually found the Gobi gazelle associated with the wild ass, and whenever a chase was begun, gazelles would appear seemingly from nowhere, and we would have herds of both animals running in front of us.

The gazelles are extraordinary creatures. Their speed is incredible and, after repeated demonstrations, we all became convinced that they actually can reach a pace of sixty miles an hour for a short dash. Mr. J. B.

This picture shows an antelope in repose. When in action this animal evidences a well-nigh incredible capacity for speed. On one occasion a herd made a semicircle about Mr. Andrews' car, which was moving in a straight line at the rate of forty miles an hour, and the speed of the animals, therefore, was probably not less than fifty-five or sixty miles an hour. The desert species never gathers into great herds but its relative of the plains may form aggregates consisting of thousands of individuals. Photograph controlled by American Museum of Natural History and *Asia* Magazine

Shackelford, the official photographer of the expedition, and I followed a splendid buck for ten miles on a chase straight across the plains. At first the animal easily ran away from us, although the car was traveling at forty miles an hour. After three miles, we began to overtake him and the last seven miles he maintained a steady speed of forty miles an hour. This was as rapidly as the car could go, and how much faster he could have traveled, we cannot tell.

The Gobi gazelle (*Gazella sub-gutturosa*) is a fine-limbed, clean-built animal and is entirely a desert species. On the grasslands lives the Mongolian gazelle (*Gazella gutturosa*), which has very different habits. It seems not to be able to exist on the dry and sparse vegetation of the desert, but is found in great numbers on the grasslands of Inner Mongolia and those just south of the northern forests. During the spring, immediately before the young are born, the Mongolian gazelles gather into enormous herds, composed entirely of females. These may include as many as six or eight thousand individuals—in some instances even more—which travel slowly to the flat plains, where they disperse.

On the great plain near Turin during the summer of 1919, my wife and I saw one of these enormous herds and a few days later the plain was alive with baby antelope. As we rode along on our ponies, the little fellows would jump up in front of us and go bobbing away like rabbits. We would often see them lying flat upon the ground, with their necks stretched straight out and their long ears drooping, and in this position they would remain absolutely motionless until they were certain they had been discovered. Even when only a day or two old, the babies can attain a speed of twenty-five miles an hour, as we demonstrated many times by following them in the car. Their greatest enemy is the wolf, and speed is their only protection. Almost as soon as they are born, they must be able to outrun the wolves, and the mothers select the flattest part of the open plains so that their babies may not be ex-

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SEVEN MASTERLESS STEEDS OF THE DESERT

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AN ANTELOPE DOE EXTENDING HERSELF IN FLIGHT

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THE DOG OF MONGOLIA

No animal is so dreaded in Mongolia as the dog. In a country where the dead are exposed instead of being buried, these animals acquire a taste for human flesh. They are savage and fearless, and not to be trifled with. Photograph by Mr. Roy Chapman Andrews posed to the crafty approach of a wolf under cover. Wolves, by the way, cannot reach a higher speed than thirty-five miles an hour and can only maintain this for a very short dash.

When the expedition was returning to Peking last September, we saw half a dozen great herds of antelope. In one there appeared to be at least ten thousand individuals, both bucks and does. The Mongols told us that these herds would remain intact until late in the fall, when the mating is over. Apparently the desert species, *Gazella sub-gutturosa,* never gathers into great numbers, probably because there is no region of the desert which would provide sufficient food.

On the Altai Mountains we had the unique opportunity of seeing argali, or mountain sheep, and ibex on ranges where no white men had hunted before. Both these animals were in great abundance and we obtained a splendid series for groups that will be installed in the new hall of Asiatic life. During the summer the male sheep and ibex retire to the highest peaks, leaving the females and young to carry on their lives alone until the mating season about the middle of September. Although the argali reach enormous size, some of them having horns 20½ inches in circumference at the base, and more than 60 inches in length on the curve, such individuals are by no means common. During last summer I suppose we saw at least two hundred argali in a single locality but not more than ten or fifteen of them had horns more than 50 inches in length.

The Mongols hunt both sheep and ibexes continually and the result is that the animals are always wary. The ibexes, which are true goats, are among the most difficult to kill of all mountain animals. Not only are they hard to approach but they are so tenacious of life that if a bullet does not reach a vital spot, it means a long chase for the hunter.

The expedition has not as yet reached the country inhabited by wild camels, wild horses, and the rare saiga antelope. Wild camels were reported from a place in the desert about one hundred fifty miles from where we shall begin work in the summer of 1925. They live in a sandy region and it is doubtful if we shall be able to follow them in the motor cars as we have been doing in the case of antelope and wild asses, but other means of hunting them will be devised. The wild camels are very similar in appearance to the domestic two-humped Bactrian camels of Mongolia but are somewhat smaller. The wild horses are only about one hundred miles to the west of the region where we shall begin work, and doubtless the expedition will have little difficulty in obtaining specimens of them. The extraordinary saiga antelope—an animal with a great wrinkled Roman nose—lives in the west, not far from the habitat of the wild camels. It is one of the most grotesque of living animals and also one of the rarest in museums. We are hoping to be able to obtain a complete group for the new hall of Asiatic life.

In this short article it has been possible to mention only a few of the more interesting large mammals of Mongolia but in China proper there are dozens of others which will find a place in the Asiatic hall. Group material and study collections of mammals, reptiles, batrachians, and fish are being obtained with such rapidity and completeness that already the American Museum holds a unique position in the field of Asiatic zoölogy.

Map of the basin regions of Mongolia.—Mountainous areas are shaded with slanting lines; the great lowland regions are white, and the deeper depressions, called *talas*, are stippled. The still smaller sedimentary basin units, called *gobis*, are located mainly within the *talas*, but are too small to be indicated on a map of this scale

Geological Reconnaissance in Central Mongolia

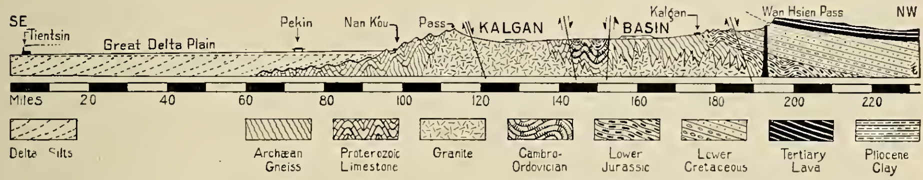
By CHARLES P. BERKEY
Chief Geologist of the Third Asiatic Expedition

PRIOR to the reconnaissance undertaken by the Third Asiatic Expedition the geologic story of Mongolia was almost wholly unknown,—not because the region was beyond reach of observation, but because both those who lived there and those who had traversed it had not seen the significance of its features. Mongolia is not all a wild uninhabited impossible desert; on the contrary, large areas are as beautiful plains country as the arid regions of the world afford, and primitive peoples have roamed over its great open spaces ever since man began to migrate.

This country lies athwart the great routes of trade connecting centers of early civilization, and from earliest times to the present there have been travelers and traders, adventurers and messengers, caravans and expeditions crossing and recrossing this very region that is still largely unknown. Some have been collectors in search of any

Key map of Asia.—The area in solid black is that of the basin regions of Mongolia, shown in detail in the map at the head of this page rare or new thing; some have been hunters in pursuit of sport; some have been restless souls simply in quest of adventure. Occasionally in recent lay out an exploratory traverse deliberately into a region of such reputation.

But to the geologist there are no hopeless regions. Wherever rock is to



Cross section from Tientsin to the Wan Hsien Pass above Kalgan.—The section is designed to emphasize the step-like approach to the Gobi region from the plains of China. With it is indicated something of the underground geologic structure and the relation of the principal rock formations. These fall naturally into three groups: (a) a simple delta, made of sand and clay built out into the China Sea; (b) complex rocks emerging from beneath the delta silts at Nan K'ou, and continuing a little way beyond Kalgan; (c) the gravels and sands, capped with basalts, at the Wan Hsien Pass. It is particularly noteworthy that the uppermost formations of both the plains of China and the plateau of the Gobi are simple sediments that lie unconformably over a floor of much more complicated rock

times exploratory expeditions have gone out, nominally for scientific investigation,—actually, in some cases at least, to make military and economic observations.

Thus, after untold centuries, in a land not new but old, in a land not isolated except by its own immensity and barrenness, virtually everything is still unknown, and one may project, as was done by the Third Asiatic Expedition, a traverse of three thousand miles, and not touch a single spot the scientific story of which is known.

It was common report that the desert countries of central Asia were particularly unpromising ground for geologic exploration. Caravans crossing the country found what was to them a wearisome stretch of wind-driven sand, and travelers returned almost exhausted by long weary months of toilsome journeying. It is not surprising, therefore, that the verdict of even the best-informed was that "the Desert of Gobi is a hopeless place," and it took some courage to

be seen or the surface of the earth has features, there some sort of story is to be read, and there the desolate aspect of the present day may be but a passing phase in a succession of greater events. So in the face of discouraging advice, and in full appreciation of the nature of the task, the expedition set out to lay a line of geologic observation across the Desert of Gobi and bring back, if possible, the major secrets of its story. A region of such intimate relation to the historic and prehistoric migrations of man and beast ought itself to have an important contribution to make.

What was promised can be told in a word; what was found we shall probably take years to explain. In one year central Asia has become one of the great fields of geologic research and central Mongolia is already classic ground.

Under patient study the sands of the desert have resolved themselves into strata with definite structure and a long story of changes, while their fossil

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Nan K'ou Pass, with the Great Wall.—This is the place marked "Pass" in the cross section on the preceding page, and shows the rugged country of the southern barrier, just before the level Kalgan basin is reached. Photograph by Roy Chapman Andrews

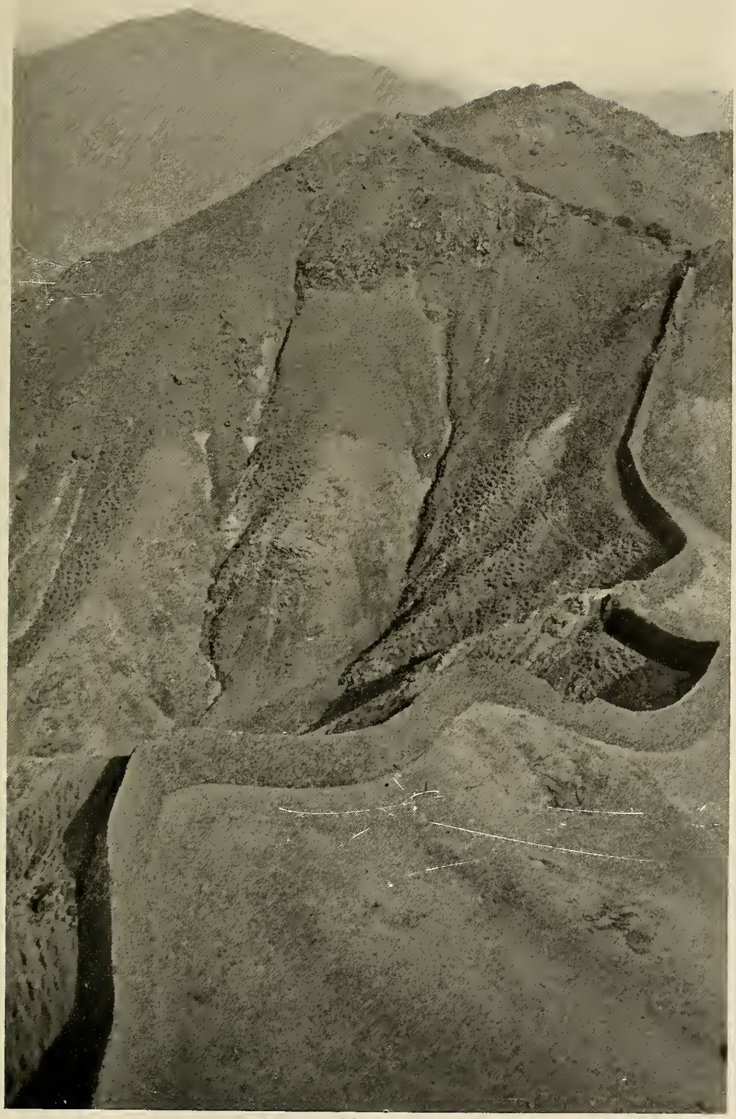
content makes it possible to populate this barren-looking waste with as strange an assortment of living things of former time as this earth of ours has ever produced. The desolations of the desert are softened by the hand of Time, whose course we shall follow backward to the paradise of long ago.

APPROACHING MONGOLIA

The most effective approach to the region is from the plains of China, low-lying, monotonous, just barely above the sea. There the great rivers of China,—the Yangtze and the Hoang-ho, coming from central Asia, have been engaged for ages in carrying sediments from the plateaus and mountain ranges of the interior to the bordering plains below. And there they have slowly dispossessed the ocean waters and, in the course of time, have built all this flat country lying between the mountain uplands and the Yellow Sea.

Here and there a hill or a mountain ridge rises out of the plain, as an island would stand out of the ocean. They are indeed islands, surrounded now by the sands and silts of the plain where of old the sea lay at their feet. Beyond them the same low plain, with the same monotony, continues.

Farther inland, beyond Peking, one comes abruptly to a mountain barrier looming high above the plain, as if a great broken block of the earth had been lifted there to bar one's progress. This is, in fact, about what has happened, as one who looks closely may see, although the reason for it is not so simple. It is here that the great wall of China was built, doubtless to add still greater difficulty to the passage of this natural barrier. But at Nan K'ou Pass one may climb to a new level lying beyond, two thousand feet higher and almost even with the tops of the frowning mountains. And then on this higher level one finds himself again on a plain, though a much smaller one, a broad open country through which one runs half a day by rail to Kalgan. Here, as abruptly as at Nan K'ou, a new escarpment, even more formidable



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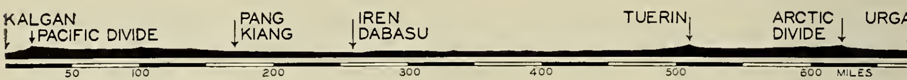
THE RUGGED COUNTRY OF THE NORTHERN BARRIER, WITH THE OUTER GREAT WALL NEAR KALGAN

This picture was taken fifteen miles south of the Wan Hsien Pass (shown on p. 161) on the borders of Mongolia. Photograph by Charles P. Berkey than the other, stands across the course. Here other and still more primitive walls mark the efforts of Chinese civilization to protect itself from the invaders of the desert.

If one is to go farther into Asia, it is necessary again to toil over the passes of the new barrier. When this is done, one finds himself not on a mountain range at all, but on the edge of a great plateau 5000 feet above the first low plains of China and the sea; and now for a thousand miles one may go forward without encountering another such barrier. This is the outer rim of one of the great interior basins of central Asia,—this is the border of Mongolia, the edge of the Desert of Gobi.



Profile across the Great Basin of the Gobi from Kalgan to Urga.—The base line is sea level. The profile itself is founded on nearly 1000 altitude readings reduced to scale, so that the vertical measurements are exaggerated ten times over the horizontal. At the south, the Pacific divide at Wan Hsien Pass (see map on p. 161) stands at about 5000 feet, and parts the waters that flow into China from those that flow into the desert basin. At the north the Arctic divide stands at about 6000 feet, and parts the waters that flow northward into Siberia from those that flow southward into the desert. Between the two divides lies a great cradle-like sag, descending gradually to the depression at Iren Dabasu, where the elevation is not much more than 3000 feet. This is the Great Basin of the Gobi

PHYSICAL FEATURES OF THE GOBI

It is comparatively easy to give a mental picture of the essential features of the great basin region of central Mongolia, to the edge of which we have now approached. The Gobi is only one of a series of great basins, all of semi-desert character, which together stretch across the continent of Asia. It is the easternmost and the largest of them.

As one stands on the edge of the plateau and turns toward the Desert of Gobi, the view is entirely transformed. Instead of rugged country, deep valleys, mountain barriers, and difficult passes such as have been encountered in reaching this land, one looks out over a great rolling plateau. It gives a curious impression of endlessness, and this picture from the edge of the escarpment sinks into one's soul. It will steal into the mind over and over again, even though one be hundreds of miles from the region, making one feel quite unaccountably that this land is the veritable roof of the world and that a little way ahead, just beyond the next rise of ground, one must be able to look over the edge and see the rest of the world spread out before him.

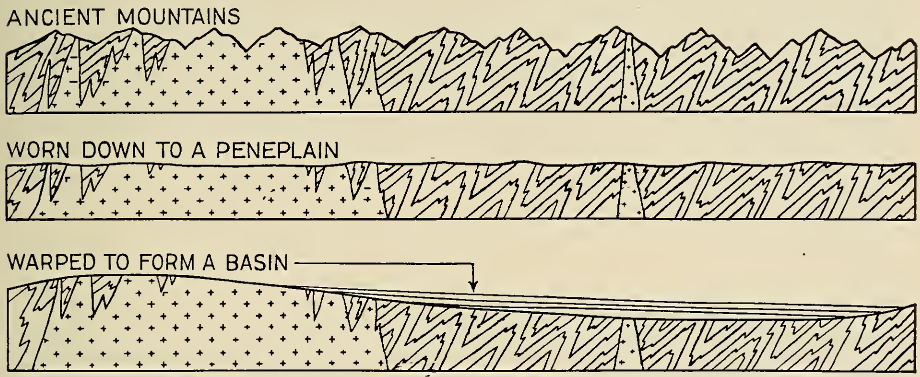
It is not as endless, of course, as it appears to be, but as far as one can see, and indeed for hundreds of miles beyond, it is a gently rolling, open country, with stretches of level, monotonous plain between other stretches with more variety of relief. Here and there hilly country or a mountain ridge replaces the flatness, but this is certain to be succeeded only a little way beyond by the gently rolling or level, monotonous plain.

Thus, the trail stretches over hundreds of miles of desert to the mountain divides of the north, which separate the wooded Siberian slopes from the desert basins of central Asia. From all sides these lands slope to the interior.

Central Mongolia is truly a basin. It is 2000 feet lower in the central portion than on its uplifted margins. But it is nearly a thousand miles across, and on such a scale its basin form is not at all apparent. Such streams as there are now, behaving just as other more ancient streams have behaved for ages past, flow out into the basin, whenever they flow at all, losing most of their waters as they go, either by evaporation or by sinking into the sand. Here and there a trickle struggles bravely through to some salt lake, but for the most part there is no surface water.

This large, basin-like region is itself a complex of smaller basins, each one of which is marked by a smooth, flat, level surface and is separated from its neighbor basins by rolling hill country or by semi-mountainous ridges. These secondary basins, with their great open stretches of level ground, some a hundred miles across, are characteristic of the region. Such an open, smooth plain is called *gobi* by the people of Mongolia, and this is the name that has now come to be applied to the whole desert region of central Mongolia, the Desert of Gobi.

Across this bare, open, unprotected plateau region fierce winds seem to blow interminably. Dust is swept entirely away to settle down again in distant regions, while the heavier sands, formed by the disintegrating action of the weather on exposed rock ledges, accumulate near by in dunes. Great quantities of the lighter material must have been swept off the Gobi and carried to the lower border lands of China. Other great quantities of sand shift about over certain tracts of the desert, making travel slow and difficult.



This diagram is intended to illustrate successive stages in the development of a Gobi basin. The upper section shows the complex structure and rugged profile of the original land, the second indicates the effect of erosion in wearing this ancient land down to a peneplain, and the third illustrates the development of sedimentary beds of still later date on the down-warped portions, after the region had been lifted and warped into basins

Thus it happens that such rain-wash erosion as there is, together with the work of the wind, has swept from the rock floor almost everything that in other countries would have made a soil, and one may travel mile after mile and day after day over the nearly barren surface of the rock formations that make up everywhere the solid "crust of the earth." True it is that

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Typical rock desert along the Urga caravan route.—The floor is solid rock, and is virtually bare. Residuary boulders of granite lie scattered about, left by the disintegrating action of the weather. There isn't an inch of real soil under the wheels of the motors. Photograph by Charles P. Berkey

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The far-flung landscape of the Gobi.—A characteristic view in the center of the desert, looking across a sediment-filled basin. These are the boundless plains that impress one so much on the plateaus of central Asia. Photograph by Walter Granger there is much drifting sand, so abundant in certain belts that it is impossible to cross successfully except with camel caravans. For the most part, however, the Gobi is not strictly a sand desert. In all essential respects it is a rock desert, with the underlying geologic formations so near the surface that one trained to see such things is not confused by the thin veneer of sand. Looking through this he soon learns to unravel the underground structure, and read, with as much success as in other regions, the geologic story that is hid away in the strata beneath.

GEOLOGY OF THE GOBI

One soon learns, for example, that the rolling, hilly, and mountainous portions of the country dividing the Gobi plains are underlain by complex, comparatively ancient rocks, and that the smooth, level, monotonous stretches between are underlain by much younger sediments with much simpler structure and a very different story. Together they must carry the secrets of the geologic history of central Asia. If these strata do not, then it must be that the story is lost.

Thus the geologic formations of Mongolia consist of two grand divisions,—one an exceedingly complex series of ancient rocks carrying the story back to the very dawn of geologic history, the other a simple series of sediments recording the last chapter.

The older story is much the longer and more complicated one, involving foldings of strata and upheavals into mountains, outbreaks of volcanoes and igneous activity in the ground below, the sinking of lands beneath the sea and their emergence again, followed by the making of mountains a second or a third time, only to be destroyed in turn like those before them. To tell this as it should be told is much too long a story for the present purpose. It must suffice to catch merely a glimpse of these mighty movements reaching back farther and farther into geologic time.

Between this ancient series and the later one a long interval is lost. Everything since that remote time is simpler and easier to read. The continent has been more stable. Strata formed since then are little disturbed, and tell a clearer story. They lie on the upturned edges of the older series, and form the smooth plains of the Gobi.

Our immediate interest is directed particularly to these level *gobi* areas that we have now discovered are underlain by simple sediments of later date. It is quite worth while for us to find out how these sediments are related to the more complicated rock formations of the hilly districts forming the divides and to determine whether either of these formational groups carries minerals of value or fossils of scientific interest, or evidences of any kind that will help us to unravel and understand the whole geologic story.

For this purpose there is little promise in the smooth level tracts of unbroken plain. But not all portions are so monotonous,—not all of the plains areas are unbroken. Here and there, in former times, streams have cut down into the deposits, and have scooped out valleys across the plains, and gulches have been carved that still remain as evidences of former erosion conditions. If one stops, therefore, at such a place on the margin of an old valley, one may find the edges of the strata exposed, and these beds can be inspected one after another. One has, therefore, occasional opportunity to see not only what these sediments are and

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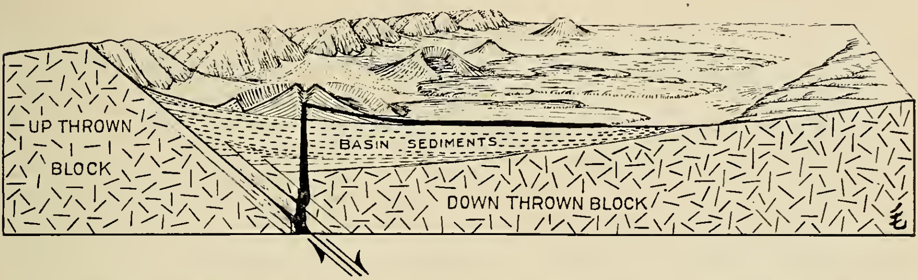
Horizontal strata in one of the Gobi basins, where erosion has exposed the edges of the sedimentary beds as effectively as if one had dug trenches through them. Such places as these are the normal hunting grounds for fossils. Photograph by Walter Granger

how one layer differs from another, but also what they carry. Still more rarely erosion has cut through to the very floor, exposing the underlying basement rock on which the sediments were originally laid down, and one can then see that this basement, or floor, is the same complex of older formations that was before noted in the rolling divides between the basins. Everywhere, therefore, there is this complex old floor that was once a land surface itself, until changes took place that permitted some of it to be covered with later sediments. At such places the character of the bottom sedimentary beds can be seen and, if one's search is continued far enough, other and higher or younger beds will be seen. If conditions are particularly favorable, it may be that nearly every individual stratum in the whole basin can be thus examined at one place or another. By piecing together bits of evidence, then, from one outcrop after another, it is possible to formulate the essentials of the whole story of the basin sediments and to determine what relation this story has to the much more complicated one of the still more ancient floor.

This is a part of the story,—almost the closing pages of it. Long before the Age of Mammals, doubtless many million years ago, northern Asia had been worn down, chiefly by the slow work of stream erosion, to the monotonous relief of a peneplain (a low erosion plain). In still more ancient times, it had been three times at least a mountainous continent; but the steady wear of weather and rain, of wind and water acting through immensely long intervals of time had destroyed these mountains and carried off their waste and had carved out a new plain of its own design across the complicated rock formations that then made up the structure of the continent. This was accomplished almost as perfectly as if one had taken a great knife and had pared the continent down, throwing the shavings into the adjacent sea. Thus the mountains were sliced off, but one can still see the complicated structures of the roots of them in the rock floor of the present desert and beneath the sediments of the basins.

At that time the continent may not have stood very high above sea level, but at a certain stage some powerful gravels and muds were laid down there, year after year, age after age, until the smaller basins were filled and united with their larger neighbors, to make a still more extensive cover of sediments. These are now the strata that lie on the old rock floor, and this in a word is the origin of the "later sediments" that lie beneath the *gobis*.



This diagram represents a rectangular block sliced out of the earth, exhibiting the features of a warped and faulted basin. The front of the slice shows the cut edges of all the rock structures. The center of the slice is the down-sinking area, and here the sediments have accumulated. A split or fault has developed near the left-hand end, and the old crystalline rocks are heaved up, making a long straight mountain front. Volcanoes have broken out along this fault zone; the foremost volcano is pictured sliced in half, exposing bedded ash and lava flow. A breached cone stands farther away along the same zone and two perfect cones are seen in the distance. New sediments are being carried down from the uplifted block by streams, which are depositing their load in the form of alluvial fans on top of the previously formed lava flows. In time these sediments will form a new series of overlying strata

internal earth forces caused the continent to be lifted higher and higher above the sea to something like its present position. In the course of this movement it was raised more at the margins than in the middle, and it was warped enough so that it took the form of a great shallow basin. This warping was not very uniform either, so there came to be small basins within the larger one.

Then the rivers that had aforetime flowed to the sea began to flow inland, into the basin which had been made where previously there had been outward-sloping upland. And the sediments that these streams carried were now deposited in the basin instead of being borne to the sea. Sands and

At times in the course of this process new warping took place, making still greater unevennesses, developing new basins where there had been none before, deepening some that were not so deep before, and lifting up places that had been level before. Then the work must begin all over again. Uplifted places where sediments had already been laid down were thus exposed and eroded, so that these beds were destroyed almost as soon as they were made, and the erosion débris was carried off to fill in the adjacent, newly formed depressions.

Not infrequently an area that had thus been the seat of deposition and had subsequently been uplifted so that its sediments had been in part removed, found itself later, after another change, the seat of deposition for a second time. Thus there are often exhibited two or three series of sedimentary beds, one on top of the other, with erosion intervals between. Streams sometimes cut deep channels into these new deposits, uncovering their internal structure, showing up their peculiarities of composition and their evidences of changes of level or of shiftings of centers of deposition.

Sketch of the range Baga Bogdo, one of the Altai chain, seen from the north at a distance of forty miles. It is a fault-block mountain, like that shown diagramatically on p. 169. In this view we are looking southward at the steep front face of the block, which rises to 7000 feet above the floor of the basin. The remarkably even sky line, sweeping gently up from either end to the highest peak represents one of the ancient peneplains, carved upon hard rock, and now uplifted. In the broad basin of the foreground lie several thousand feet of sedimentary strata, some of which have proved to be veritable treasure houses of rare fossil forms. There are Cretaceous beds bearing dinosaurs, fossil fishes, and fossil mosquitoes; Oligocene beds carrying the monster *Baluchitherium*, and a Pliocene formation in which are the bones of horse, deer, and ostrich

In some places, also, earth disturbances were much more pronounced. Instead of gentle warping the floor was broken. On one side of the fracture the earth dropped down and the other side was lifted until it stood as a frowning escarpment. Of such deformations there are all grades, from a gentle warp that simply tilts the strata or a dislocation that displaces the strata only a little to great fault blocks uplifted till they stand as mountains. The fine north face of Baga Bogdo of the eastern Altai, standing majestically above the adjacent basin plain, is such a faulted block. It has been pushed up out of the plain at least 7000 feet above its former level, and for all we know the movement may still continue.

At many places where such movements took place, volcanoes broke out along fractures where there was considerable dislocation. One finds abundant accumulations of ashes and cinders, now forming beds of tuff, lava flows, and all sorts of intrusions of once molten rock. This complicates the story. Occasionally one finds old lava fields, covering hundreds of square miles, and, still more rarely, a volcano, so recent that the weather has not yet destroyed the gloss on the glazed surfaces of some of the rocks at the vent, where hot gases must once have poured out. But volcanoes are at best transient things. The loosely built pile is soon destroyed. So it happens that the old ones have been demolished and only the less destructible evidences remain.

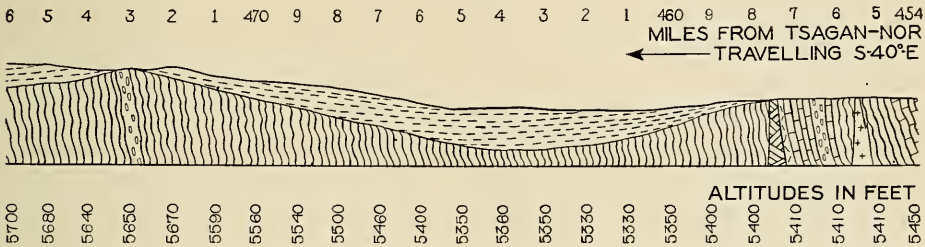
Such changes can be read from the structure of the rocks alone, but an added interest attaches to the sediments of the basins, because of the fact that these same strata carry fossil forms representing the living creatures of that time. The bones of the animals that roamed over the continent of Asia during the period when the deposits were being made were sometimes buried in them, and may be dug out again if one finds the places where they have been entombed. These places are the fossil fields of Mongolia.

One learns where to find them and how the strata of one field are related to others by unravelling the geologic story that interprets the ground.

METHOD OF WORK

But the story is to be read, if at all, only by most careful and painstaking work. There is no base from which to start—there is no map worthy of the name to guide one—and if there is to be an explanation, it must be built

To this end a route map is kept, on which is sketched the course of the traverse and the bordering topography. From aneroid barometer readings, made with every change of level, a running profile is constructed mile by mile. On this the geology is sketched in cross section, representing as true to life as possible the succession of formations, the underground structure, and the interpretation of their relations one to another.



A page from one of the note books, showing a fragment of the 3000-mile geologic cross section made on this reconnaissance. This illustrates the method of representing certain geological data en route. The profile is constructed from aneroid readings; the underground structure is an interpretation based on the outcrops of rocks examined while driving over the surface. This particular section shows a portion of the eroded and warped old rock floor, once doubtless completely covered with sediments of later age, now uncovered again at its highest points by recent erosion

up from the ground itself. This requires constant watchfulness for every bit of evidence. During a few minutes of inattention one may pass by the best find that the region affords. One must make literally thousands of observations and inspections and judgments and trial studies as rapidly as it is possible to work. It is not an unusual thing to make a thousand examinations of rock outcrops in a day, and record their meaning in whatever way is practicable, considering the speed of travel imposed by the movements of the expedition. These records must be kept in a running account, so that they can be picked out again in their proper setting, and so that the succession of changes can be reproduced.

When the expedition is moving rapidly, such an undertaking is extremely trying and exhausting work. One must spend every minute, when the expedition can be halted, in examining the ground, while notes and sketches must be made largely on the move. One must jump out and examine an outcrop, or run to the top of a hill or collect a representative specimen or detect the presence of fossils or take a measurement and be off again, while the rest of the caravan moves leisurely on. Then one must drive all the faster to catch up if he can, making his notes like the wayfarer,—on the run! Several times more than a hundred miles of such cross section work was done in a single day.

Route studies covering more than 3000 miles have been made, and these form the basis of the related exploratory investigations, and of what is known about the distribution of the later sediments and other strata in the Desert of Gobi. Where a promising fossil find is encountered, there a longer stop can be made, and the geologist, for a time, turns fossil-hunter with the rest. But at the first opportunity he is off again to extend the section and locate new fields. Thus exploration for new sites and development of proven ground go hand in hand.

These route studies must be carried everywhere and must be kept continuous so that one does not find himself geologically isolated in a completely unknown country. But special local studies may be made wherever there are longer stops. These may take the form of joining in more diligent search for fossils or of engaging in a detailed examination of the succession of strata, or they may result in making a local geologic map as a method of recording more complicated data in a form suitable for reference and record.

If a locality proves to be particularly critical and productive, so that all interests may work together for a longer time, then a much more elaborate, special areal study is made of as large a surface as can be covered in the time. These special areal studies become the key maps, or standards of reference for future work, and the areas chosen for them are always selected because they give special promise of returns in unravelling the history of the region. At least 700 square miles were thus mapped in detail during the intervals of travel in the first season. It is such studies as these which really give the most reliable scientific returns, and without them the whole effort would be reduced to simple reconnaissance, because the moves of the expedition are made too rapidly to allow adequate checking of the more difficult and critical points. In these places, chosen for special study, the structure can be worked out in detail, the succession of strata with their fossil content can be much more exhaustively determined, and the geologic story can be pieced together with great assurance.

Altogether the task is an arduous one. The heaviest work comes when it would be much more convenient to ride along with the rest of the expedition and enjoy the scenery. It is one thing to bowl along for a hundred miles over a rolling plain, musing on the fortunes of the day or the fame of the morrow, and quite another to be responsible for the geologic record of the route and of the meaning of the ground over every mile of the journey. It is a severe tax on endurance, and on devotion to science, but the success of the enterprise is quite as much dependent on this kind of persistence as on any other factors.

If one has such work, it is physically impossible to record all of the observations and assemble them in presentable form during the day's operations, and as soon as camp is pitched, one must therefore retire to his tent and continue on the day's notes far into the night. Maybe exploratory work is attempted in a less strenuous manner, but it is not done that way if the responsibilities of the expedition are suitably cared for, and if the expectations of the men at home who vouched for it and who foot the bills are fully to be met.

There are few better places in which to sleep than the Desert of Gobi,—but it does not fall to the lot of a geologist to take full advantage even of that opportunity. After the other members of the expedition have all turned in, the geologist must wait for the proper time, set up the instruments and "shoot Polaris," so that by means of the stars he may determine where this place is. After all of these things are done, little enough time is left for rest.

One gets his inspiration from the work, and from a belief that if it is well done, we shall by and by unravel the story recorded by the rocks, and the expedition will find what there is to be found.

If one has learned to interpret the meaning of the features to be seen, then, after these keys have been found, one can tell with considerable assurance where the more promising fields are and where, on the other hand, it would be wasted time to stop.

It is always a most satisfying thing to appreciate that the rock formations of the earth are just as they ought to be. This is because they have been made through processes and by agents and under laws that can be understood. If one can read his geology in these terms, and if one's interpretation is sound, the rock formations behave just as they are expected to behave, and they occur where they ought to be, and they carry what they ought to contain. Rest assured it is not because of any wizardry or supernatural competence in the investigator that the strata begin to reveal their secrets. And it is not because of any erratic or mysterious or accidental behavior of the earth or any trickiness or unreliability of the rocks themselves that mistakes are made. Their story is always there, and one must learn how to read it from the few scattered records still preserved in the only symbols that the earth knows how to write.

One reads this language, if he is an explorer, else he does not learn the story; and one follows these obscure pointers of the ground, otherwise its choicest treasures will not be found.

The earth does not respond to a whim. One may search blindly, to be sure, and make an accidental find. But it would not be to the credit of a scientific expedition to search in that way. One cannot make a discovery where there is nothing. And one should not seek where it can be shown that the earth has not produced. But if there are hidden treasures and if there is a new story and if it falls to one's lot to cross such ground, then one must not fail to find what there is to be discovered.

It is not good fortune alone that leads to discovery. Clairvoyance and magic will not do. Back of it all is a lot of plain hard work. Through it all runs a lot of vigorous discussion, an endless amount of revision of hypotheses and many a try out of new theories, many a ruthless rejection, and many an hour of groping thought. Fortunate indeed are they whose ground has been favored and whose final working hypotheses are true enough to solve their major problems and lead to contributions of real value.

A RHINO AND HER CALF

It is believed that this is the only photograph ever secured of the one-horned Indian rhinoceros (*Rhinoceros unicornis*) in a wild state. These two animals lived in a patch of thorn and bush cover near the camp established by the Faunthorpe-Vernay Expedition. They might easily have been shot, but only good specimens were desired and the horn of this female was poorly developed and her calf too small. Because the members of the expedition saw her again and again during their sojourn, they came to feel for her a familiarity that was untainted by contempt. They named her Lizzie

The leaders of the expedition, Colonel Faunthorpe on the right and Mr. Vernay on the left

Jungle Life in India, Burma, and Nepal

SOME NOTES ON THE FAUNTHORPE-VERNAY EXPEDITION OF 1923

By LIEUTENANT COLONEL J. C. FAUNTHORPE

Late Commissioner of Lucknow, India

THE PICTURES ACCOMPANYING THIS ARTICLE WERE TAKEN BY MR. G. M. DYOTT, THE PHOTOGRAPHER AND CINEMATOGRAPHER OF THE EXPEDITION

THE fauna of India have until now not been well represented in the American Museum of Natural History, and it was to remedy this deficiency that the expedition to India was undertaken by Mr. Arthur S. Vernay and myself in 1923. The specimens collected will be shown in the Asiatic hall, which is one of the additions to the Museum now being built.

A matter to which Prof. Henry Fairfield Osborn is devoting much attention is the deplorable rapidity with which the wild animal life of the world is being destroyed, and recent articles of his entitled, "Can We Save the Mammals?"[1] and "The Close of the Age of Mammals"[2] have attracted widespread attention. The almost complete disappearance of game animals in the United States is, of course, notorious, but the same thing is going on practically all over the world.

Sir H. H. Johnston, in his introduction to Schillings' book, *With Flashlight and Rifle in Africa*, draws attention to the "ravages of European and American sportsmen, which are still one of the greatest blots on our twentieth century civilization." He adds, "All the wrongdoing does not rest with the white man. The Negro or the Negroid, armed with the white man's weapons, is carrying on an even more senseless work of devastation," and "Public opinion should strengthen as far as possible the wise action of governments in protecting the world's fauna all the world over, wherever the creatures thus protected do not come into dangerous competition with the welfare of human beings. Moreover, it

[1] "Can We Save the Mammals?" by Henry Fairfield Osborn and Harold Elmer Anthony. NATURAL HISTORY, Vol. XXII, Number 5, pp. 388–405.

[2] "The Close of the Age of Mammals," by Henry Fairfield Osborn and Harold Elmer Anthony. *Journal of Mammalogy*, November, 1922.

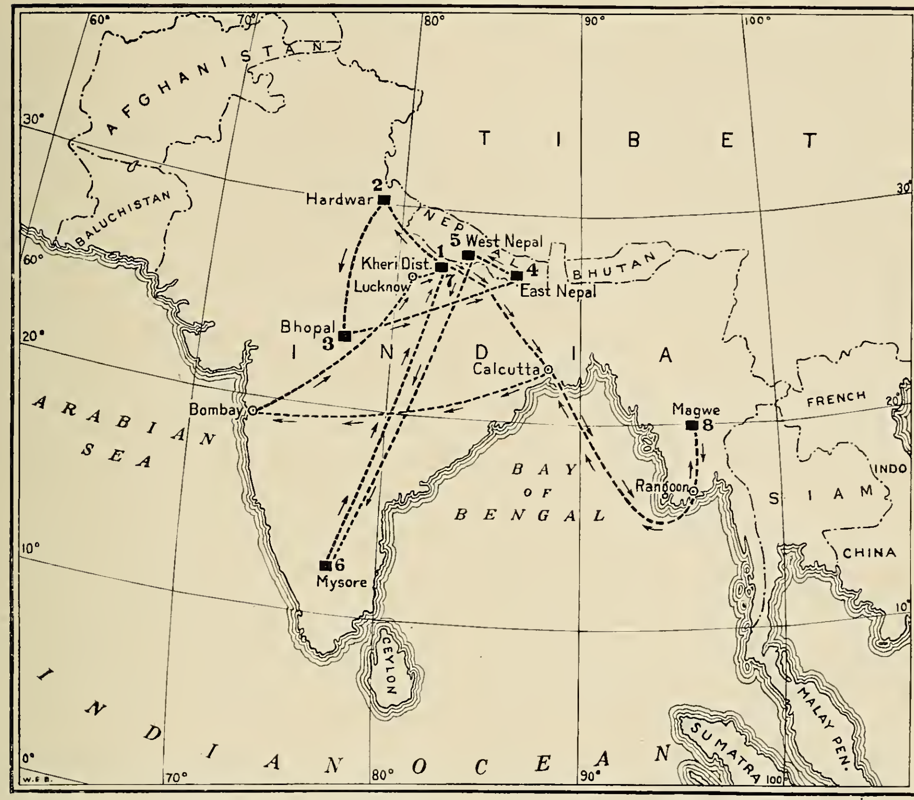
is for the welfare of humanity in general that this plea is entered. The world will become very uninteresting if man and his few domestic animals, together with the rat, mouse and sparrow, are its only inhabitants amongst the land vertebrates. Man's interests must come first, but those very interests demand food for the intellect." Schillings himself writes: "Already a great number of the inmates of our zoological museums have been struck out of the book of living things, though they existed in millions in the time of our fathers. The work of destruction entered upon by civilized man goes on with terrible swiftness. . . . To-day there is still time in the case of many species. In a few years it will be too late."

And the extermination of wild animals is not confined to Africa, nor to the United States, where it is already practically complete. Particularly since the introduction of the "Reformed" government in India, which has resulted in a generally slackened enforcement of existing laws and rules (the Arms Act and Forest Act among others), the dimunition of game, as I can state from my own personal observation, has been rapid. There are many more guns in the villages than formerly and I know many districts where game animals and birds, abundant not many years ago, have now practically disappeared. Within a measurable space of time there will be no game in India, except in preserves maintained by native chiefs and in the more inaccessible of the government forest reserves. And even in the government forests, the depredations of the Indian poacher are becoming continually more extended and at the same time are less resisted by the Forest staff.

It was the consideration of these facts which led the American Museum authorities to plan an Asiatic collection and to welcome the offer made by two Englishmen to provide the Asiatic wing, adjoining the Roosevelt hall, with a representative collection of the animals of the plains of India and Burma.

The idea of the Indian collection began as far back as 1918 when, owing to a disagreement with my superiors as to the proper administration of the branch of the Intelligence Department of which I was in charge, I left the Army in Flanders and went to New York on the British War Mission. One of my fellow passengers on the good old "Baltic" was Mr. Arthur S. Vernay, an Englishman who has been in business in New York for the last twenty years or more. Another was Mr. William Beebe of the New York Zoological Society, author of the well-known *Monograph of the Pheasants.* Through him I met Prof. Henry Fairfield Osborn, who showed me over the American Museum, including the taxidermy rooms. I was much impressed by the perfect system of taxidermy in use and by the artistic manner in which the animals were shown in groups in a reproduction of their natural surroundings, as well as being struck by the fact that the fauna of India were represented by very few specimens, and those of a very poor quality.

Later, on my return to India after a period of duty with the British Embassy at Washington, I wrote to Professor Osborn and offered to make a collection of Indian animals, if he would provide me with a capable taxidermist. Vernay came to India on a shooting trip shortly after this, and we discussed the matter, with the result that when he returned to America, it



Route of the Faunthorpe-Vernay Expedition to India, Burma, and Nepal, with the hunting areas indicated in solid black and designated by numbers showing the order in which they were visited

was arranged that a collection should be made. The Museum promised us a taxidermist, and Vernay, who not only has ideas but the energy and the means to carry them out, undertook to finance the expedition.

It was obvious that photographs and cinematograph films would add greatly to the value of the collection, especially as the American Museum makes a feature of lectures, illustrated by films. The Museum's educational activities with the schools reach yearly, I believe, about a million and a half people. The services of Mr. G. M. Dyott, F.R.G.S., as photographer and cinematographer to the expedition were fortunately secured. Dyott has done a great deal of exploration and photographic work in the wilder parts of South America, and during the War was a commander in the Naval Flying Corps and specialized in aërial photography.

Dyott had his first introduction to the Indian jungle when we were collecting specimens of swamp deer. Wearing a pair of rubber thigh boots (surplus government stores), he took station, with his movie camera, in about two feet of water to await the arrival of the deer, which we undertook to drive in his direction. Vernay having roused a fine stag, the line went off in a different direction, and the unfortunate photographer did not get his pictures until about three hours later. Although the leeches are rather active in those swamps, he made no complaint.

He was always ready "to take a chance on anything" in order to secure a good film. On several occasions he was posted on the ground when tigers were being beaten out of the thick growth, and twice, when in this precarious position, he secured an excellent film of a tiger galloping across the open, as well as "close ups" of elephant, rhinoceros, tiger, and many other animals.

I had arranged to have a shooting party in the Ranee of Khairigarh's jungles in the Kheri District at Christmas, and was fortunately able to secure Jonas, a taxidermist sent by the American Museum, in time for this. I was successful in obtaining fine specimens of that beautiful and rare animal, the swamp deer, as well as some other mammals and certain rare birds. It was a good omen for the success of the expedition that one of the two stags I shot carried very massive antlers, having twelve points and measuring 39½ inches, which is, I believe, a record for the province. It is certainly by far the best head I have ever seen.

Vernay and Dyott arrived early in January, and assisted by Turner, the Forest Officer of Kheri, and by Kunwar Dillipat Shah of Khairigarh, completed the swamp deer group, and secured some other specimens as well as good pictures.

The chief difficulty which confronted us was how to obtain groups of the maximum number of species in the short time available, for, owing to the extreme heat and the rainy season, shooting in the plains of India must practically cease by the end of May, and in Burma by the end of June. We had only about five and a half months in which to do our work.

The India Office and the government of India had already given their approval to the expedition, and the local governments and native chiefs provided generous help. The India Office persuaded the Indian government to place me on special duty (without pay) to assist the expedition for a period of three months.

After completing the swamp deer and the nilgai groups, Vernay made a special expedition into the lower range of the Himalayas on the Ganges to shoot a big tusker elephant which the year before had chased the Forest Officer and would undoubtedly have killed him had the officer not succeeded in scrambling across a nullah, which the elephant could not cross. It is curious, by the way, how small a ditch will prove impassable to an elephant. In the old days, in some of the forest divisions, deep and square-cut but surprisingly narrow, ditches used to be dug around the forest bungalows to keep the elephants out. I don't think an elephant can get over a six-foot ditch; one of seven feet will certainly defeat him.

This big tusker was, no doubt, somewhere in the neighborhood, but could not be located, which is perhaps not surprising considering the great density of the Sal Forest up north, compared with the forests in the Billigirirangan Hills in southern India, in which we got our elephants later.

The next place visited was Bhopal, where Her Highness the Begum and her ministers were most helpful, and Vernay was fortunate enough to secure a sambur stag with a massive and symmetrical head of 41-inches, and also specimens of the Indian antelope and gazelle. A 41-inch sambur is a fine trophy in these days.

I fear that game has become very scarce in Bhopal, as His Excellency the Viceroy, who visited that state about the same time, and no doubt had the pick of the jungles reserved for him, did not succeed in securing a sambur.

While Vernay was hunting in Bhopal and elsewhere, I was continuing to do a bit of useful staff work (in addition to my ordinary duties of misgoverning the Lucknow Division) by arranging for future trips. The chief point was to get the specimens in the shortest time. This depended mainly on selecting the best locality and season for obtaining each species. Colonel O'Connor, the British Envoy to Nepal, had offered to help and very kindly asked Vernay and Dyott to join his tiger shoot in eastern Nepal, where Vernay bagged a couple of tigers and Dyott got some good films. The permission of the government of Madras was obtained to shoot one tusker and one female elephant, and the bison required for the group, in Madras Government Forest, and the Maharajah of Mysore allowed us one tusker elephant in his territory.

Our object was to obtain a group of each animal. For instance, of the bison—one bull, one cow, and one calf; and, in addition to this material for a group, one skeleton of an adult bull. The skeleton series is of great interest for anyone studying the evolution of types. In the case of elephant and rhino we omitted the calf; in the case of the smaller deer and antelope, we added an additional male or female or both.

THE RHINOCEROS HUNT

The animal of which we were most anxious to secure good specimens was the great Indian one-horned rhinoceros, now extremely rare in British territory, and decreasing rapidly in Nepal. In the Morang District of the Nepal Tarai this rhinoceros was plentiful not many years ago, but now not a single specimen is, I believe, to be found within two hundred miles. As regards British territory, only a few still survive in Assam.

That enlightened ruler, my friend His Highness Maharajah Sir Chandra Shumshere Jung of Nepal, fully appreciated the importance of the expedition. He first arranged that we should visit the tract of country where His Royal Highness the Prince of Wales and staff had recently shot tiger and rhino, but later proposed that we should enter the more inaccessible Gandak Valley, where there was a probability of our obtaining better specimens in a shorter space of time, once we got on the ground. But getting on the ground was not so easy. This interesting tract of country is cut off from the plains by ranges of broken hills, through which the Gandak River cuts a tortuous way to the plains, flanked in its course by a series of precipitous gorges. The valley is inhabited almost entirely by Tharus of a very fine type.

The only ways of entering the valley are by boat, towed up a swift-running stream, which takes two days, or on foot over the hills, where there is no road. In many places the trail resembles the dry bed of a mountain stream more than anything else. We took fifteen hours to do the first march of eleven miles. We came out by boat in five hours.

The Maharajah provided us with coolies and six elephants for transport, but although I have for the last fifteen years been accustomed to riding elephants over all sorts of country, the going was so bad that we did practically the whole march on foot, picking up on the way a very fine specimen of the Indian sloth bear, which luckily fell to a single shot from a .275 Rigby

Typical rhino country in the Gandak Valley of Nepal.—The female obtained by the Faunthorpe-Vernay Expedition was shot a short distance from the tree with broadly forked branches that is conspicuous on the right of the photograph

Rhino tracks deeply impressed in the soft soil

Mauser, the only weapon we had actually with us when we sighted the bear.

The Nepalese government keeps six or eight of its elephants in the Gandak Valley, near where we camped on the second day after entering Nepal, and some of the mahouts have the reputation of being expert rhinoceros trackers. We first started beating for rhino with elephants and drove out a female rhino with a small calf that lived in some patches of thorn and bush cover near the camp, which was on the river bank. We refused to shoot them, as the calf was very small and the cow had a very short horn, and we wished to make certain of obtaining good specimens. The trackers expressed surprise and regret. With this lady rhino, whom we met frequently and whom we called Lizzie, we became quite friendly, but I think she was glad when we left. Vernay on one occasion crawled up to her private mud bath and watched her at about four yards' range. Dyott with his movie camera sat over the mud bath for the next two afternoons, but Lizzie did not appear. She had a distinctly peevish expression when I last saw her.

The local trackers did not seem keen to show us big rhino, but a little heart-to-heart talk and the promise of good rewards to the trackers and also to the villagers induced the former to take us to a large solitary male rhino, that was located in a valley in the Sal Forest, containing heavy bush cover and several pools of water. This enormous

This rhinoceros, wounded by the first shot fired by Mr. Vernay, turned and charged him, but was dropped by his second bullet slate-colored beast, apparently quite unconcerned at the presence of several men in the trees who were watching him, allowed us to approach on elephants to within about seventy yards, from which range both Vernay and I fired, with the result that after galloping about a hundred yards, the rhino pitched over dead. He was a big and very old male, whose horn had been splintered and worn down to about 8 inches by digging or fighting. This rhino was shot several miles from camp, and the taxidermist and his satellites had to spend the night by the carcass.

The trackers were bitterly reproached because we wanted horns of at least 12 inches, and it was decided that it would be more sportsman-like and also more effective to stalk the remaining specimens on foot rather than to shoot at them from somewhat unsteady elephants.

The next day, after a fruitless expedition under the guidance of the trackers, we were informed by the villagers on our return to camp that a rhino had been seen drinking in a pool on the other side of the river. The energetic Vernay immediately crossed in a boat. I sat down and ordered tea.

Shortly after arrived the Nepalese Munshi (the District Officer's assistant), who had gone out with the local Nepalese Lieutenant to shoot birds with my gun. He brought us the news that there was a big rhino wallowing in a pool not far from the river, about a mile down stream. The Munshi was breathing heavily from excitement and exertion. His account of how they came to see the rhinoceros was amusing. He said he saw what he took to be a black water bird in the pool and said to the Lieutenant, "Give me the gun and I will shoot that bird." To which the Lieutenant replied, "Brother, if there is any bird shooting to be done, I will do it myself." They then approached the supposed bird under cover of the heavy jungle on the bank above the pool, only to find that it was the horn and ears of a rhino which lay soaking in the water.

I jumped into a boat and hustled down stream. It was rapidly becoming dark, and after a hurried scramble for about half a mile over most uncomfortable pebbles, I saw the rhino still in the water and managed to get up near him just as he was leaving the pool. This proved to be a fine male with a horn measuring 12½ inches. He had evidently been fighting and had festering incised wounds on flank and in stomach.

On returning to camp I found that Vernay had accounted for the other rhino, also a very fine male, with a horn more than 12 inches in length. This animal after being wounded had tried to charge him but had been dropped in the grass on the river bank by another bullet from his .465 Holland. I was using a .400 Jeffery rifle.

The great Indian one-horned rhinoceros is, of course, the biggest rhinoceros in the world. His horn is smaller than are those of the African rhinoceroses, either the black or the white, but in height and bulk he far exceeds the African species. The males we shot measured well over seventeen hands at the withers. The one-horned rhino is a curious animal to look at. With its shields and warty protuberances it has a kind of prehistoric appearance.

It seems to be extraordinarily regular in its habits. In the evening or late in the afternoon the rhinos of the region where we hunted emerge from the heavy jungle and wallow in the numerous pools and backwaters near the

Gandak River. They spend the night in feeding and in the early morning are to be found at the edge of the heavy covers, into which they retire during the heat of the day.

We had now obtained our male rhinos, and the unfortunate taxidermist had his work cut out. We had brought down from Lucknow a good Indian skinner, named Pancham, a servant of my old friend, the Ranee of Khairigarh, but we were able to find only a very few Chamars (low-caste Hindus who skin dead cattle) in the valley to do the rough work. The villagers are almost entirely Tharus.

We still had to obtain a good specimen of a female rhinoceros, but it was necessary to wait a day or two in order to enable the taxidermist to deal with the skins of the males.

Stimulated by the rewards which we had paid for the rhinos, an intelligent headman of one of the villages, assisted by the Munshi, who, by the way, spoke a weird mixture of Nepalese, English, and Hindustani, had volunteered to locate some tigers.

THE TIGER HUNT

We went out after a tigress next day and beat for her in a patch of tree and bush jungle, along the edge of the Gandak River. I posted Vernay on the point and put Dyott, with his movie machine, in the broad nullah that divided this strip of cover from the heavy forest. I myself took up a position on the edge of this nullah, to one side of the patch. The tigress, curiously enough, was not in the patch at all but lying in a little thorn bush outside it, and Dyott, when he got off my elephant with his movie camera to go and stand in the nullah, must have passed within two or three yards of her.

She rose behind me when the beat was nearly over, dashed across the nullah, and was knocked over by a lucky shot at about one hundred and fifty yards, but recovered herself and went on. Dyott was in time to secure a picture of her galloping up the bank. We put an end to her in the heavy forest not far from the bank. She had been practically crippled by the first bullet, which had hit her in the hind quarters. She was a beautiful heavy-coated animal measuring nine feet, and will be immortalized in the American Museum.

Another day we beat for a tigress farther north, also in a strip of heavy bush, thorn, and tree jungle, which narrowed down to a point to the south and was there separated by a broad nullah from the covers in which our friend Lizzie habitually lived. This tigress had come from the north and the trackers said it was impossible to beat her southward. On the other hand, there was no hope of obtaining a picture of her except by forcing her out to the south, for to the north the jungle broadened out continually and was impossibly thick with heavy thorn undergrowth. About fifty Tharus were enlisted for the purpose of beating and placed in batches between the six elephants with instructions to make a good deal of noise, while the Nepalese Lieutenant, armed with my gun, maintained an intermittent fire of shot cartridges. The tigress was forced out at the southern end of the jungle and galloped across the broad nullah, giving Dyott an opportunity of which he took full advantage, obtaining a beautiful motion picture of her dashing across the open, including the splashes of dust kicked up by bullets ineffectually fired at her. This tigress was now in the upper section of Lizzie's home, which we knew well.

RINGING THE TIGER

To ring the tiger (*Tigris tigris*) numerous elephants are employed in an encircling movement, one group going in a wide arc silently and in single file to the left and the other group in like manner to the right until the leaders of each of the two lines meet and the ring is complete. Then the elephants face inward, their riders begin to make a din, and the host of hunters converges upon the beleaguered animal. The circle becomes smaller and smaller. The tiger has secreted itself in the densest patch of jungle. The fateful moment has come. Two large tuskers are sent in to rout out the concealed beast. As they move cautiously toward the center of the circle, suddenly the tiger with a great whoof makes a bound for freedom. While the agitated elephants that form the circle hesitate whether to stand the charge or turn in flight, one of the four mounted gunners takes quick aim and fires, more often than not stopping the tiger in its tracks

THE PURPOSE ACHIEVED

After a tiger has been shot the rite known as *puja* is performed and every one gathers round to view the animal

BRINGING IN THE TIGER

Even in death the tiger is dreaded by many of the elephants that are used in hunting it and more than one elephant rebelled at having the dead enemy placed upon its back. The elephant in the picture stoically accepted the burden.

The Indian elephant is an exceptionally intelligent animal and invaluable when progress is to be made through the jungle. Even when full-grown trees stand in his way they are no obstacle to his advance, for he has been taught to bring his great bulk to bear against them and uproot them. Steep banks he climbs and descends with caution, testing the ground before taking action. Though his weight may equal that of thirty-five or forty men, he moves through swampy ground with comparative ease because of the fact that his foot contracts as soon as pressure is relaxed, enabling him to lift it out of a hole in the mire without suction resulting

AN EXCEPTIONALLY FINE TIGER

The power of this animal is still apparent even though it has been deposed from its rule in the jungle and has become a museum specimen.

In the tiger group that is to find place in the Asiatic hall of the American Museum, specimens obtained by the expedition will have their reincarnation. Two cubs are still required to complete the group as planned, but the tiger and tigress that are to be the center of interest are available, thanks to the marksmanship of the members of the expedition. The animals will probably be shown drinking at a stream in a jungle thicket, with the tall grass densely massed so as to form a background

Dyott was then posted with his movie camera on a fallen tree in the center of an open space to the south, while Vernay and I on elephants took one corner each. The tigress, came out first of all, in front of Dyott, but withdrew in horror when he started turning the handle. He secured, however, a brief picture.

She then tried each corner in turn and found both stopped; the final shock to her nerves came when, upon showing herself, she was immediately charged with violence by my elephant. With morale absolutely shattered she then made a bee line to the Gandak River and swam across this swift and broad stream. We did not grieve over her escape. We did not want her as a specimen, and she had given us a film probably unique in the history of cinematography.

RESUMPTION OF THE RHINOCEROS HUNT

Having now given the skinners two or three days of comparative rest—for a tiger is a mere trifle to cope with in the taxidermy line—we got two female rhinos marked down to the south of camp, about five or six miles away. The first one retreated into impenetrable thorn scrub, but after wading through a swamp, we found the second standing in a dense clump of low trees. She had a half-grown calf with her, which was wandering about making most extraordinary noises, resembling the squawking of some large bird. We could see the mother dimly through the saplings, and Vernay stalked her on foot and shot her through the neck, at a range of about twenty yards, killing her with one bullet. The neck shot is the most deadly for rhino, aim being taken between the deep neck creases, which are such a marked feature of this curious animal, about two-thirds of the way up the neck. For this shot a soft-nosed bullet is best. The rhinoceros proved to be a fine specimen, but her horn was much worn down, measuring only about 8 inches. The taxidermist outfit spent another night out with this specimen, as in the darkness they could not return through the swamps. The Tharus built shelters of branches for them.

It was now March 14 and getting fairly warm and the skins were giving us some anxiety, as portions of the epidermis had begun to slip on one of them, but with a liberal application of a mixture of salt and alum this deterioration was arrested and, I believe, they arrived in New York in practically perfect condition.

We came out of Nepal by boat through most picturesque scenery. The river is frequently flanked by precipices and in places runs very swiftly through the gorges. Where the river bed widens, there are banks covered with crocodiles of both species, and some good films were obtained on the way down.

THE ELEPHANT HUNT

Our next trek was a long and weary one to the Billigirirangan Hills, which lie partly in Mysore territory and partly in the Coimbatore District of the Madras Presidency. This is the country described by Sanderson in the well-known book[1] in which he tells of his life among wild animals while in charge of the government kheddah operations.

Our ground was more than seventy miles from the railway. It is a charming tract of country averaging about 4500 feet above sea level, with the higher hills running up to 6000 feet.

We were dependent here on the help of the coffee planters, especially Cap-

[1]*Thirteen Years Among the Wild Beasts of India.*

tain Fremlin and Mr. Ralph Morris, who made all arrangements and provided us with skilled Sholaga trackers. We went up into the hills some seven miles from Morris' coffee estate, to a spot where he had built grass huts in a shola close to one of the many routes used by the herds of wild elephants. But the first tusker elephant was bagged before we went there. Two elephants had been for some time haunting Fremlin's coffee estate and the neighborhood. One was a muckna, or tuskless elephant, and the other a large tusker with one tusk only. It was decided to shoot the latter for the skeleton series in the American Museum, and he fell to Vernay's rifle on the day of our arrival. The Sholagas were pleased, for this elephant used to come and ravage their banana plantations. The lament, "Yes, we have no bananas" in Canarese (a most unmelodious language) was often heard in the land.

We regretted afterward that we had not shot the muckna instead for the skeleton, as he was a magnificent elephant,—I think the finest I have ever seen, either in the wild or in captivity. An elephant has as many points as a horse, and this huge muckna was not only perfectly shaped, but had a smooth and effortless action, reminding one of a really good race horse. It is extraordinary how noiselessly a huge beast like this can move through heavy forest and how invisible he is when standing motionless. When in movement he resembles a shadow and when at rest might well be mistaken for one of the big gray rocks which are abundant on the hillsides.

Warned by our difficulties with the rhino skins, we were taking no chances with the elephant hides. In addition to Jonas, the American taxidermist, we had Pancham, the Ranee of Khairigarh's skinner, four expert Indian skinners provided by Van Ingen, the taxidermist of Mysore, and twenty Madigas, low-caste men similar to the Chamars of Upper India, to do the rough work. We also had ropes and pulleys to enable us to turn the elephant's body over when necessary.

An elephant is skinned in three pieces; first the head and neck are stripped and then the body skin is taken off in two pieces by skinning down the backbone and along the center of the stomach. There still remains a good deal of work as the skin is of great thickness and has to be considerably pared down.

When on the way to the grass-hut camp at Hool Patchi Hulla we were lucky enough to fall in with a large herd of wild elephants, which contained no really big tusker (for these are generally found living solitary or semi-solitary lives) and obtained some wonderfully fine cinematograph pictures, including one of a tusker that came so close to the camera that a rifle had to be fired into the air to turn him off. This herd eventually left the shola in which they were temporarily staying and made off at a rapid pace down one of the beaten tracks which the elephants have made and regularly use in this neighborhood. These elephant tracks are, in fact, the only paths of any kind available in these jungles.

Our big tusker specimen was a stranger that arrived one day from some distance and was reported by one of the Sholagas as having taken up a position under a large and shady tree in a valley two or three miles from our camp. Making a very early start the next morning, we found him within a few hundred yards of this spot. Rain had fallen and the forest was open enough to

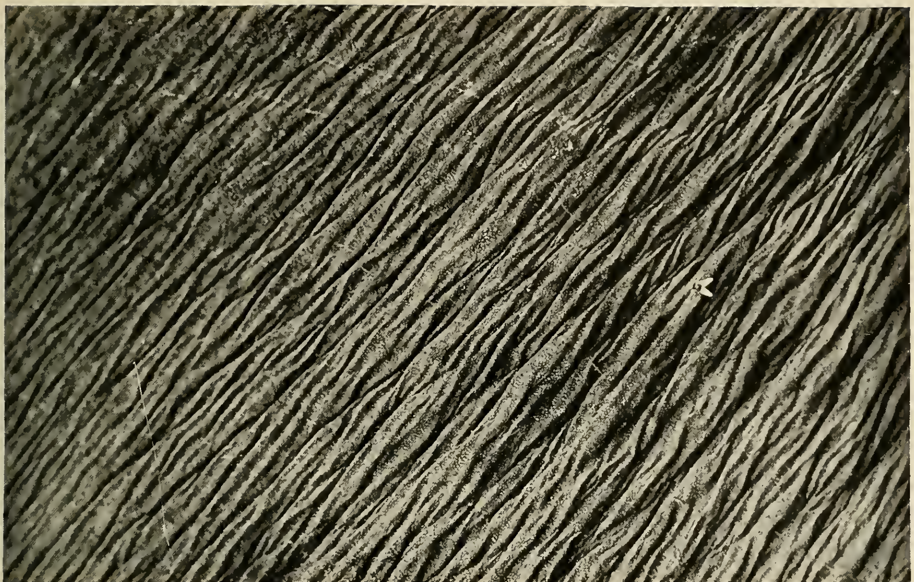
This tusker (*Elephas maximus*) was shot at a distance of not more than forty yards. He sank into a sitting posture and even in death, which was practically instantaneous, looked singularly lifelike

enable us to see from some distance this magnificent animal loafing slowly along on the hillside, plucking and eating a branch at intervals. The stalk was an easy one on the damp ground and we got up to within forty yards without any difficulty. We were slightly to his left rear. We had arranged that Vernay should take the brain shot. I supplemented this by one behind the shoulder, but Vernay's .465 bullet had reached its mark. This magnificent tusker slowly extended his forelegs and then slowly sat down, stone dead. He was supported in a sitting position by a stout tree and as he sat there dead, looked singularly lifelike.

I have had so much to do with tame elephants that I never wanted to shoot one, and we both regretted having to destroy this splendid animal. We took comfort, however, from the thought that he will attain something near immortality when set up under the Akeley process of taxidermy in the American Museum, where he will be a worthy counterpart to the fine African tusker in the group prepared by Mr. Akeley. It was with even more regret that Vernay later shot a very fine female elephant. This completed our elephant group, namely, one tusker and one female, and one tusker for the skeleton.

THE BISON HUNT

Owing to the grass having been very little burned, bison tracking was difficult, but on March 30, a big solitary bull was located in the lower



The elephant, when viewed at close range, looms so large that one is apt to have one's attention absorbed by his bulk and proportions to the neglect of the details of his anatomy. Yet a closer examination reveals many points of interest. In the upper picture is shown a section of the hide, rugose and tough in character. The head of the animal is not bald but, as indicated in the lower picture, is covered with a rather plentiful growth of upstanding hair country. To approach him involved not only climbing an awful mountain, which almost invariably had to be negotiated before one could get anywhere, but also walking along the ridge with a similar descent at the other end. I shall never forget that mountain. Walking up and down hill never was one of my favorite recreations; Vernay seems to enjoy doing so.

The Sholaga trackers took some time picking up the bull's tracks and by the time they did so the sun was well up and we had to hurry, as the bull, they said, was making for some heavy cover where he would probably lie for the day. After crossing a couple of low ridges we came up with him on a steep hillside. The stalk down hill was a simple one and he was disposed of without difficulty, a fine old black solitary bull with horns measuring more than 20 inches in girth at the base, but considerably worn and splintered at the tips.

SLOTH BEAR, TIGER, AND LEOPARD

We still had to get another bison bull, a cow, and a calf. These Vernay and Morris undertook to shoot and, as it was now April, I was anxious to get up north in order to secure the required specimens of sloth bear, tiger, and leopard. There was also a better prospect of getting good cinematograph films, especially of deer, up north.

Dyott and I left the Billigirirangan Hills and made the long and wearisome journey up to Oudh. Here we were joined by Turner, the Forest Officer, and by Kunwar Dillipat Shah of Khairigarh. Turner undertook to arrange cinematograph pictures of deer in a small block of outlying forest, which had been carefully kept undisturbed. Dyott and he put in three or four days of strenuous work and obtained some really good pictures of herds of chital, antelope, and nilgai.

In the meantime Dillipat and I were concentrating on getting a bear group, and at first were singularly unsuccessful, not because there were no bears about, but because we seemed to be unable to hit them. Very few elephants are steady to bear, and those we had were not. Dillipat is, as a matter of fact, an exceptionally good shot at a running animal, but both he and I missed several bears before I eventually hit a large male in good coat, worthy of being included in the bear group in the Museum. This bear, when hit, stood up and bit through a sapling before he fell dead. The female bear we had previously obtained in Nepal when after rhinoceros. Turner shot another very big bear, which, although it had a bad coat, was desired for the skeleton series.

The sloth bear is a very bad-tempered animal and will frequently attack human beings absolutely unprovoked, as will also the wild boar at times. The jungle people are much more afraid of the sloth bear than they are of the tiger and leopard.

One day we were beating ratoa grass patches (ratoa is a very dense grass somewhat resembling sugar cane) for bear when the elephants gave sign of the presence of tiger and I was fortunately able to shoot a fine male in good coat, measuring 9 feet 8 inches, which was immediately earmarked for the Museum tiger group. I also shot a very fine leopard close to camp one evening.

Quite by chance I found one morning a place which provided us with very beautiful pictures of deer and pig coming down to drink at a pretty little pond just inside the forest. I saw a herd of chital there and we found a tree in which Dyott could sit with his movie camera and command the pond. He spent about three days in this tree, and the results are, I think, the most beautiful cinematograph pictures I have ever seen.

On April 19 we were joined by Vernay, who brought with him—as I had a shooting pass for tigers and certain other game in Nepal across the border—Fremlin and Morris, the coffee planters who had been so good to us in Mysore. They had shot tigers before but never had seen the method of beating them out with elephants, which is practically the only method employed in my part of the country. They secured three tigers.

Vernay had, as anticipated, completed the bison group in addition to shooting a big leopard, and had safely delivered the skins and skeletons of bison and elephants to Van Ingen of Mysore, who undertook to pack them for shipment to New York.

No one who has not seen the enormous size and weight of a big elephant's bones and hide can appreciate the labor involved in transporting them across country. We were about 5000 feet up in the hills and the whole collection had to be carried six miles by coolies and twenty miles by bullock carts. For the balance of the distance to the railway, motor lorries were fortunately obtained. It required a good deal of organization.

Curiously enough, although leopards are numerous in that neighborhood, we failed to obtain a female leopard and two cubs, which were wanted for the group, although we spent some time trying to get them. Conditions had been unusually wet at the time when the grass outside the fire-protected forest is usually burnt, and the leopard, extraordinarily skillful in concealing itself and evading the line when being beaten with elephants, had us at a disadvantage.

Dyott had an interesting experience one day. One of my men who had been sent to a place eight miles away came in with the local forest guard and reported that early that morning they had seen a large tiger asleep by a pool of water near a patch of ratoa grass just inside the forest. It was a terribly hot day but it was decided that, if the men thought it worth their while to walk eight miles, it was up to us to go and investigate matters.

Four elephants—all that were available—were therefore sent off at once and Dyott and I followed in a light Overland car, which is a first-class conveyance over unmetalled roads and forest tracks.

The tiger, which, judging by the smell, had a kill in an extremely high condition, was duly aroused, ran out of the grass, and stood in the forest with his head and shoulders concealed by a

A chital faun.—This beautiful animal (*Axis axis*) retains the white markings in the adult stage and is popularly known as the spotted deer. The chital is inclined to be gregarious in habit and this little faun showed no timidity when handled by its captors

Typical tiger country on the Nepal border

One day a tiger, though wounded, succeeded in secreting itself in the high ratoa grass. Four elephants moving abreast were directed toward the area where the tiger was supposed to be. Colonel Faunthorpe, gun in readiness, was mounted on one of them. Suddenly the tiger jumped from its place of concealment right up on the elephant's head, but its claws had scarcely touched the thick hide when it dropped back dead, shot by the Colonel in a vital spot. The picture shows the elephants approaching the place where the tiger lies crouched, invisible in the high grass tree. I was, therefore, compelled to shoot him through the center of the body instead of getting a deadly and crippling shot at the center of the shoulder, which is the most effective shot of all, as it not only brings the animal down with a broken shoulder but also kills him.

The wounded tiger dashed back into the grass, where we hunted for him for some time without his showing a sign. The men, who had had a long trek in great heat, were getting rather disheartened, especially when one of them found a bullet mark in a tree where the tiger had been standing when I fired.

Examination proved, however, that this was merely the base of the nickel-covered soft-nosed .400 bullet, which had clearly, therefore, gone through the tiger. The men, of course, did not believe this, but we went on beating up and down this extremely dense grass. I was, personally, confident that the tiger was either lying very close in it or was actually dead, and the grass was so thick and matted that had he been dead, he might easily have escaped notice. We were beating the grass for the third time, when there was a sudden snarl and a rush at the edge of the grass and the tiger jumped on the flank elephant and clawed her severely across the top of the trunk. The beast was now located. There happened to be a forked tree close by, into which Dyott climbed and lashed his movie camera.

The four elephants were formed in line and, with extreme reluctance, advanced on the place where the tiger had settled down. Each mahout was trying to keep a little bit behind the others. They were eventually persuaded to advance with a little more speed and the tiger, with another snarl, jumped right up on to my elephant's head, but a snap-shot, as he landed, took him between the eyes, a very lucky fluke which saved old "Lachma" from a severe mauling. She received only one almost invisible puncture from a claw. Throughout she stood like a rock, otherwise I should no doubt have missed the tiger.

Not always is the tiger ringed or driven out of the jungle by the heavy approach of elephants. Another method of hunting is to place a platform, known as a *machan*, high up in the fork of a tree and from that point of vantage await the return of a tiger to his kill

While this was going on Dyott was turning the handle of the movie camera. We hoped for a wonderful film. It is one of the greatest disappointments of my life that, owing to the height of the grass, the tiger does not show in the film when on the elephant's head, though one can clearly see that something has charged the elephant and has been shot.

A common Indian squirrel (*Funambulus*)

CONCLUSION OF THE SEASON

The expedition concluded its work with a visit to Burma, where the Governor, my old friend Sir Harcourt Butler, gave us every possible assistance.

We wanted groups of tsine, an animal akin to the Indian bison, and of the thamin, or brow-antlered deer, and succeeded in getting both in the Magwe District. We also obtained a group of the barking deer and added several interesting specimens to our collection of the smaller mammals, birds, and reptiles. We did not succeed in finding a hamadryad, but secured several specimens of that beautiful but dangerous snake, the Russell's viper.

It took a lot of work on foot to get the tsine. In fact, I think this animal is the most difficult to stalk that I have ever met. He is very active and when grazing and wandering about, appears to move much faster than the bison, and when he has settled down for the day, is so wary that it is almost impossible to approach him. Hunting the tsine was really hard work, and it was infernally hot.

The bamboo rat (*Rhizomys*) of Burma lives in holes in the ground under bamboo clumps

Our work for the season was now complete. The collection totals about 450 specimens, of which 129 are mammals. We have also some 26,000 feet of cinematograph film, including many animal pictures which I believe to be absolutely unique. Nor was the cinematograph work confined to shikar subjects. We took a very large number of pictures illustrating native life, which, when shown in America, will lead to a better comprehension of the true condition of India and Burma. The movie camera used was an "Akeley," which, because of its simple and rapid elevating and traversing mechanism, is by far the best for this kind of work.

We obtained groups of all the larger animals of the plains of India, with the exception of the Indian buffalo and the Indian lion, and we hope to secure these this year.

The expedition is not over. Vernay is now going from Moulmein on the coast of Burma across the Ta-Ok

Plateau, which lies partly in Burmese territory and partly in Siam, to the Meping River and thence to Bangkok, and hopes to obtain some valuable specimens. The Ta-Ok Plateau is very little known and has never been properly explored from a natural history point of view. It is believed to be particularly rich in birds, and an ornithologist, obtained from the British Museum, is accompanying the expedition. I, myself, shall probably visit India to complete the Indian collection this year and it is possible that both Vernay and I may also visit French Indo China.

As for the collection made in India, Burma, and Nepal last year, complete groups were obtained in nearly all cases and the collection as it stands is probably unique for this reason.

The elephant, bison, and rhino specimens are exceptionally fine ones and both the tiger and tigress are unusually good specimens, with good coats. Among the deer, we have several specimens which approach the record in horn measurement; for instance, a 39½-inch swamp deer and a 38-inch spotted deer.

In addition to the mammal groups, numerous specimens of reptiles and

The blackbuck (*Antilope cervicapra*) is one of the most beautiful of the Indian antelopes. The popular name does not apply to the young males. These are tolerated by the lord of the herd until they begin to turn black, when he forces them out of the family circle birds were collected—some of the latter in particular being of rare species. We made particular efforts to obtain the pink-headed duck but the nearest we came to this rare bird was hearing of one which had been eaten by a planter two years before. Renewed efforts are being made this season to obtain it and, if it is not extinct, I am not without hope that a specimen may yet be secured.

It only remains to add that, with the exception of three or four tigers and here and there a specimen required by Mr. Vernay for his private collection, we shot nothing which did not go to the American Museum. And we are proud to be able to say that not a single animal got away wounded.

Russell's viper (*Vipera russellii*), a beautiful but dangerous snake, of which the expedition secured several specimens

Stalking Tsine in Burma

By ARTHUR S. VERNAY
Joint Leader of the Faunthorpe-Vernay Indian Expedition of 1923

ONE of the objects of the Faunthorpe-Vernay Indian Expedition of 1923, was to obtain representative groups of the bovines of the plains of India, and also of Burma. To accomplish this purpose it was necessary for us to secure specimens of the gaur (*Bibos gaurus*)—known to sportsmen as the Indian bison,—the banting or tsine (*Bibos banteng*), and the buffalo (*Bubalus bubalis*). The mithan (*Bibos frontalis*), which in parts of Assam is domesticated and even in its wild state breeds very freely with tame cattle, we did not consider worth pursuing. The yak (*Poëphagus grunniens*) we excluded because its habitat is principally Tibet and northern Ladakh, and these regions on account of their remoteness did not figure in our plans. We were fortunate in being able to obtain in Mysore magnificent specimens for a group of the gaur. The buffalo requires a special bandobust; this has been arranged for and will take place in the spring of 1924, when, it is hoped, the material necessary for a group may be secured. The tsine we decided to hunt for in the dry zone of Upper Burma.

I had a good deal of experience two years ago, and during the last year, in pursuing the gaur and found this animal sufficiently wide-awake to require considerable effort on the part of the hunter. The ground where we hunted, the Billigirirangan Hills, southern Mysore, which lie partly in Mysore territory and partly in the Coimbatore District of the Madras Presidency, is the country which Sanderson described in his book, *Thirteen Years Among the Wild Beasts of India*, in which he writes of his life while in charge of the keddah operations of the government. Our actual hunting ground was seventy miles from the railroad, in a country of irregular steep hills, from 4000 to 6000 feet above sea level. One can readily imagine that a wild country of this kind with obstacles in the shape of precipitous hills and heavy jungle make the tracking of bison a somewhat arduous but at the same time fascinating pursuit.

Colonel Faunthorpe and I came to the conclusion that it was pretty stiff going, and that the bison is a wily and difficult animal to stalk. However, the bison is a mere novice in comparison to the tsine. I had heard from a friend of mine who had previously hunted tsine, of the difficulty of tracking them. He had told me that he considered the tsine the best sporting animal of the bovine family, for apart from being gifted with a wonderful sense of smell, perfect eyesight, and acute hearing, it is of a most uncertain temper and, even when unwounded, is liable to charge on sight, and, when wounded, will fight to the very last. Consequently, after finishing our shoot in India, it was with great interest that we journeyed to Burma to hunt this animal.

We arrived in Rangoon in May, hoping vainly that the rains would descend so that tracking might be easier. Going up the Irrawaddy to Migyaungyi, we turned east to Taungdwingyi, where we fitted out and proceeded through the jungle to a place called Zilon. The weather still continued fair. We hunted for several days without result, and decided that we

WHERE THE TSINE IS AT HOME

To pursue the wary animal through the trackless bamboo jungle that is littered with windfalls of hollow stems, hour after hour in the heat of the day, requires patience, endurance, and no small measure of devotion to one's task

would move our camp to a place called Shweban; and here the serious tracking began. Unfortunately the rain would not come, a condition which made tracking extraordinarily difficult. The ground was dry and hard, with the result that tracks showed very indistinctly, making pursuit extremely baffling, for the tsine, being almost always on the move, naturally goes a great deal faster than the tracker. If by chance the wind is in the wrong direction, all one hears is a loud snort as a huge animal crashes through the jungle. That is the end for the time being of one's efforts; the only thing one can do, once the tsine has been alarmed, is to rest for an hour and a half or two hours without making any noise whatsoever, and then again take up the tracks with the hope of coming up to the animal. Notwithstanding, we eventually secured one good herd bull, but what we wanted was a fine old solitary bull, which is of a chocolate color, the herd bull being of a pale brown, somewhat like the brown of the Ayrshire cow.

Generally in hunting the tsine, it is necessary to start before daybreak so as to get on the tracks made during the night. Quiet going is extremely difficult as one follows these tracks through the jungle, which is, as a rule, bamboo, and is cluttered with leaves and with windfalls of the hollow stems. One morning we started out at 4 A.M., and at about 7 o'clock came upon the tracks of what must have been an enormous solitary bull. The mere fact of seeing such large tracks is exciting in itself. One mentally compares the hoof marks with other bull tracks one has seen, and visualizes the size of the animal that made them. After stalking this bull for an hour, we came across the tracks of a smaller bull, and a few yards from the point where they had met were the evidences that a battle had been waged. The tsine, always ready

The tsine is one of the members of the bovine family that was especially desired by the Faunthorpe-Vernay Expedition and that proved more elusive and difficult of pursuit than most of the other big-game animals collected by this expedition to fight, had come face to face with an antagonist of his own stamp, and the issue had to be decided there and then. The whole place was trampled down; small trees were crushed and broken; large trees were scarred; bits of bark, which had been ruthlessly torn from the wood, hung down like great brown ribbons; and the ground bore the imprint of a multitude of hoofs. Eventually, the signs indicated, the smaller combatant had been driven off, and the solitary bull, doubtless still snorting with anger, had gone on his way victorious. The record of happenings in the jungle can be read by any one used to hunting. In the case of tiger, elephant, rhinoceros, and bison, the various struggles, the hours of sleep, and the hours of standing still and feeding are all indicated, but this was the greatest evidence of battle I had ever seen.

We were cheered by the thought that the solitary bull must be tired after all this fighting and we took up the pursuit hopefully. We followed on and on. The sun was hot, and no glimpse of the animal rewarded our efforts. At 5 o'clock, after having made a huge detour (and one can never know exactly where one is going in this bamboo jungle maze), we came back to exactly the same spot where the old bull had fought the battle. He had started out probably satisfied that he had given his foe a thorough beating, but on mature consideration had decided to return to the place of combat and see if his adversary required any more attention. Apparently he did not; but our expressions of disgust, if repeated, would

Native helpers enjoying a brief respite in the course of the day's tramp shock the reader. Apart from the physical fatigue, we had no ambition to continue the pursuit because we figured the bull might repeat the performance, and that would become rather tiresome. Also we thought that eight hours of solid tracking of this particular animal entitled him to exemption from further annoyance.

We obtained besides the herd bull a fine specimen of a cow, which is to be used in the American Museum group. Still the rain did not come; as a result, during twelve days we tramped over more than 200 miles tracking tsine, and only saw the two which we shot, although we heard several others of which we did not get a glimpse.

As our next expedition into Siam will give us the opportunity of obtaining a large bull including its skeleton, we decided to go back to India and catch our boat for England. I left, having the greatest admiration for the tsine and with an ardent desire to come to close quarters with him once again. I hope when the next hunt takes place it will be raining.

The home of the tsine is throughout Burma and the Malay Peninsula, as well as in Sumatra, Siam, Borneo, and Java. The tsine is very like the gaur, but with a smaller dorsal ridge and legs that are longer in proportion to the body. The color of the cows and young bulls is a rather bright reddish brown, but it varies greatly. The old bulls are darker, but not black as is generally asserted. Both sexes have a whitish oval area on the buttocks extending to the root of the tail. The tsine, which is about 5 feet, 4 inches at the shoulder, shows a greater preference for the grass plains and the flatter bamboo jungles than does the gaur, and although an extraordinarily good climber, is not quite such an adept as the latter. If any sportsman has the ambition to test his patience, determination, and skill in tracking, I suggest that he visit the habitat of the tsine. He will then have every opportunity of testing himself out, and if he obtains a good specimen, I think it will be placed in his trophy room as the most treasured of his acquisitions. The tsine asks no quarter and gives none, and though the hunt ends successfully, one cannot but regret that such a fine animal has been killed; at the same time the trophy serves as a reminder of a great event in a sportsman's life.

This structure, typical of the architecture of Burma, brings to mind the settlements of that land just as the tsine recalls the bamboo forests and life in the open

The Disappearance of Wild Life in India

By LIEUTENANT COLONEL J. C. FAUNTHORPE

Although much of the wild life of India has disappeared and what has survived is in jeopardy, the Faunthorpe-Vernay Expedition has made possible the perpetuation in the form of lifelike groups of a number of animals that might otherwise to a large extent have passed out of ken. Altogether it obtained 450 specimens, of which 129 are mammals.

It was particularly fortunate that Messrs. Faunthorpe and Vernay when in the field, chose with a rare sense of discretion just the representatives of this magnificent fauna that President Henry Fairfield Osborn was most anxious to have on exhibition in the Museum's new Asiatic hall. Especially noteworthy among these are: Indian elephant (*Elephas maximus*), one-horned rhinoceros (*Rhinoceros unicornis*), gaur (*Bibos gaurus*), chital (*Axis axis*), thamin (*Rucervus eldi*), sambur (*Sambur unicolor*), the swamp deer (*Rucervus duvaucelii*), tiger (*Tigris tigris*).

Other invaluable contributions are a bull and cow tsine (*Bibos banteng*), nilgai (*Boselaphus tragocamelus*), and blackbuck (*Antilope cervicapra*). Among the series of deer we cite the barking deer (*Muntiacus muntjac*), the hog deer (*Hyelaphus porcinus*), and the pygmy musk deer (*Tragulus*). The Artiodactyla also include the Indian gazelle (*Gazella bennettii*) and fine horns of the ibex (*Capra sibirica*). Besides the tiger mentioned above, there are other carnivores, such as the leopard (*Panthera*), hyæna (*Crocuta*), sloth bear (*Melursus ursinus*), wolf (*Lupus pallipes*), jackal (*Thos aureus*), and a number of smaller forms. A few bats, rodents, and Primates bring this collection up to about forty-two species.—Herbert Lang.

In a previous article of this issue I stated that within a measurable space of time there will be practically no game left in India, except in preserves maintained by native chiefs and in certain of the more inaccessible tracts of Government Forest Reserves. I believe that this statement is no exaggeration. Causes of the disappearance of wild mammals, and of game and other birds are as follows:

1. The destruction of the jungle in which they live, owing to the expansion of population and the placing of larger areas under cultivation.
2. Disease.
3. The demand for skins and feathers by the fur and plumage trades respectively.
4. Destruction of game by firearms.

I shall deal with these causes *seriatim*.

THE DESTRUCTION OF JUNGLE

In many parts of India the disappearance of game was inevitable as population increased and all the arable land came under the plow. There are now large areas where cultivation is so universal that there is not even enough waste land to provide grazing for the village cattle, which in many heavily populated districts are now stall-fed. This cannot be helped nor, indeed, is it to be regretted: there is plenty of jungle left.

DISEASE

Owing to the fact that the Hindus, who form the majority of the Indian population, consider the cow to be a sacred animal, enormous numbers of feeble and worn-out cattle are kept alive. Foot-and-mouth disease is common; rinderpest occurs less frequently. When fodder and water are scarce, the village cattle are pastured in the jungles, where they would not usually penetrate, and may communicate these diseases to such wild animals as are susceptible to them. In times of famine, the government must necessarily throw open to cattle reserved forests which in normal times are closed to grazing.

In the great famine of 1897, when practically all the drinking water, except in the larger streams, dried up over large areas in the forests of the Central Provinces, as described in Kipling's *Jungle Book*, cattle and wild animals had to use the same drinking places, and the buffalo (*Bubalus bubalis*) and bison (*Bibos gaurus*) were attacked by rinderpest and much reduced in number. In most of the forests of the Central Provinces the bison have recovered, but the mortality among the wild buffalo, a rarer animal, was greater, and even now buffalo exist only in small numbers. In the Biligirirangan Hills in southern India, where the Faunthorpe-Vernay Expedition obtained specimens of bison and elephant for the American Museum, there was considerable mortality among the bison two or three years ago. Cattle infected with foot-and-mouth disease had been pastured in remoter jungles than usual.

I remember, also, local epidemics of foot-and-mouth disease among antelope and swamp deer. The mortality, however, from this disease is not very high. Only a certain proportion of the animals are attacked and it is probable that of these some recover. Disease alone will never exterminate the game of India.

THE FUR AND PLUMAGE TRADE

Few Indian animals have valuable fur, and not so many, therefore, are destroyed by the pelt hunter as in some other countries. Demand, however, creates supply, and if there is a popular desire for the skin or plumage of any animal or bird, the effect soon becomes noticeable. For instance, about ten years ago the skin of the snow leopard (*Uncia uncia*) became fashionable in England as a fur, and the result of this has undoubtedly been to diminish very largely the number of snow leopards in India and across the border. This animal lives only in the higher hills of the Himalayas, most of which are beyond the British border, but native hunters from Thibet and elsewhere bring skins of the snow leopard to certain markets in British territory. Such a skin is now worth, in the local markets, about four times as much as it was fifteen years ago, and even so it is difficult to buy good skins.

The demand for the white egret's plumage (that of the *Herodias alba*, *intermedia*, and *garzetta*) brought about the almost complete extinction of these beautiful birds. Wandering gangs of plumage hunters used to scour India for them. Their *modus operandi* was to catch one with bird-lime and peg it down on the ground. The other egrets in the colony would then fly around the tethered one and were caught in nets without difficulty and killed. As the plumage develops only in the breeding season, when the young are dependent on the parent, the extermination of the birds was rapid. Legislation was introduced eventually, prohibiting the export of egret feathers, and I am glad to say that in a few places the plumage-bearing egrets are now on the increase. I find, however, that egret plumes, like whiskey, are obtainable in New York.

DESTRUCTION OF GAME BY FIREARMS

The disappearance of game is frequently ascribed to over-shooting by sportsmen, but moderate shooting by sportsmen will never exterminate game, because the sportsman does not kill females or immature males and does not take game in the closed season. When game is exterminated in places where suitable cover for it remains, it is, as far as my experience goes, invariably due to the ravages of the local pot-hunter. The number of guns in the villages has of late years greatly increased; the use of modern rifles by Indians of the upper and middle classes has become common; and the rules about the closed season, etc., have practically become a dead letter. In the Lucknow Division, the District Officer of Sitapur District told me recently that partridges, both black and gray, formerly abundant, had been almost exterminated. In the Hardoi District of the Lucknow Division, the Indian antelope (*Antilope cervicapra*), formerly abundant, is now very rare. I made careful inquiries last year in several districts where the great Indian bustard (*Choriotis edwardsi*) used to be found, but was unable to come upon anyone who had seen any of these birds recently. The pink-headed duck (*Rhodonessa caryophyllacea*), which is a nonmigratory bird with a very local habitat, is either extinct or very nearly so, and this fate will no doubt overtake other nonmigratory ducks and other edible birds.

In the Nepal Tarai, the low-lying tract of country between the Himalayas and the British border, it is extremely unusual to see any deer at all. These have all been shot out by the Tharu villagers, who, armed with guns, have been accustomed to sit in trees over every game path and drinking place. The Carnivora now live practically entirely on cattle. The swamp deer (*Rucervus duvaucelii*) in some of the best grounds in the Kheri District of the Lucknow Division have similarly suffered from the proximity of Tharu villages, and in the Kheri District it is now only in the preserves of the Rani of Khairigarh that this rare and beautiful animal is found in considerable numbers.

In the Magwe District in the "dry zone" of Burma, where the Faunthorpe-Vernay Expedition went in search of the brow-antlered deer, or thamin (*Rucervus eldi*), we found these beautiful animals very scarce indeed, and in many jungles in which they undoubtedly occurred in large numbers a few years ago, not a single specimen is now to be seen.

In several districts in the United Provinces, the Indian gazelle, or chinkara (*Gazella bennettii*), has been largely reduced in numbers by netting. This animal lives in ravines. A net is placed across a steep ravine and the gazelles are driven into it. A similar method is employed for antelope, which are first forced or maneuvered into a field of millet, or other high crop, and then driven into a net erected around one corner of the field. The destruction thus wrought is, however, trifling compared to the damage done by firearms. Netting will not exterminate game.

The great Indian one-horned rhinoceros (*Rhinoceros unicornis*), formerly abundant in the swampy country of the Tarai all the way from north Oudh to Assam, now survives in British territory only in a small portion of the Assam province. Its survival in certain tracts of Nepal is due solely to the fact that in that country it is considered royal game and is rigorously preserved. And even in Nepal it is, I believe, rapidly diminishing in numbers. In Burma, where the *Dicerorhinus sumatrensis* and *Rhinoceros sondaicus* both occur, there is demand for their flesh and, on the part of the Chinese, particularly for their horns, which Mr. Douglas Burden tells me are also in demand in French Indo

China. As a result these mammals have been slaughtered to such an extent that last year the Burmese government prohibited the shooting of rhinoceros altogether. Whether this prohibition will be effective, in view of the difficulty of supervision over the tracts where these interesting animals still survive, remains to be seen. A native forest guard requires a lot of supervision, and a gift of rupees or meat by the poacher naturally appeals to him.

The Governor of Burma, Sir Harcourt Butler, has, however, given special permission to Mr. Arthur S. Vernay, who is now collecting for the American Museum in Burma and Siam, to take specimens for that institution. If Mr. Vernay can get these rhino specimens, he will be lucky.

CONCLUSION

From the above remarks it will be seen that in places where suitable jungle for animals still remains—and there are many such localities—the only cause which can lead to the extermination of game is the more or less unrestricted use of firearms by the natives. As things stand now, there is very little game in British India (I am not referring to the native states) except in the Government Forest Reserves. These are likely to be provincialized, and who can tell what will then be their fate? Especially as (I quote from a recent report to a Royal Commission) "it is not unlikely that the lawyer will soon dominate the political world in India." Government Service in India is becoming increasingly unpopular—with the causes for this it is unnecessary to deal in an article of this kind, but the disappearance of wild life in India is one of the reasons why.

The chital (*Axis axis*) one of India's most characteristic animals

Fossil Animals of India

THE IMPORTANCE OF THE COLLECTIONS MADE BY THE SIWALIK HILLS INDIAN EXPEDITION UNDER BARNUM BROWN

By W. D. MATTHEW
Curator of Vertebrate Palæontology, American Museum

INDIA today vies with central Africa as the home of many magnificent types of large mammals. Yet its great game animals, hardly rivaled elsewhere in the world, are but a pitiful remnant in comparison with the fauna that inhabited the country toward the close of the Age of Mammals. These extinct animals are principally known from the fossils preserved in the Siwalik Hills, or Sub-Himalayan ranges, south of the main range of the Himalaya Mountains, and hence are generally called the Siwalik Fauna. This fauna has been well known for many years and is notable for the great number and variety of large animals it contains. Many of these are among the classic examples of geologic textbooks, and the giant tortoise *Colossochelys*, the extinct elephants, stegodons, and mastodons, the *Sivatherium* and other extinct giraffes, the hippopotami and hornless rhinoceroses, were familiar in the last generation to freshmen taking Geology 1, and even perhaps to that remarkable schoolboy that Macaulay used to write about.

Skull of the extinct Siwalik hippopotamus. It differs from the modern hippo in having three, instead of two, upper incisors on each side. *After Falconer and Cantley*

The fossils of the Siwalik Hills were discovered about ninety years ago. They were made famous by the great collections brought together and described by Sir Proby Cautley, an English army officer, and Dr. Hugh Falconer, a very able and active Scotch palæontologist. The chief discoveries were in the foothills along the southern flank of the great Himalayan range, from the Sutlej to the Ganges. The Nerbudda River in central India, the Irrawaddy River in Burma, and Perim Island in the Gulf of Cambay, were also sites of some of the early discoveries, and in more recent years great finds have been made in the Salt Range of northern India and districts in Baluchistan, as well as in the classic Siwalik Hills.

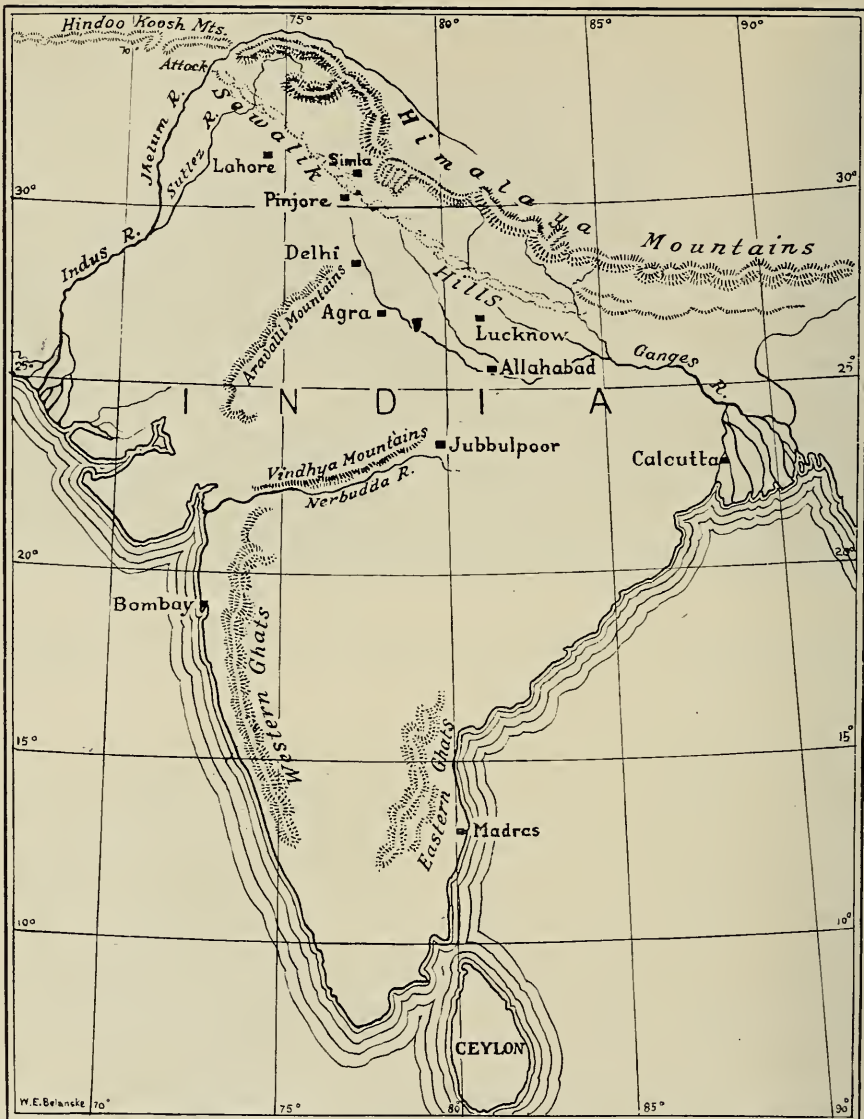
The specimens are mostly in the British Museum, London, and in the collections of the Indian Geological Survey in Calcutta. A few were sent to the Edinburgh, Oxford, and Dublin museums. They were described and illustrated in a magnificent series of

The *Sivatherium* as restored in H. N. Hutchinson's *Extinct Monsters* from remains found in the Siwalik beds of India. The animal was related to the giraffes, although very different in appearance and as large as a rhinoceros

folio plates issued under the joint auspices of the British government and the East India Company, and later in a series of memoirs of the Indian Survey.

Until last autumn there were no Indian fossils in the American Museum except for a small collection received in an exchange, and a number of casts, mostly of very poor quality. So far as the writer is aware, there are none of any importance in any other museum in this country or on the continent of Europe. Professor Osborn had hoped for many years to make a collecting campaign in India, but the opportunity to carry out these plans came only two years ago through the generous support of Mrs. Henry Clay Frick, who has met the entire costs of the Siwalik Hills Indian expedition.

The Indian government authorities responded most courteously to inquiries made by the Museum as to collecting in that country, giving us a cordial welcome and valuable assistance in many ways. The question may well be asked, why should we wish to do over again a task that has been done so well by Anglo-Indian scientists many years ago. Well, there were several reasons. First, that the field was probably far from being exhausted and a new search would almost certainly disclose many new or little-known animals, in addition to those already well known. Second, that it was important for the researches of this Museum to have a large series of these extinct animals of India for comparison with those of other parts of the world, especially of China and Mongolia. Third, that the methods and technique of collecting specimens and the exact recording of the geological horizon of each specimen have been very greatly improved in recent years by American collectors, and we believed that we could secure more perfect specimens

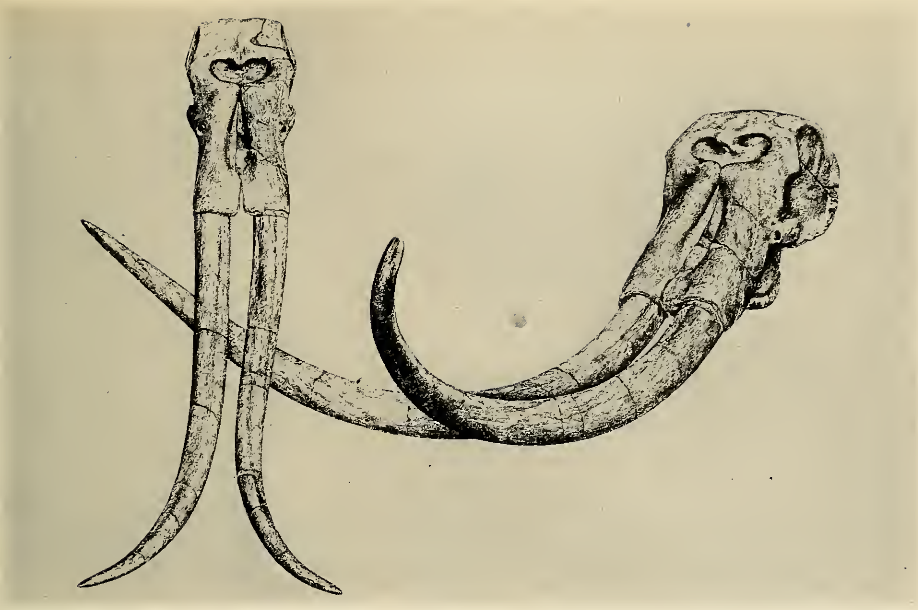


Sketch map of India, showing the location of the Siwalik Hills. Re-drawn from a map published by Falconer

and a more certain knowledge of the succession of faunas that inhabited the region than was possible under the old methods. Fourth, that we might secure additional evidence bearing on the evolution of man.

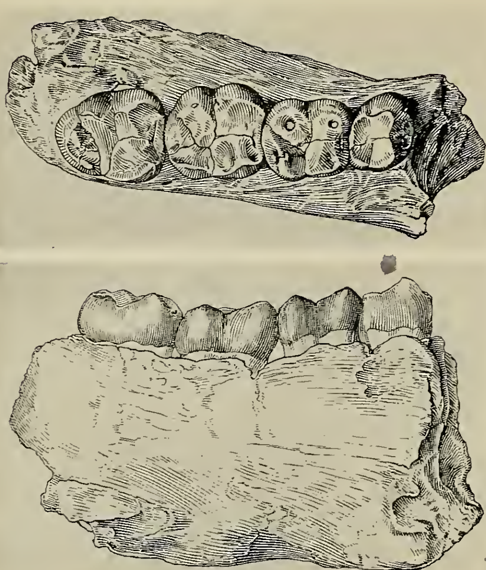
The field campaign was undertaken by Mr. Barnum Brown, whose practical experience and skill in overcoming the difficulties of a region somewhat different in type from our usual collecting grounds gave the best promise of success.

The Siwalik terrane is one of enormous thickness (about 14,000 feet). It was made up of the outwash from the main ranges of the Himalayas at a time when they were rapidly rising, although



Skull of *Stegodon ganesa,* the finest of the extinct Siwalik proboscideans. The tusks are nine feet long. The original skull is in the British Museum; casts of it may be found in many of the older scientific museums of Europe and America. *After Falconer and Cantley*

Skull of a Siwalik mastodon in the Brown collection, partly prepared.—It will be described and figured in Professor Osborn's forthcoming memoir on the extinct Proboscidea. Courtesy of Professor Osborn



Jaw fragment of an anthropoid primate found by Mr. Barnum Brown in the Middel Siwalik beds. Remains of the higher Primates are very rare fossils in any of the Tertiary formations, but of extreme interest because of their bearing on the problem of the ancestry of man. The three specimens secured by Mr. Brown add materially to the scanty evidence available from the Siwalik beds. They are being carefully studied and compared by Dr. William K. Gregory and Dr. Milo Hellman and will shortly be described. These illustrations made by Mr. Malcolm Jamieson under their direction, is published in advance through their courtesy. The drawings show the top and inside views of the jaw fragment, natural size

not so high as they are now. The formation has shared in the later upheaval, so that it is exposed in a long range of considerable mountains, the uptilted edges of the strata facing toward the central ranges. There are immense exposures, most of them as barren of fossils as they are of vegetation, but here and there are areas or pockets where fossils are to be found. Some of these areas were known to the Indian Survey and we are deeply indebted to the Survey for information as to their location. Others were discovered by Mr. Brown in the course of extensive prospecting. The best season for such work is the late winter and spring; in the rainy season of autumn nothing can be done, and summer is almost unendurably hot.

The Siwalik Fauna belongs to the later part of the Tertiary, or Age of Mammals. It was at one time supposed to be a unit, but later researches, especially those of Dr. Guy H. Pilgrim, have shown that it consists of three distinct stages, covering the later Miocene and Pliocene. The middle portion is about equivalent to the famous Pikermi beds near Athens, Greece; the lower division begins with the Sansan and Simorre faunas of France; the upper Siwalik beds compare with the Montpellier of France and Val d'Arno of Italy.

These Siwalik faunas give a fairly consecutive history of the life of India from the middle Miocene to the end of the Pliocene. Through comparison with the record in other parts of the world we get a good line on the origin and dispersal of various races of animals during this time.

The finest series in Brown's collection is that of the proboscideans, including elephants, stegodons, various kinds of mastodons, and dinotheres. Of these there are 142 catalogued specimens, including five skulls.

Two mastodon skulls are nearly complete and of very large size; one of them has the tusks almost entire. There are also two stegodon skulls, equally large, one of them with the tusks preserved. These four skulls are from the Middle Siwaliks. From the Lower Siwaliks there are numerous jaws and teeth, and one skull with tusks complete but not full-grown. From the Upper Siwaliks was obtained a large series of palates, jaws, and teeth of stegodons and primitive true elephants.

An extract from one of Mr. Brown's letters shows some of the obstacles overcome in collecting these skulls. "Some of the difficulties I have encountered in making this collection will interest you. It took one week to build a passable road for carts out of the bad lands and then required four bullocks and twenty-one men to move each mastodon skull. Fourteen days were consumed in transporting these skulls sixty-five miles, thirty-five of which were without road. The Indian countryman does not know how to work except in the grain field, and as he eats nothing but bread and chili, he has the strength of a small boy. . . Traveling is done at night now, for the daily temperature in the Punjab averages from 100 to 115 in the shade, and around 200 in the sun. It is the most taxing heat I have ever endured. . . . It is difficult to secure adequate boxing lumber for big specimens. Part of my material came from America and the rest had to be sawed by hand on the spot. I have used flour paste for bandages, as plaster is not obtainable."

Three jaws of anthropoid apes are of extraordinary interest because of the evidence they give regarding the evolution of these animals and their relation to the line of human descent. Mr. Brown's exact records of locality and geologic level show that these three specimens come from three successive horizons or geologic stages, and the teeth of the three indicate in some respects a progressive evolution from first to last, in a direction leading more toward the type of the modern gorilla and chimpanzee than toward the human type. If these jaws are really in a line of descent, it is one that points not so much toward man as toward the gorilla.

There are several antelope skulls and two of the singular extinct giraffoids, one rhinoceros skull, and three or four of hippopotami. There are two or three skulls of the three-toed horse, one of them with an associated skeleton that is probably nearly complete. Remains of carnivorous animals are extremely scanty, but there is one good skull of a very rare primitive carnivore (*Dissopsalis*), of which only a few fragments of jaws had previously been known. In addition to the series of skulls, about forty in all, there is a great number of jaws, fragments of jaws, and teeth of various animals, some of which, when carefully studied, will doubtless prove to be new or rare types. A point of especial value to the student is that the exact locality and distance above the base of the formation is carefully recorded for every specimen, great or small, in the whole collection, so that each can be placed in its exact time relation, be it earlier, later, or of the same age as that of others of its kind.

It has been a common criticism of the older palæontological researches that specimens in an evolutionary series were arranged arbitrarily in accordance with their progressive structural or anatomical differences, but that there was no evidence that these differences coincided with their real geological succession or sequence in time. The criticism was sound enough as applied to the older work, which followed too much the methods of comparative anatomy and traced the evolution of structures but not the real evolution of a race of animals through mutations of species in successive stages of geological time. It is not true as applied to the more recent work in America, where, with exact data for every specimen, the progress of the race is traced continuously, through comparisons and averages, often based upon some hundreds of specimens from each geological level. It is this kind of work that we hope to do with the Indian collections, and to obtain more exact and more certain results as to evolution, migration, and extinction of races than has heretofore been possible. We shall also be able to make direct comparisons with the collections from Mongolia and China, and with those which we hope to secure from other regions.

In addition to the mammalian fossils, there are skulls of crocodile and gavial and a large part of the carapace and skeleton of the huge extinct tortoise (*Colossochelys*) of India, thought by some to be recalled in the ancient legends that couple the elephant and the tortoise as gigantic figures in Indian mythology.

Mr. Brown's collection is not so large as those in the London and Calcutta museums; but some of its specimens, notably the skeleton of the three-toed horse *Hipparion* and the skull of the primitive carnivore *Dissopsalis* are much finer than anything of their kind heretofore found in India, and some of the skulls of proboscideans and other large animals are quite as fine as anything in the older collections. It gives us a magnificent representation of this classic fauna, will make a splendid exhibition series, and will be of very great importance in researches upon fossil mammals.

Sketch made by Prof. Edward Forbes in one of Dr. Hugh Falconer's notebooks. It shows the earth resting upon the head of an elephant, which in turn is supported on the back of a tortoise, as the ancient Indian cosmogonies declared

Hainan

AN ISLAND OF FORBIDDING REPUTATION THAT PROVED AN EXCELLENT COLLECTING GROUND

By CLIFFORD H. POPE
Assistant in Zoölogy, Third Asiatic Expedition

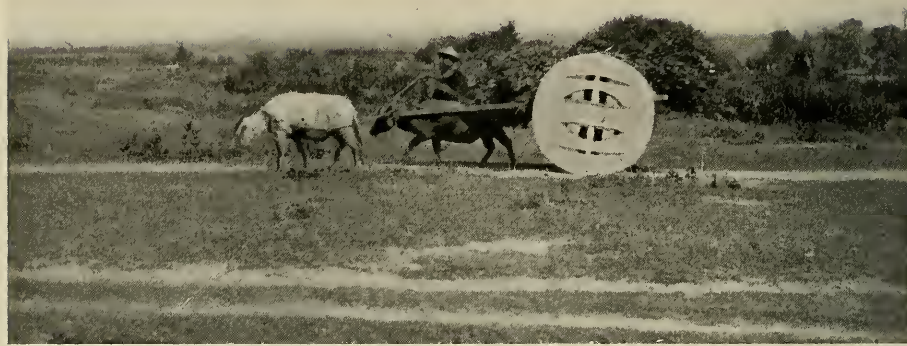
EARLY in November, 1922, we left Peking for the island of Hainan, China's southernmost territory. First to be mentioned in the party is our artist, Mr. Wang, who had for more than a year been making drawings from life of Chinese fish, reptiles, and amphibians. He had already stood the test of work under great difficulty and capture by bandits, so we felt we could place full reliance upon him.

Next came our assistant, whose name was also Wang. Though only twenty-three years old, he had attended to the purchase and preservation of thousands of specimens. Wang not only showed skill in this work but did very good skinning; he too had faced bandits. Kang and Jong, though new to our party, were tried "taxidermists" and promised to keep up their end of the work—trapping and skinning.

On the fifteenth day after leaving Peking, we disembarked at Hoihow, Hainan's only port. I soon decided to head for Nodoa, a small inland town situated in the hilly country intermediate between the island's rolling northern plain and its wild southern highland. Members of the Hoihow branch of the American Presbyterian Mission not only gave much-needed advice, but actually hired a boat that would take us to Fa Hi, the head of navigation on the Golden River. We reached Fa Hi after three days of slow traveling up the river, and then a two-day journey overland brought us to Nodoa.

Late one afternoon, after a weary day's march through rolling, bushy country, we saw in the distance on a low hill foreign houses, and beyond, blue mountains standing out against the sky. Our porters made a bee line for these houses, not even waiting for directions. Of course, foreigners were coming to see foreigners! Once inside the compound, I was greeted by name and told that my dinner would soon be ready. The missionaries at Hoihow had sent a message and so we were expected. Mr. Leverett showed me a room that he said was to be mine and also an empty one in which we might store our equipment. In time, not only half of his bungalow had been turned over to us, but also various rooms in other buildings. We even invaded the hospital compound and before we were ready to leave, it seemed to me that we had used, in some way or other, every bit of the entire compound. Doctor Salsbury's assistant very patiently put up with bad odors resulting from the preparation of bats, rats, porcupines, hares, muntjacs, mongooses, genets, wild cats, wild pigs, monkeys, a varied assortment of squirrels, and many other mammals, all of which took place in the room next to his.

My thankfulness increased and also my surprise, for the Chinese had only discouraging tales to tell of the supposedly dangerous interior. It is said in Peking that the Hainanese have short tails and live on snake meat.



A typical central Hainan landscape.—The ornament in the foreground is a native cart. The screeching of these carts, though ear-splitting and nerve-racking, is effective, the natives assert, in frightening away evil spirits. When a few Hainan roads have been traversed, it is readily understood why such carts are used. They are perfectly adapted to their environment and well able to cope not only with the roads but with the lack of roads, the crossing of flooded paddy fields or newly cleared areas being easily achieved. Because of the enormous size of the wheels, the shocks caused by small holes and bumps are hardly noticeable, while the effects of the deep mud holes and the many gullies are lessened by the snail's pace of the draft animals

Even in Hoihow it was hard to get a "boy" sufficiently venturesome to make the journey with us as interpreter. The one we finally induced to accompany us, proved, before the end of a week, to be unable to cope with the local dialects and was therefore useless. We soon learned something of the difficulties. In Nodoa, which is the district's market town, no less than five distinct dialects are spoken—one for the town itself and one for each point of the compass. The so-called Mandarin spoken by the people of Nodoa is a corrupt form of the northern language. Hainanese, Hakka, Domchiu and Lim-ko Loi, Cantonese, and the local Mandarin all may be heard on the one "street." The missionaries have to study three and four dialects.

Mr. Leverett, anticipating my need for a local man to act as both guide and interpreter, had engaged Ah-sen, one of the old, faithful servants of the mission. During the following months Ah-sen handled nine dialects for me. Some of these could justly be called distinct languages. He could not write Chinese nor could he speak a word of English, but he knew a little northern Mandarin. No other Chinese in the district could speak so many dialects, nor was any quite so courageous as Ah-sen. He was invaluable. While with me, he had two encounters with bandits and congratulates himself on having come through with his life and without having taken that of a single bandit—a distinctly Chinese way of thinking. Ah-sen was famous for two exploits: once he had carried water, bare-footed and bare-legged—but with an old, high silk hat balanced on his head! On another occasion, in his "table boy" days, he had appeared at dinner, tray in hand, and a discarded corset drawn snugly about his waist.

Through the cooler winter months we spent most of our time studying and collecting mammals, but before February had passed, hot weather set in and we turned our attention to reptiles, amphibians, and fish. There were some days of warm weather before the endless rains began, and during these few days fish collecting was good. All the creeks and small rivers were so low—a result of the dry winter weather—that the fish were trapped in the deeper pools. The Chinese raced with us to the best places. They dumped quantities of lime into the water and thus forced the fish to the surface. Only a few days of the mild weather had passed when the spring rains came down; the thin trickles of water that barely connected the pools became torrents; and the fish that had escaped dynamite and lime were liberated.

With the mission compound for a base, ponies at our disposal, and the missionaries ever ready with advice and help, we were fortunate indeed. Kang and Jong were busy setting out and taking in traps, bargaining with local hunters, and skinning, while Wang was occupied with the boys, many of whom had become expert in catching snakes and frogs. A local man had been hired to help with the trapping and had himself become a good trapper. One day he put down his bag and, cautiously opening it, took out a rat trap in which a large cobra was securely caught by the neck! Ah-sen was kept more than busy hunting and circulating the news among local hunters that the new foreigner at Nodoa would buy all kinds of animals. If the village people were not reminded frequently, they would stop bringing in their catch. Two large cloudy leopards were killed and eaten on a mountain only seven miles from Nodoa. When Ah-sen asked the hunters why they had not brought the animals to us, the men said they had not been sure that we wanted leopards.

Though totally illiterate, Ah-sen could converse in nine tongues and was the only man who would do night-watching alone. Ordinarily watchmen work in pairs, but Ah-sen drew a double salary because he dared watch unassisted. Once he wandered north to Shantung and at Chefoo was employed as table boy in a foreign household. To Ah-sen is due a great deal of the credit for the collection of 1150 mammals taken out of Hainan by the Third Asiatic Expedition

At one time the Nodoa merchants accused us of having cornered the wild-cat market. To these Chinese each kind of wild animal has its own peculiar virtue as a medicine or tonic; therefore each species has a more or less definite market value. Monkeys, though common enough, are expensive and especially hard to secure because of the great demand for "monkey

"Taxidermist" Jong and assistant Wang are skinning a python (*Python molurus*). In spite of rumors of gigantic snakes on Hainan, none of the several pythons secured exceeded twelve feet in length. Python steak was tried and found to be delicious. There is always a ready sale for the meat, and it is said that the gall has remarkable medicinal value. Pythons though not extremely rare, are uncommon and hard to catch. They are generally discovered and held at bay by dogs

paste." We are told that this medicine is made of the entire animal. After a monkey's whole body—bones, hair, skin, and all—has been reduced to a uniform consistency by some special process, the resulting compound is administered to the decrepit old and the lazy young. The monkey is one of the most active and agile of animals and the "paste" certainly contains the very essence of monkey. He who eats the "paste" will, it is believed, become more active and agile.

In the case of animals having this set market value, purchasing was easy, but when it came to buying an uncommon toad or lizard or snake—well, the problem was far from simple. Any little slant-eyed boy would be glad of the chance to earn the fraction of a cent by gathering a few common frogs, but if a large or rare creature was brought in by a farmer, we hardly knew what to do, and generally left the decision to Wang. Under such circumstances, Wang, apparently not even deigning to turn from his work—thus appearing to be as unconcerned as possible—would quickly size up the object by glances out of the corner of his eye. The captor of the prized specimen would, on his side, lose no time in trying to impress Wang with the scarcity, difficulty of capture, and good condition of the animal. The next stage would be an effort on the part of each to force the other to name a price first—neither having the slightest idea of the other's conception of a

The cobra's attention is being attracted by assistant Wang, who stands just outside the picture. This is an example of the smaller and common kind of cobra found on Hainan. A specimen of the larger variety was not secured although a headless skin measuring eleven feet was brought in by a farmer. It is this large kind that is dreaded by the natives, who sometimes carry pieces of sulphur around with them as a protection against attack. The Chinese are very fond of snake meat, and discarded bodies were often taken by them

Scene on a stream fished by the Third Asiatic Expedition. The boat, built by popular subscription, was to serve as a ferry. The men are soldiers who came along to guard the gentleman (not in picture) who volunteered to show us a good fishing stream. Mr. Li dared not go even a short distance from Nodoa alone for fear of being kidnapped and held for ransom. He comes of a wealthy family

From this compound, at the very edge of a central Hainan forest, pioneering Cantonese manage one of their new tobacco plantations. Kang, one of the "taxidermists" of the expedition, made the compound his headquarters for many days. These thatched houses, with walls made of upright saplings, are the coolest and most economical houses that can be built. The compound is protected by a living stockade. In the center of the picture a few skins may be seen sunning fair figure. After some moments of deadlock, the one finally forced to name his price would have to bear the brunt of the fierce sarcasm certain fairly to radiate from the other. For instance, if Wang had, as a starter, offered fifteen cents, the farmer would immediately have appeared to be either mortally wounded in pride,

Although Mr. Wang is a thoroughly trained artist, he had always drawn in a purely Chinese school; never before joining us had he been introduced to scientific conceptions and methods in art. It can barely be seen that Mr. Wang holds in one hand two brushes. He changes from one to the other without putting either down or using his left hand. He is able to hold even three brushes at once, easily shifting them about by movements of the fingers. By no means does Mr. Wang consider this sleight of hand, but merely one of the numberless things that every well trained artist must be able to do. The frog being drawn is in the glass vessel on the table at the right

overcome with burning disgust, or choked with convulsive laughter at the very idea of such a ridiculously low price. If the farmer had been forced to name his price, Wang in his turn would have shown similar symptoms of varied and violent emotion. After many minutes of alternate emotional explosions the purchase would be concluded by Wang shouting after the fast-disappearing and thoroughly disgusted Chinese that his last price, though ridiculously high, would be given because—and here would follow a long series of apologetic and conditional excuses for giving in, duly punctuated with anything but complimentary remarks about the mental, moral, and physical make-up of Hainanese in general and one snake-catching farmer in particular. In all such bargaining the figure finally arrived at is sure to be about half-way between the two original conceptions of value. One wonders why it would not be simpler at the very start to subtract one figure from the other, divide the difference by two, and add the result to the smaller sum, thus arriving more promptly at the inevitable half-way point.

Through all the many ups and downs of our efforts while on Hainan, Mr. Wang worked steadily, never for an instant becoming slack. He drew with a steadiness that only an Oriental can show. One afternoon he came up to me with a most worried expression—something unusual for him—and told me that the toad on which he was working appeared to be seriously ill—yes, but he hardly dared breathe it, the creature was already almost dead! I hurried with him to see just what could be the trouble. Sure enough, there it lay all rigid, its legs stretched out in a pitiful manner. Could it be that the toad had actually "passed on?" Then Mr. Wang began sadly to relate how it had happened.

"About an hour ago," said he, "the

A bridge on the highway to Nodoa.—This was a favorite place for robbers to lie in wait. One robber, taken here, was duly tried but, though found guilty, was granted further trial in a higher court. However, on his way to the district city, he got no farther than the scene of his crime. Here he was asked to step to one side—he took his last step. The three men with hats are doubtful as to the prudence of being photographed by the foreigner, but the one on the right, an old mission servant, is quite familiar with cameras

toad began to scratch its sides and rub its mouth in a peculiar way. I couldn't imagine what was wrong. 'Surely it is suffering or is very sick,' I thought. Soon a thick substance began to ooze out all over its body. This puzzled me still more. Then I saw what I could hardly believe,—tears appeared in its eyes and I told myself that the poor toad must be actually crying. I felt sorry for it and said—'That's all right; don't cry, don't cry —you mustn't cry!'"

All his encouragement failed, however, to save its life, for the creature had been chilled while shedding its skin. But how should Chinese artists know that toads shed and eat their skins? When first asked, more than two years ago, if he would go in the field with a foreigner to draw living animals, Mr. Wang wanted especially to know whether he would have to handle snakes. That was one thing he could not do. Last year it was most amusing to see him lovingly caress and nurse a little snake he was drawing.

A remarkable and beautiful tadpole, its body a mixture of rich browns, was brought in. On its back was a delicate pink frill which even the weakest current swayed. The two tiny legs with their fully webbed feet were kept moving in a truly unusual manner—not as ordinary polliwogs are wont to move theirs. Mr. Wang became interested at once. Surely this tiny creature could not be merely a tadpole; certainly it was the child of some weird dragon! So, day by day, as he watched the development, Mr. Wang gave rein to his fancy. What manner of strange fog dragon[1] would it turn into? Its parents were certainly hidden deep in some wild jungle! But alas, what disappointment! As the limbs slowly developed, the rich colors blended and faded, finally disappearing altogether. Ordinary shades of dull green gradually appeared and the head assumed a decidedly "froggy" aspect. All Wang's dragon dreams were shattered and quickly melted away. We had before us only a tiny, ugly specimen of the commonest frog on Hainan, the frog that nightly makes the air alive with its incessant calling from the paddy fields.

In the spring a band of about one hundred deserters worked their way inland from the coast and threatened to give trouble. They laid an ambush along the highway one day and, after blowing off a sergeant's head, looted the loads of some fifty carrying coolies. The ten privates of the command had dissolved upon seeing their leader fall to the ground headless, and, of course, the defenceless coolies wasted no time in disappearing. The mission suffered a loss of property valued at $500. Worse than this, such a bold attack, perpetrated so near, threatened to cut off our line of supplies. Carriers did not dare to travel that road alone and there was no other. For some time we had to take turns in escorting loaded coolies through this dangerous region. No one knew just when the outlaws would return or others appear. To make things worse, a feud broke out in Nodoa. The first victim was rushed to the mission hospital with a stab through the kidney—all had happened in broad daylight on a crowded street. I was strongly reminded of the doings in and about a small town in my native state of Georgia. The spring fighting season had evidently opened and from then on the monotony of collecting was broken by frequent rumors of battles and raids.

The intense heat and the violence of the sudden storms made work during the day difficult. Foreigners who have lived in Indo-China and latitudes as far south in the Orient well know how carefully the white man has to guard against the heat of spring and summer. Yet one often passes Chinese working while the noonday sun beats down upon their bare, shaved heads. One feels foolish beneath a thick pith helmet and wet towel and is tempted to find out by experiment just how much truth there is in the belief that a foreigner cannot stand the sun. However, experiment invariably convinces one that though the Chinese farmer may be quite sunproof, the foreigner is not. The Chinese sometimes catch small fish and snails by bailing out shallow swampy stretches. This they will do in the middle of the day under the hottest sun. Often a whole village will appoint a time for fishing and, putting aside farm work for the day, descend upon a stream, shut off a section from above and below, and then make a raid on the fish, the men working in the deeper pools with nets and the boys among the rocks and grass in the shallows. As the day goes on, the fish become more and more exhausted from constant fright and gradually fall victims to either the boys or the men.

In the preparation of the rice fields it is necessary for the men to wade

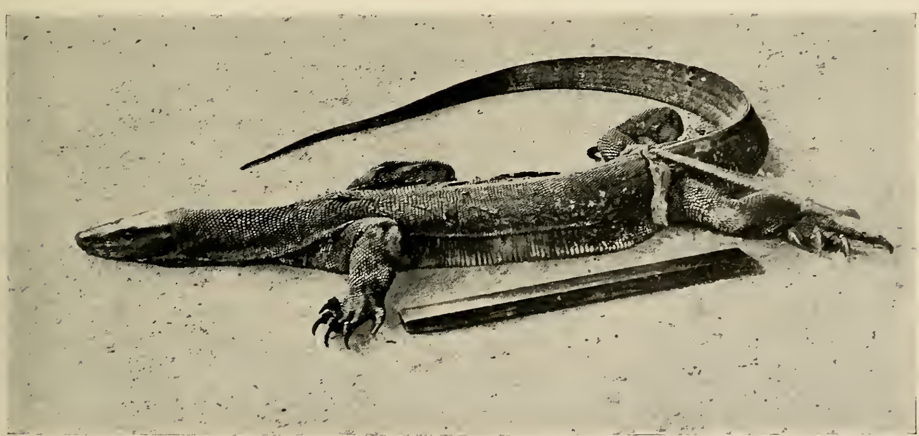
[1]In certain parts of China salamanders are called by the natives foggy-air dragons. They are worshipped; incense is burnt before their haunts; and people kowtow to them because it is thought they control the rain. During the rainy season one might safely catch them without arousing suspicion but let a drought set in, and the part of prudence is to leave them alone.

around in the souplike mud of the flooded fields for hours and hours and one soon becomes convinced that the skin of these farmers must be as waterproof as their heads are sun-proof.

The hot season, when work in the day is most difficult, unfortunately coincides with the fighting season, when night work is dangerous. All the patches of jungle have villages in them and at night the roads are carefully guarded and kept clear of stragglers. Lookouts are posted on high places and, because of the vigilance of the watch kept at all quarters, it is the part of prudence to be extremely careful as to prowling about after dark. One is more apt to be shot for a robber than taken by robbers, and the Chinese cannot be persuaded to go about at night.

Our collection steadily grew. Considerably more than 100 species of reptiles, amphibians, and fish were represented. A large series of all the common forms had been secured. Besides specimens we had measurements of all the mammals, many photographs, and abundant notes. Mr. Wang had illustrated the life histories of 15 species of amphibians and had painted many fish. About fifteen local men—cooks, frog catchers, and fishermen,—had helped in the work, while innumerable hunters had taken part in the collecting of our 1150 mammals. Countless boys were responsible for the thousands of frogs, snakes, lizards, and the like, packed away in our tins.

Early in July news of the reassemblage in Peking of the members of the Third Asiatic Expedition reached me and I prepared to leave Hainan. It was not easy to part from the good people who had for so many months helped us in every way. Each member of the mission, not excluding seven-year-old Chalmers Salsbury, himself an ardent collector, had joined in making our efforts fruitful and our life on the "Isle of Palms" pleasant in every way. Not only the writer but the American Museum itself owes a debt of gratitude to these unselfish workers.



A good idea of the size of this lizard may be obtained through a comparison of its length with that of the foot-rule lying beside it. The Hainan monitor belongs to a dwarf race, and, though similar in appearance to its Indian and Malayan cousins, in size it is not to be compared with some of them. The monitor, a big bluffer, is quite devoid of poison and harmless in spite of its habit of thrashing the keen tail about and blowing ominously. The natives believe that anyone struck by the whiplike tail is in danger of "dying about ten days later"

Through the Yangtze Gorges to Wan Hsien

By ANNA G. GRANGER
Third Asiatic Expedition, American Museum

"WAN HSIEN! The place that gives us more worry than any other spot in China!" said Mr. Willys Peck, first secretary of the American Legation in Peking, when he learned where the past winter's work had taken the American Museum's party. Doubtless the legation is concerned about the unsettled state of Szechuan Province, but the traveler who ventures into it soon loses consciousness of its protecting arm and learns to be his own diplomatist as fast as he can. Almost the first remark that the few foreigners in Wan Hsien made to me on my arrival in that city of ten thousand smells (as everybody dubs it, although the literal translation is "ten thousand district") was, "You were brave to venture down here when you didn't have to come." Two American gunboats, stationed alternately at Chungking and Wan Hsien, seemed alone to offer a definite zone of safety, and even one of these was recently fired upon by bandits when the captain, exercising his prerogative in releasing a Standard Oil junk which had fallen into their hands, incurred their displeasure. In this case the outlaws paid dearly for their temerity.

Such was the place we were headed for on the evening of November 9, 1922. Mr. Granger's experience in this Upper Yangtze valley in the preceding year had prepared him for the possibilities in the line of moving armies and flying bullets which awaited us, but for me the trip had all the zest of the unknown.

The first stage of our journey, the overland trip from Peking to Hankow by rail, should have been accomplished in thirty-six hours. All went well until the second evening. We were just retiring for the night when the train came to a halt and remained at a standstill the next forty-eight hours, the interval being required to chase an army of bandits numbering several thousands from the immediate vicinity of the railroad tracks not many miles ahead of us. Throughout the first day of our stay on the siding, trainloads of Chinese soldiers from the North passed us on their way to the scene of action. When finally we were able to proceed, it was dark, and although we all were anxious to see what had taken place in the area where the bandits had operated, we could make out nothing except the numerous red glows on the horizon indicating the spots where buildings were still in flames.

November 15 was a late date to be thinking of securing good accommodations on the Upper Yangtze steamers. The large boats had long since stopped running on account of the low water. The delay of forty-eight hours in the middle of the province of Honan caused us serious concern, and we were greatly relieved to find, upon reaching Hankow on the morning of the thirteenth, that the steamer "Kiang Wo" would leave for Ichang that same evening. Four of the Chinese members of the party had been sent on ahead to Hankow. These were Mr. James Wong, our interpreter; "Chi," the taxidermist; "Buckshot" (so christened by an officer in the American Guard in Peking, for whom he had worked as a boy); and "Huei," our accomplished cook.

"Chow," the table boy and general handy man, had made the journey from Peking with us.

By vigorous efforts on the part of all, banking business was attended to, additional supplies of tinned goods bought, and our formidable array of baggage transferred to the upriver steamer by nightfall. Hankow carrying coolies are a difficult set of men to deal with. It took all of Mr. Wong's unfailing good humor, tact, and much talk to effect a reasonable bargain for their services. When the last packet was put aboard, it was with a great sigh of relief that we ourselves clambered up some steep stairs aft. We managed to reach the cabins assigned to us without stepping on any of the sleeping coolies who paved the way. It was past the tourist season. We were the only first-class passengers, and no better means of entrance was provided.

The next three days gave everyone opportunity to be lazy. Chi, Huei, Chow, and Buckshot spent much of their time playing mah-jongg. Mr. Wong had long confabs and several dinner engagements with the ship's compradore, a man whose good will it is well to cultivate. Mr. Granger and I found endless entertainment in watching the native life along the river, as the steamer, following the deepest channel, went close to one shore or the other. Often we were near enough to be within speaking distance. At such times there was always a crowd of children running along the bank, crying out to us to throw them empty bottles. The captain, as well as we, tried to hurl some over to them, but never succeeded, all falling in the swift current, much to their disappointment and ours. Tossing articles shoreward to the eager children is one of the regular diversions for passengers on the Hankow-Ichang run.

In certain stretches of this part of the Yangtze, high mud dikes, thrown up to keep back the summer flood, hide everything from sight except the tops of the tallest trees, but for the most part we had an uninterrupted view of the low flat plains and could see the Chinese performing their autumn chores about their farmhouses. We could not help feeling sorry for some of these industrious people when we observed how steadily the river was stealing away their property. Even as we passed, many feet of earth tumbled into the water, intensifying its chocolate color and adding to its burden of silt. I find the following entry in my diary for November 16: "Saw a cormorant, blue heron, swan, besides literally clouds of duck and geese." Mr. Granger's notebook makes special mention of many birds seen at this same point in August, 1921.

The sky had been overcast ever since we had come in sight of the Yangtze, a condition usually prevailing as winter approaches. On the seventeenth, however, the sun shone. Also, the country became more hilly and interesting. The river banks, instead of being abrupt, here sloped away gradually from the water and were cultivated down to the farthest limit. Only such crops were planted as could be safely garnered before the summer rise. We anchored opposite the city of Ichang about three o'clock. This was fairly quick time, considering that we moved only from dawn to sunset. Unless there is a clear moon to guide, captains do not usually attempt to negotiate the ever-changing channel a ter dark. It is a common incident to hear of a steamer stranded on a sand bar.

The "Kiang Wo" had hardly come to a standstill in midstream when Monsieur Kaplain, then director of

View of the bund at Ichang, photographed at the time of medium high water. Extreme high water floods the bund

The Yangtze, taken from the bund at Ichang during the period of low water.—Under these conditions mud flats of considerable extent are exposed posts at Ichang and formerly at Wan Hsien, stepped aboard to greet us, and to carry us ashore in his sampan as soon as we should be free. He brought word that the steamer "Shu Hun," flying the French flag, would leave for Wan Hsien at daybreak the following morning. Mr. Wong was at once dispatched to see if any first-class cabins were still available and, if so, to bargain for them with the compradore. Earlier in the season, while the large river steamers are running, tickets are sold and baggage is carried at a fixed rate, but when these boats are taken off and competition ceases, one is obliged to pay whatever the comprador may demand, and his price is frequently excessive. Mr. Wong was instructed to say that rather than pay an exorbitant sum, we would hire a junk. Fortunately we did not have to resort to this slow and dangerous method of reaching our destination. There proved to be ample room in the first-class cabins, but in the second- and third-class sections not space enough to make it possible for our Chinese even to spread out their bed rolls. However, as nothing else offered, and the Yangtze was getting lower every day, there was nothing to do but accept conditions as they were, and our men did so cheerfully.

Leaving Mr. Wong to complete arrangements, we went to have tea with Monsieur Caplain and his wife at their home, returning to the "Kiang Wo" for dinner, and later going over to the "Shu Hun" with Mr. Wong to sleep. During the little sampan ride from one steamer to the other, I was surprised to notice that Mr. Wong's pistol was more in evidence than usual. He explained that this show of arms was simply to insure our being taken where we wanted to go, and that, too, without any argument as to the fare. To my eyes, accustomed only to Northern Chinese all the boatmen looked capable of making daring holdups, and it was not difficult to picture how badly we would fare in a sampan on a dark night, surrounded only by those who turn a deaf ear to cries for help.

The "Shu Hun" had been under way about half an hour when I awoke and looked out to find that the marvels of the Gorge scenery were already beginning to unfold. Hastily donning enough clothes to keep warm and wrapping a steamer rug around me, I went out on deck. Captain Bienami, to whom we had had a card of introduction from Monsieur Caplain, was already about. He stopped to chat with me. It was quite evident that he had seen nature enthusiasts before and was accustomed to early morning apparitions! Mr. Granger was taking a much-needed rest, and could not be persuaded by any of my bursts of delight to leave his berth before breakfast was called.

The two days that followed were full of wonder and intense satisfaction at nature's handiwork, of awe in the presence of a waterway requiring so long a period of time in the making, and of astonishment at the powers of destruction still inherent in the mighty stream. We were fortunate in seeing the Gorges at just this season when, by reason of the low water, the precipitous sides of the chasm were revealed in their full, majestic height, and when the autumn colorings were upon all the various plant growths that find lodgment in these rocky uplifts, even in the most unlikely places. The beauty was enhanced by a bright sun, an all-too-rare circumstance in these parts. At times, owing to the sharp turns in the river, we seemed to be traveling on a harmless lake, with further progress barred by encircling mountains. Not a ripple ruffled the surface, the great depth of the water apparently making the whole body move as one mass. Here one forgot its power. It was at the wider places along our course, caused by the palisades having slipped out of position, filling the bed of the stream with rock piles, that the dashing spray and vicious-looking whirlpools made one aware of the presence of a strong current.

It is no easy matter for a small craft to fight its way up this seething rapid (the Hsin T'an), even though under full steam and directed by a Chinese pilot who has attained his position only after long experience with the difficult waters of the Upper Yangtze

Going up the Hsin T'an (new rapid) gave us all genuine excitement. As has already been said, we were carrying a super cargo of human beings. Some of us were asked to place ourselves in the forward part of the boat, the better to distribute the weight. If there had been any means at hand for removing about half our number during the passage of the rapid, it would have eased our minds. Next, the woodwork immediately touching the boiler stacks was dampened to prevent scorching while the engines were under forced draft. Mr. Granger made some private preparations for the fray by taking off the heavy ulster he was wearing. In the event of an accident, which was not unthinkable, he felt it would be expedient to be as unhampered as possible. Finally everything on the lower deck was made tight, and our prow entered the seething water. Each of us now chose some fixed spot on the shore by which to measure our advance, and watched breathlessly to see which of the contending forces would be the stronger. The captain had said he wasn't sure he could "make it" under his own steam alone, and for several moments our boat showed no gain whatever, but just when we thought that the water would conquer, we began creeping slowly ahead, and the struggle was won.

Captain Bienami came around directly afterward to enquire pleasantly if we had been sufficiently thrilled. We replied that indeed we had and that we didn't wonder that the mail for Wan Hsien, carried in tiny post boats, arrived at its destination frequently in a soaked condition. We then invited him to share a box of chocolates with which some good friends in Peking had provided us and which we had opened in celebration of the safe transit. One other box had served to beguile the idle hours on the side track in Honan. It was during one of these sociable moments with this most genial of skippers that we learned that the actual control of the wheel is not in the captain's hands, but is left to the Chinese pilots, who have attained their position only after many years of experience in dealing with the special difficulties of the Upper Yangtze waters.

We should have enjoyed continuing on to Chungking under this friendly guide had there not been work requiring our presence at Wan Hsien. We reached that city some time after dark on the nineteenth, too late to do more than hire a sampan, selected from the many that always swarm about so thickly as to hinder rather than facilitate disembarking, and put the camp equipment aboard it. This was not effected without some little unpleasantness. It seems that an attempt was made on the part of some of the ship's crew to prevent the removal of our goods unless an extra fee was paid. Mr. Wong was obliged to threaten to use violence before our men were allowed to proceed with the work of unloading. It is such unexpected altercations as this that make moving about in China a trial. The plan was to leave the steamer's side before she would get under way the next morning. Our four Chinese were glad to abandon their cramped quarters and to spend the night in the sampan, guarding the luggage, which would otherwise have been stolen. No one slept soundly for thinking of our early start on the morrow. A patter of rain, which we had been dreading, awoke us in good season. By five-thirty our hand grips had been lowered over the steamer's side and we ourselves had dropped into the sampan by descending a hatchway even more thickly strewn with human forms than had been the one on the "Kiang Wo." The nearest shore toward which we must go first was only faintly discernible when we said our final good-byes to the captain and pushed off. He waited until we had reached our position of safety, then the siren blew, and a distinctly eerie feeling settled over us as we watched the twinkling lights disappear.

We had been cautioned not to cross to Wan Hsien until the swells caused by the propellers had had time to go to the bank and return again, since many a small boat has been known to founder in the second commotion after safely weathering the first. We were content to follow instructions, especially on noticing, as it became lighter, that we were more heavily loaded than we had supposed, because of some freight which the boatman had added on his own account. About the time that our pilot decided it was safe to start to the opposite shore, another shower came on, which did not add to our feeling of well-being, for there was no shelter on our boat. Midway across we entered the swift water. Our course was directed diagonally upstream. The current took care of the rest, bringing

A view along the river front at Wan Hsien

us down again and butting us sharply against some sampans, by whose side we had to moor for want of a free space on the shore. The "excess" freight nearly slid off by the impact.

Daylight had now fairly come, or as much of daylight as Wan Hsien often gets before noon. While the men were busy separating the boxes which were to be taken to a place of storage from the pieces that were to go to the China Inland Mission, our headquarters, and Mr. Wong was getting in some of his Szechuanese jargon with the carrying coolies, I had time to look about. Happening to glance toward the river and seeing how madly it was careering along, I realized, as I had not in the half dawn when we were actually upon it, the danger to which we had been exposed.

If anyone wants to visualize the "pestilence that walketh in darkness," he should certainly visit Wan Hsien. It has the reputation of being the dirtiest city in China. We found it fully as

A river divides the town of Wan Hsien into two parts. During high water the Yangtze backs up in this stream channel to the full height of the bridge arch seen in the background

black as it is painted. It is loathsome yet to recall that first ride in a sedan chair from the landing place to the Mission. There is only one thing worse than being carried over the unspeakable filth and running the risk of being dropped into it, and that is to have to trail through it on one's own feet. Even along the fore shore and on the steep banks of the stream that divides the town, where one would think the sweet airs of heaven might predominate, the odors were scarcely less noxious than they were in the paved alleys and endless stone stairways within the town itself. Subsequent rides in other directions showed that outside of the compounds under the control of foreigners there is not such a thing as a clean spot anywhere.

During the time which it took our Chinese to prepare the ancestral hall of the Tan families at Yen Ching Kou for another season's occupation by the Museum party, Mr. Granger and Mr. Wong remained at Wan Hsien. It was necessary to pay respects to General Chang Tsong, commander of the Szechuan military forces in that city, and to the local magistrate. Upon the presentation of our credentials, a pass was issued, permitting travel in the neighborhood. This accomplished, we called on all the foreigners (they were only a handful) who had the ill luck to be billeted in Wan Hsien, and made the acquaintance of the officers on the gunboats, British as well as American. I should like to record that all of these people, including Mr. and Mrs. Darlington and their fellow workers at the Mission, were unfailing in their courtesies to us throughout our stay in the province of Szechuan.

It was not until December 21 that I made my first visit to the Museum camp at Yen Ching Kou. Mr. Granger came to Wan Hsien to accompany me. Practically a whole day is consumed in going between the two places, although the distance is only twenty miles.

The attraction of the ride consisted in keeping so close to the shore that we could land at almost any moment, and we were glad to alight several times, to warm our chilled bodies by a brisk walk. It was interesting, too, to watch the methods of propulsion which the Chinese have developed to overcome the swift current. Our crew consisted of two men and a boy; all three stood to their work during the whole of the four hours that it takes to reach Pei Shui Chi, the small town at the head of the troublesome little rapid known as the Fu T'an. By means of two oars attached by a loop of bamboo to upright pegs about two feet high, a bamboo tracking rope, which it was the small boy's lot to carry ashore at intervals, and several long poles tipped with iron and used to thrust into holes in the rocks, a forward motion was teased out of the water. The last-mentioned instruments have been used for so many generations of boatmen that in places the rocks are fairly honeycombed with holes four or five inches deep made by the repeated use of the same spots as points of leverage. When we came opposite the lower end of the Fu T'an, we had to cross the river. The two older men of our crew took the tracking rope, and with the assist-

Deep holes have been worn in the rocks where successive generations of boatmen have thrust their iron-tipped poles in order to force their sampans forward against the swift current

The sampan bearing the Museum party and flying the American flag is being tracked and poled over a difficult place on the Yangtze between Wan Hsien and Pei Shui Chi

A mute testimony to hard labor are the grooves worn in the stone by the bamboo ropes used by trackers

A section of rice paddies high up on the mountain face.—The entire slope was similarly carved. The T'an ancestral hall is seen in the foreground

ance of a Chinese from another sampan and of Mr. Granger too, our boat was hauled over.

Quite a sizeable stream, spanned by a beautifully arched stone bridge, enters the Yangtze at Pei Shui Chi. The same water flows as a small brook past the Museum camp at Yen Ching Kou. We were soon following up its course, —Mr. Granger and Chow on foot and I in a sedan chair. Before setting out we stopped at a so-called Chinese inn, in this case simply a matting-covered shed containing two tables, benches resembling sawhorses to sit on, a Chinese bed, called a *kang*, and the usual cement stove. Here we obtained hot water for our tea and delicious native tangerines and peanuts to supplement our luncheon sandwiches. By three o'clock we were started up the twelve miles of stone-paved trail, narrow and in a bad state of repair, passing by highly cultivated mountainsides that are truly nothing less than marvels of agricultural architecture. One slope must have had more than a hundred terraces carved upon its face, some filled with water, others planted out to vegetables, as is the custom in the winter season. Night shut down upon us about two-thirds of the way up. As I could no longer see where the pitfalls were ahead, I gave up worrying and contented myself with drinking in long drafts of the sweet-smelling mountain air. At about seven o'clock Mr. Wong's cheery welcome was heard in the darkness, and we knew that the Museum camp was at hand.

(In a later issue of NATURAL HISTORY Mrs. Granger will give an account of life as she lived it in a Chinese ancestral hall converted for the time being into a Museum camp, and of excursions to fossil pits in the neighborhood from which of old the "dragon" bones of Chinese medicine were taken and which more recently have supplied specimens of extinct animals to the Museum.)

The ancestral hall and a part of the village of Yen Ching Kou.—It was here that Mr. and Mrs. Granger lived while Mr. Granger collected fossils in the region

A black bear strolling by, at a distance of about thirty yards from the camera

In the Realm of the Kamchatka Black Bear[1]

By WALDEMAR JOCHELSON

Leader of the Ethnological Division of the Kamchatka Expedition of the Imperial Russian Geographical Society

THE Kamchatka Peninsula to the south of Petropavlovsk is at present almost uninhabited. The natives have either died out or were exterminated by the Russians. Only on the western shore are there three small villages, and one of them at the mouth of the Osernaya River was recently established by Russian settlers. From this settlement I had to ascend the mountainous Osernaya River to Lake Kuril, fifty-five miles from the shore of the Sea of Okhotsk.

The purpose of my going to Lake Kuril was to excavate the site of an ancient village which existed in prehistoric times on a small promontory on the eastern shore of the lake. This village was inhabited by natives of mixed blood—a cross between Kurilians and Kamchadal. Just as I had anticipated, I found there evidence of the historic and cultural connection of the old local population, on the one hand with the Kurilians, Ainus, and other ancient inhabitants of the Japanese Islands, and on the other—through the Kamchadal, Koryak, and Chukchee—with the Indians of northwestern America.

Our party consisted of myself as leader, Mrs. Jochelson, M.D., as assistant and physician to the party, and eleven laborers, of whom seven were Russians, three Kamchadal, and one Japanese.

The Osernaya River, with its slanting bed, rocky banks, rapids, falls,

[1]Illustrations by the author.

Unloading the boats, preparatory to ascending the rapids of the Osernaya River

and curves, forms a most difficult and dangerous route of travel. We had two boats and two canoes. One of the boats was for Mrs. Jochelson and myself; the other boat carried the tents, instruments, food, and other supplies. The canoes served for reconnaissance and errands requiring dispatch. It was very difficult to make progress on the boisterous river, particularly on the way up. Several times we had to disembark and carry our freight on our shoulders while the boats were pulled by ropes through the rapids.

While there are no human habitations anywhere in the country, we were amazed to find well-beaten paths in the forests and on the mountains above the river, as if there were numerous human settlements. But realizing that these were roadways made by bears, we walked cautiously amid the dense vegetation with rifles ready for action. We did not see any bears while following these paths, but we heard the breaking and cracking of bushes and tree branches, and on the ground we found left-over pieces of fresh salmon, the remnants of the bears' meals. The animals are very nervous and easily become alarmed. They have sufficient reason to be afraid of a man with a gun.

It is well known that at Lake Kuril and in its vicininity scores of bears are to be found. The abundance of fish and of many kinds of berries furnishes them ample food and favors their increase in number. The sparsity of human population is also favorable to the multiplication of the bears, although the few hunters of the coastal villages kill them annually by the hundreds.

After five days of painful effort we finally reached our destination. It was a windy day and our frail boats nearly capsized on the stormy lake, which is surrounded by the peaks of extinct volcanoes.

We were entertained every day by the sight of bears fishing and gathering

When rapids were encountered, the occupants of the boat disembarked and pulled at the ropes instead of at the oars

An inner pond in the Lake Kuril region, with Doctor Jochelson's encampment in the foreground

berries, particularly when we increased our field of observation by the use of opera glasses. The bears stood with their hind legs in the mountain rivers and creeks, and with their front paws they managed to throw out on the banks sea salmon that in order to spawn ascend the rivulets that flow into the lake. Then they went after their prey and, eating off the heads and spines, which are the most palatable parts of the fish, cast away the remainder. Their movements, turnings, leapings, and jumpings, were so amusing that we could not restrain our laughter.

My laborers were anxious to hunt bear, but I could not allow them to go on such an undertaking as my time was short and a government steamer was expected on a certain date at the mouth of the Osernaya River to take my party to Petropavlovsk. Only once I allowed two of them to go for a night hunt and they secured a little bear cub. The meat they cooked and ate.

The morning of our contemplated departure from Lake Kuril, when all the specimens found in the excavations had been packed, the lids of the boxes nailed down, and the boats loaded, I was tempted to linger just a little longer upon seeing two she-bears with their cubs playing on the other side of a pond in the rear of the promontory. I accordingly delayed my departure until the afternoon and singling out two of the best marksmen from my party and equipped with a stereoscopic camera and a motion-picture camera, I started in the direction of the bears. We had to undress in order to cross the river in the rear of the promontory, and to carry on our heads the bundles of clothing, the rifles, and the cameras,

Doctor Jochelson's Newfoundland dog intent upon catching fish, a practice in which the bears of the region also indulge

so that they might not get wet. We reached the other bank of the river, dressed ourselves, and tried to pass as noiselessly as possible through the little jungle that led up to the open meadow where the she-bears were playing with their cubs.

We stopped on the outskirts of the forest and put up the cinema and stereoscopic cameras. As the bears were still too far away, I told one of my two men to make a circuit about them and frighten them from the rear so that they might come nearer to us. Both cameras were in readiness to take pictures when suddenly at a distance of about thirty yards appeared a young black bear quietly passing by. I quickly took a stereoscopic snapshot and was about to start with my cinema,

Salmon were abundant at the entrance of the lake

but the bear was frightened by the clatter of the falling shutter of the photographic camera and, instead of running away, rushed in our direction. We had no choice but to aim at his head and fire as he neared the cameras.

After ascertaining that the bear was dead, we looked around. None of the other bears were to be seen: they had been frightened by the shooting and had disappeared. As I could not remain on the lake any longer, I had to give up the idea of another attempt to approach bears with peaceful intent. The bear that was killed appeared to be not more than three or four years old. I took the skin and the meat of a hind leg for the laborers.

We returned to our camp late in the day and were compelled to spend one more night on the promontory. Next morning, our archæological mission fulfilled, we started on our journey to the sea.

Some Drums and Drum Rhythms of Jamaica[1]

By HELEN H. ROBERTS

SELDOM does one pick up a book dealing with travel among negro peoples and fail to find some allusion to their music, to their remarkable untaught ability to harmonize, or to the strangely fascinating effect produced by the complicated rhythms, especially of their drums, of which there are many varieties. The drums which attract the most attention are of huge size. Often their deep tones may be heard many miles and are conveyors of messages to those versed in their language. The hollowed tree trunk has provided the sounding cavity for many types, and while in some districts animal skins, such as those of the goat, furnish the vibrating membranes, in others nothing was so prized as the skin of a human being.

Throughout Melanesia as well as Africa drums play a very important part in ceremonial life. Some illustrated volumes contain pictures of huge hollowed-tree specimens standing on end in groves, almost as the original trees grew. These drums are played by priests who take as keen delight in the varied responses obtained from them as an organist in his different sets of pipes.

Although we have many photographs of these instruments and the museums contain actual specimens, and although we read of the weird effect their throbbing notes produce on the nerves and emotions of whites as well as blacks, practically no notation has been made of the rhythms, tempo, or tones. Most of the travelers who have heard them are either missionaries, to whose untiring efforts we owe the greater part of our knowledge of far-away lands, or scientific explorers,—both primarily interested in other fields, and rarely sufficiently trained in music to report in more than a casual way regarding what they hear.

I have always wished that I might have the opportunity of listening to those great drums and of feeling the mysterious effect of their rhythms. Although that experience has been denied me, I had the privilege recently of becoming acquainted with the drum as the negro of Jamaica makes and plays it.

Jamaican negroes are, despite all of Britain's civilizing influence, very African still beneath the veneer. They have retained many characteristics of their former home: words, superstitions, folklore, customs, love of music, remnants of songs sung with words now unintelligible even to the singers, peculiar methods of planting, of house-building, and of making musical instruments, and other mementos of their past too numerous to list. The people of the more remote districts, where little contact is had with the outside world, live in a manner scarcely changed since early slave days.

Immediately upon our arrival two days after Christmas we proceeded to Lacovia, hardly more than a "four corners" in the southwest-central part of the island. Although situated in the midst of great and very old plantations and near a log-wood dye factory,

[1]The information presented in this article was gathered during a field trip to Jamaica in the winter of 1920–21, made under the auspices of the Folklore Foundation of Vassar College and of the American Association for the Advancement of Science, for the purpose of collecting folk songs.

Lacovia is remote from any real town except that of Black River, an important port before the days when Kingston at the other end of the island wrested the supremacy from her, but now a quiet little community dreaming in the sunshine on the edge of the turquoise Caribbean, of the days of pirates and rich galleons, while it waits peacefully for the only occasional

A keg-shaped drum of native manufacture

ships that now put in for coffee, allspice, and other produce, or to unload supplies.

The negroes are still in the habit of holding some pagan festivals during the Christmas holidays, although the consent of the government is given reluctantly. It is generally admitted that the festivities unsettle the people for weeks afterward, and permits for the performances are granted to cover only a limited length of time. It is during the holidays, when factories and plantations make no pretense of work for at least two weeks and general idleness prevails, that the drums are beaten most,—in the public markets, along the roads, and at all sorts of gatherings, including revival meetings.

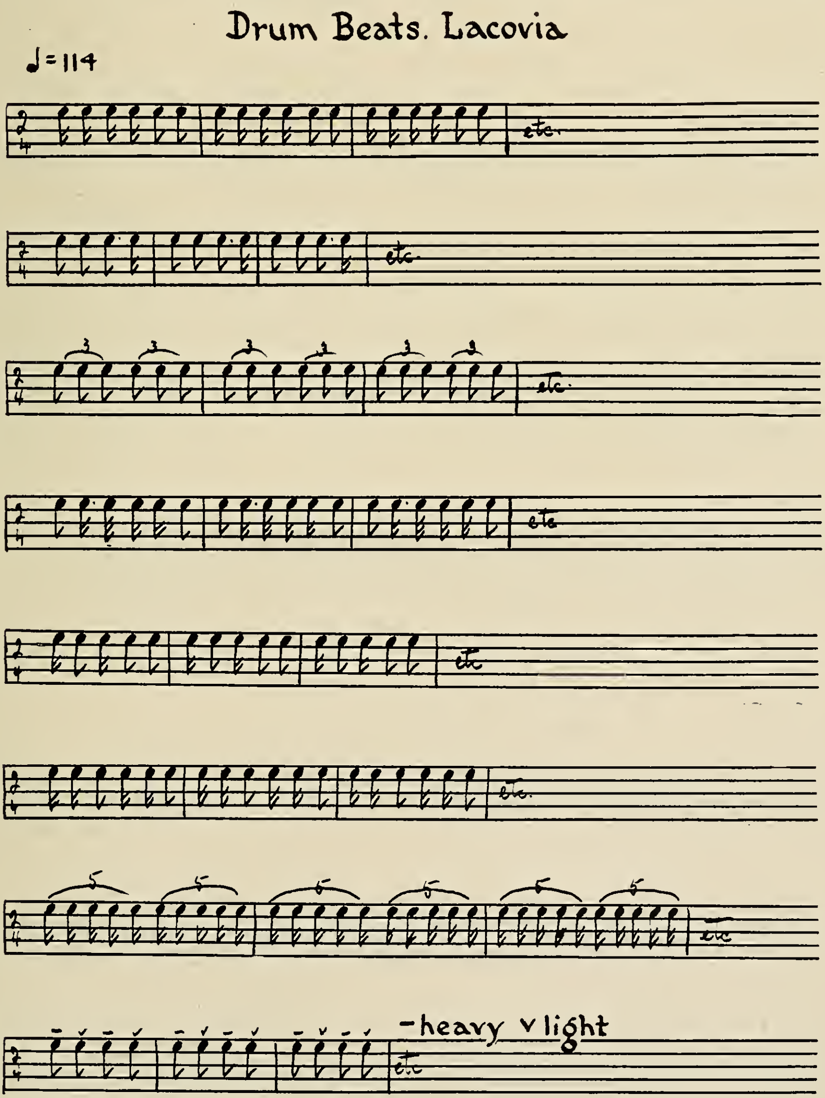
We found the John Canoe dance (a pagan survival) and other festivities in full swing in the back districts, although in the larger tourist towns these have to a great extent disappeared.[1] In the market places were erected hand-driven merry-go-rounds of ancient design upon which all but the very old rode with an utter abandon to joy in the motion, the drum rhythms, and the music. There were several little bands of strolling players that took turns in providing music for this popular pastime in the market place, near the estate where we were fortunate enough to be guests. The bands were usually composed of a flutist with an instrument of bamboo, a triangle player (who sometimes had a real triangle, sometimes merely a piece of iron suspended from a string), and two drummers, with what corresponded to side and bass drums. These, although of home manufacture—one was constructed from an old keg—were unlike most African drums in that both sides were covered with skin.

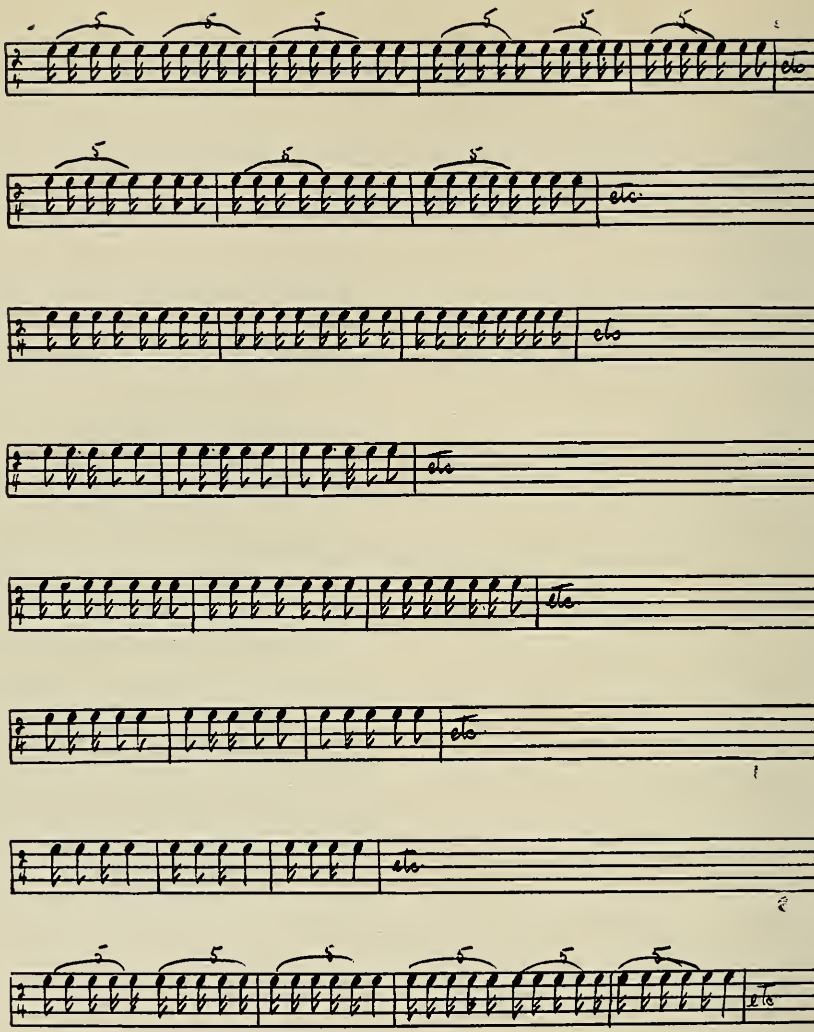
Although our visit to the market place attracted considerable attention, I succeeded in finding a seat not far from the merry-go-round, and after some time the novelty of my presence ceased to draw onlookers or to disturb the players, who may have taken my quiet sitting under a thatch shade as a sign that I was merely resting. During the hour that I was able to remain there, I succeeded in noting the following rhythms played by the side drummer, a few combinations achieved by the little untaught band, as well as four triangle rhythms. These were by no

[1]An article on the John Canoe festival is being prepared by Miss Martha Beckwith but has not yet been published.

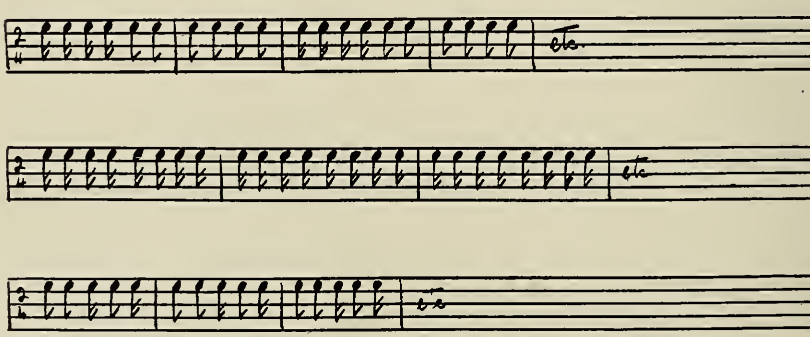
means all that were played in that space of time, for changes were constant, and while I was concentrating to hold in memory and note down one set of rhythms, another would often be substituted for it, which would be changed in turn by the time I had recorded the first.

The chief or side drummer was unusually musical, with a rhythmic sense rare even among negroes, whose feeling for rhythms of the most complicated nature is intuitive. I was not able to write down many combinational effects, otherwise his ability in holding his own and shifting his pattern while always keeping the beat would be more apparent. He later gave me information about the songs, and it was then discovered that his beautiful voice had a range of more than three octaves, for he had a rich and pure falsetto. His appreciation of melody and of harmony was very evident. When drumming, he





Triangle Rythms. Lacovia



Combinations of Beats. Lacovia
Triangle, Snare and Bass Drums

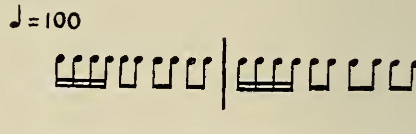
played as though inspired, his head turned to one side, as if he needed the keener hearing of one ear, while his rapt expression showed that he was oblivious to all but the task in hand.

The most significant feature of these rhythms and of the majority of others that I heard throughout my stay is that most of them revolve around two- and four-part meters, of which the two-part are the more common. The tempos of the pieces played for the merry-go-round were all about the same, as I have indicated by the metronome mark, and few if any other pieces moved more slowly. The movements might be described as a vigorous pushing on as in rather rapid walking, about mm120 to the beat. A curious strengthening of this impression is gained by the bass or heavier drum taking the quarter notes in alternate markedly heavy and light strokes. An effect very common in Jamaican drumming, in addition to the sounding of notes on the second half of the beat in syncopation, is that produced by what I am tempted to call the syncopated measure, although real syncopation does not exist in that sense. This effect is obtained by playing notes of very small value in the first part of the measure, followed by those of larger value in the last part, thus throwing the weight of the notes at the end, in much the same way as a note half a beat in length at the beginning of a measure followed by one a whole beat in length throws weight on the last half of the first beat carrying over into the second beat. In the former case, however, the beats are not split by notes which hold over the points of beginning and ending, nor is the beginning of the new measure obscured by a holding over from the last, as is the case in beat syncopation, which is as common as is this false measure "syncopation."

The variety of rhythmic patterns of which Jamaican drummers are capable seems almost infinite, and while in the music to which I listened some patterns might be continued long enough to enable me to note them clearly, the rhythms shifted apparently without rule any number of times in the course of a tune as if the leader were guided solely by caprice. The triangle player was plainly not so versatile as his chief, whose shimmering rhythmic changes were woven around the regular beat of the heavy drum.

The flutist played various tunes known to the people as *sha-shas* (pronounced shay-shays), catch-me-times, mentos, reels, lanciers, two-steps, and others. Many of these dance tunes are presumably taken from Scottish airs or from old English dance music.

For two weeks one heard drum rhythms everywhere, and always expected to remember them and jot them down later, but they would soon be supplanted by others, and so forgotten. One rhythm which stands out in memory came from a remote meeting place in the brush when the thick, warm, pulsing blackness hid even the white road beneath our feet. Its joyous, bounding vigor is but poorly indicated by the notes.



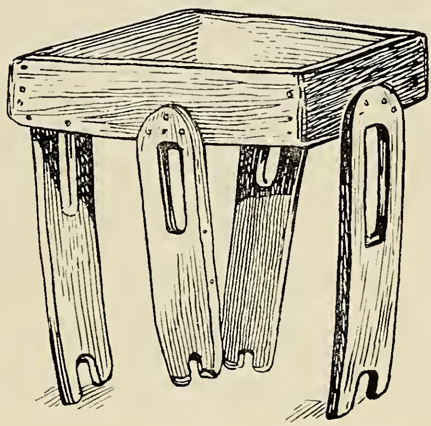
The drums used in revival meetings and by the John Canoe companies at Christmas time deserve more than passing notice, especially the curious little drum that appears in the less sophisticated John Canoe companies. The drums when used at revivals have a different significance than when played for secular occasions to the accompaniment of *Jámal* songs, as the black people call the selections that are then sung. I believe they are also different in identity, though in design they are the customary side or snare and bass. Two of the former and one of the latter supply "plenty powah" as I learned on one occasion when attending a meeting. We were given seats of honor, mine being directly in front of the drummers, but strange to say, after the first few deafening moments when the vibrations threatened to sever my spine, I found the rhythms of the drums stealing over my senses to such an extent that all the blare was forgotten in the supreme electric effect they engendered. The whole dusky audience pressed closer and closer around the drummers in the smoky torchlight, singing with more and more abandon. Religious fervor mounted high and had it not been for faithful Morrison, our black guard, I should have feared to remain. We left the gathering before it had reached its highest state of exaltation, and although in that district at least, fanatical outbreaks, during which the more zealous cut themselves with knives and beat one another, are presumably unknown, they do occur in others. Although the rhythms employed in connection with church singing are, as a result of contact with the hymns, reduced in their syncopations to the minimum possible in the case of negro performers, syncopation is never totally absent.

We were able to see and hear three John Canoe companies,—composed of strolling singers and drummers and a triangle player at Lacovia, of drummers and singers at a still more remote place called Prospect, and of flutists and drummers at Brownstown, which is a community of some importance although far from the railroads.

The company at Lacovia in addition to a bass and side drum had a curious little instrument which they called the *gumbé* (pronounced gumbay). The people assert that all their equipment is destroyed each year after the season of festivities, and they parted with it, little temple and drums, without any apparent regret after bargaining for a considerable sum.[1] But while it may be true that the temple is made afresh each year, the drums are certainly preserved from season to season, for those purchased were quite old, the *gumbé* especially, as is evidenced by the fact that its originally thick goatskin membrane had been worn through in many places and patched. When it is realized that this instrument is played with the hands only, the wear is all the more indicative of age.

[1]The specimens are in the American Museum together with a fine old bamboo flute.

The *gumbé* is square and resembles a milking stool not a little except that it has four legs, two of which, forming opposites, are shorter than the other pair. While this disparity does not appear to be necessary and might seem the result of crude measuring, it was a noticeable feature of both the Lacovia



The framework of the *gumbé* before the goatskin has been stretched over the top and the inner square of wood inserted from below and pushed upward. Note the difference in the length of the two pairs of legs

and Prospect specimens, preventing the drum from standing unsupported. The player holds it slanting away from him as he crouches on his heels and thrums it with slaps of his broad palms near the base of the hand or with his fingers and broad splay thumbs, in almost unbelievably quick and complicated rhythms, which I found it quite impossible to take down in longhand and for the recording of which the phonograph was not available at Lacovia and at Prospect.

The *gumbé* is African in general plan but the particular specimen which I examined was the crude product of more clumsy Jamaican handicraft. A brief description will be of interest.

THE DRUM KNOWN AS THE GUMBÉ, USED BY THE JAMAICAN NEGROES

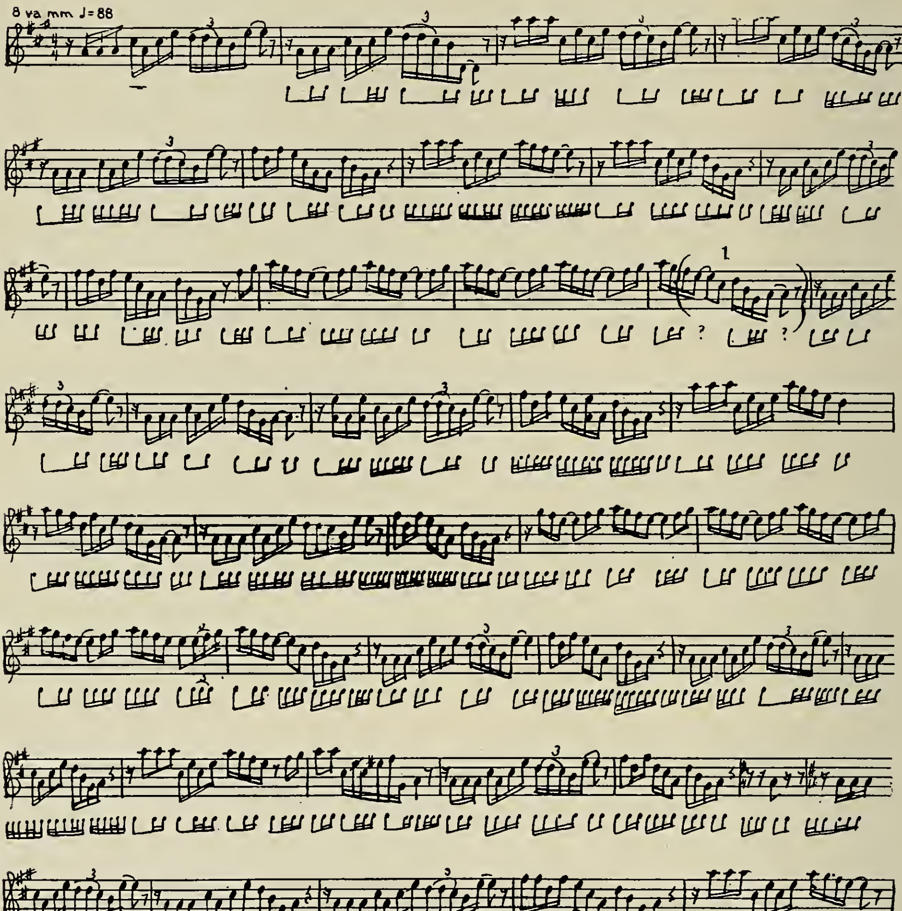
This drum, which somewhat resembles a milking stool, is played with the palms and fingers. In the picture on the right may be observed the inner wooden square which is fitted within the outer frame and forced upward, thereby tightening the goat skin covering and producing the pyramidal effect more clearly seen in the picture on the left

The fundamental frame is square, of boards about three inches wide fastened together at the ends. To the outer surface of this frame are nailed the four legs, placed not as one might suppose at the corners but at the middle of the sides of the frame, the two short legs being opposite. Into each leg for a portion of its length has been cut a broad slot; the top of each slot terminates on a line with the bottom edge of the board frame, which we might call the seat of the stool. Over this frame the goatskin has been stretched, and after being roughly shaped around the tops of the legs, has been nailed along the lower edge of the frame. Another frame which just fits within the first but the sides of which are wider, is slipped inside the first frame from underneath and pushed as far up against the skin as possible; but even after it has been forced upward its lower edge is considerably below that of the outer frame, due to the difference of width. Two cross slats, grooved slightly in the center where they cross so that they may not slip past each other, are run through the legs of the "stool" by means of the slots, and another pair is inserted in the same way, the distances between the pairs on all four sides being maintained by wedges driven into whatever intervening spaces may be left in the slots of the legs, thus keeping the inner frame of the seat as tightly pressed as possible against the goatskin. As the skin stretches with use and the wedges become loosened, others are inserted, either in their place or additionally, so that eventually the device has the appearance of being more complicated than it really is. Sometimes very small wedges are inserted between the edge of the inner frame and the first cross slat, instead of being added to the other wedges between the two sets of cross slats at the slots in the legs.

Considerable sound can be derived from the *gumbé*, especially on account of the force with which the negro slaps it, although there is no sound cavity of any size and what there is, is open toward the ground.

I have mentioned the fact that the *gumbé* is probably African in plan. There seems little doubt but that it is one of the survivals from the past. Maud Cuney Hare, writing of the drums of Africa, mentions a *gumbia* as being an instrument of Sierra Leone. This fact might not prove anything in itself, for some of the lawless Maroons of Jamaica who resisted capture and subjection by the British after the latter took the island from Spain, were eventually sent to Sierra Leone. I have examined Newland's *Sierra Leone* in vain for any mention of it, or for much about any of the music. It is known, however, that some of the tribes originally transported to Jamaica were from that part of West Africa where the so-called Tshi languages are spoken. Ellis in *The Tshi-Speaking Peoples of the Gold Coast of West Africa* refers on pp. 326–27 to finger-played drums and the language of drums. A. Werner, who wrote the introduction of Jekyll's *Jamaican Song and Story*, which compares Jamaican music and folklore with African, deals with the music at length in his own *Natives of British Central Africa.* He says on page 225 that Central African drums do not have more than one head, that some are played by hand and that there is a four-legged drum, like a small round stool, which is beaten with two sticks as it stands on the ground. Most of the better-known authors of large treatises on African life say little if anything about the music or mention it only in

R.71. John Canoe Music. Flute and Drum. Brownstown. Company from Orange Hill



(1) The notes enclosed by parentheses are reconstructed from a similar passage later in the song. There was a fault in the record covering the notes that have been replaced.

passing as being impressive. The article by Algernon Rose entitled "A Private Collection of African Instruments," published in the *Zeitschrift für die Internationale Musikgesellschaft*, Leipzig, 1904, pp. 60 ff., mentions no drum like the *gumbé*.

Finally, an examination of the Crosby-Brown collection of musical instruments from Africa, in the Metropolitan Museum of Art, reveals several, which if not like our Jamaican specimen, show where the idea for its leg structure originated, coming, as these museum specimens do, from the very part of Africa from which the Jamaican negroes were taken. One has for its base a wooden ring in one piece with two stubby pointed pegs which are stuck in the ground as the drum is played. Many drums have legs of some sort, but all are round and none has the inner frame and the slots and wedges.

The name *gumbé* is strangely like that of Senegambia and that of Gambia, respectively, a province and an island within the province, near the Gold Coast from which the Jamaican negroes came and from which the Metropolitan Museum of Art has specimens of drums with legs and but one vibrating surface.

The *gumbé* has no definite pitch but emits a sound like "thwank" in varying degrees of volume. As for the other drums of Jamaica it can hardly be said that they are pitched. Particularly does this apply to the side drums; some of the larger bass drums, on the other hand, have more musical tones. There is not, so far as I am aware, any attempt to tune the drums other than to keep the skins taut, and no conscious attempt to sing in tune with them, although I have noted that in revival meetings, when the singing has been going on for some time, the boom of the bass drums seems to influence the choice of a key so that its fundamental and the drum are in close accord.

I made a final effort to record on the phonograph the music of the John Canoe company of Brownstown, where there were drums and flutes but no *gumbé*, and this time indoors. One of these records was clear enough to transcribe although only one of the drums is audible. Subsequent experiments have shown me that the sounds of drums or other instruments of percussion below a certain pitch are not caught by the ordinary hand phonograph. The transcription of flute music with the rhythm of one of the drums is given on the opposing page.

The rhythmic pattern adopted by the drum will be apparent with a little study, and actual perusal of the notes will reveal the peculiarities better than a description. I have made no mention of the flute other than in passing, for enough flute music was collected, together with several instruments and data concerning them, to justify independent treatment. The present example is the only one where the combination of flute and drums was secured.

Courtesy of New York Zoological Society

Photograph, taken by Elwin R. Sanborn, of a gray snapper in the New York Aquarium

Notes on the Behavior of the Gray Snapper, a Common West Indian Fish

BY E. W. GUDGER
Associate in Ichthyology, American Museum

THE Tortugas islets are the far-flung last of the Florida Keys. They form an archipelago of coral sand roughly surrounding a lagoon of comparatively shallow water, and are situated on the outer, or western, end of the great submarine plateau of Florida, seventy miles west of Key West. The westernmost of these islets is Loggerhead, so named because of the great number of turtles of that name that used to "haul out" on its sandy shores to lay their eggs. Loggerhead Key is a flat crescent with the concave side facing the west; it is about three-quarters of a mile long by one-quarter wide at the middle of the crescent. The Biological Laboratory of the Carnegie Institution of Washington is situated near the tip of the northern horn, and it was at this institution that the observations recorded in this article were made.

The gray snappers (*Neomænis griseus*) are so called because of their color. Another name applied to them is "mangrove snappers" because they lurk in the tangles of mangrove roots, probably to catch the crabs that crawl in and about these roots. They are among the most abundant of the fishes found about the Florida Keys, where they patrol the shores in schools. In this connection it is interesting to note that members of these bands are approximately of the same size and that the bands include no small specimens.

Being very abundant, going in schools, and patrolling the shores, they are of all fishes at the Tortugas perhaps the easiest to study. And of all that I have observed there, none seemed more interesting from the standpoint of their behavior. About two or three dozen used to "hang around" the western dock at Loggerhead, playing or seemingly resting under its shadow. Their chief purpose in remaining there was, however, to feed on scraps thrown overboard by the cook. The fish apparently knew this individual and manifested no fear of him whatever, for whenever he appeared carrying a bucket or pan, the gray snappers were all eagerness, and as he raised this utensil, there was a grand rush and the scraps and the snappers arrived at the surface at the same time.

Let some one else, however, walk out on the dock (which was about eight feet above the water) and some of the snappers (generally those nearest) would turn slightly on one side, thus keeping a wary eye on the intruder. If now he stooped to pick up something, the snappers would move off, and if the object picked up was the grains (a pair of which was nearly always kept at the pier head), the more timid fish would depart for deeper water. The bolder, however, seemed to like the game and held their positions until the grains were thrown, when in a flash they were gone. None, so far as I can recall, were ever taken thus though our most expert strikers were continually practising on them. Some of the fish presently seemed to recognize that there was little danger and would hardly move six feet away when struck at.

Many were the attempts to take them with hooks, especially on the part of newcomers, to whom they were an ever-present temptation. For years these efforts were unsuccessful but at last, in the summer of 1915, our cook's assistant, a professional fisherman from Key West, was able now and then to hook one at night. On one occasion a number were taken by being surrounded with a seine, but when they were cooked and brought to the table there was a general outcry of condemnation, led by the man who had been working longest at the laboratory and who phrased it that these fish were our companions and playmates and that it was an outrage thus to take advantage of their friendliness.

Our favorite bathing place was at a sandy beach on the east side of the island directly in front of the station. Here a dock, which ran out into the water five or six feet deep to support the intake pipe for the pump, acted as a springboard for diving and as an observatory for watching the fish. Around this dock and in and around the reef of oölitic limestone, which extended from it roughly parallel with the shore, large numbers of fishes played, presently becoming quite tame. Among these fishes were probably a hundred gray snappers, which had collected seemingly to be sociable among themselves and toward us. When the other men had swum away, I used frequently to stand quietly on this ledge of rock, whereupon the gray snappers would swim all around me, playing with each other and seemingly with me, for they would often come within a foot, so close indeed that I momentarily expected them to nibble at my fingers and toes. Then, when I turned and swam toward shore, a band of them on either side would fearlessly accompany me into water that was no more than knee-deep. This happened not once but a score of times.

Gray snappers are fond of ghost crabs (*Ocypoda arenaria*), and used to catch them in the following fashion. It was our custom after supper to walk to one end or the other of the island. The best footing was afforded by the hard sand between high and low water marks. As we strolled along on land, the gray snappers would parallel our course in the water, and when, as not infrequently happened, ghost crabs, frightened by our approach, scuttled into the sea, there was a quick rush by the snappers and the crabs never came back. In this way the fish secured their suppers.

THE SCHOOLHOUSE OF THE WORLD

This spirited picture of represfentive animals of the past and of the present, not to mention various primitive races of man, all headed toward the American Museum as their goal, was prepared a year or more before his death by the late Erwin S. Christman

"The Schoolhouse of the World"

By WILLIAM K. GREGORY
Curator of Comparative Anatomy, American Museum

THE interesting picture reproduced herewith was made by the late Erwin S. Christman, of the department of vertebrate palæontology, American Museum, in 1920. It was originally intended for a newspaper article regarding the Museum, but was not used and has never been published before.

The picture shows the Museum as a "schoolhouse of the world," toward which all sorts of strange animals and people are heading in lines that converge from various parts of the earth. In the sky one sees on the right a long line of flamingos, and on the left several of the largest flying reptiles (*Pteranodon*). In the distance a dog team is driving across the Arctic wastes toward the Museum, while Eskimos are pulling a walrus out on the shore. Near the center a long line of horses is dragging a section of the "big tree" (*Sequoia*), which a giant gorilla is pushing from the rear. At the left we see the huge dinosaurs of varied form, the gigantic *Brontosaurus* overtopping the rest. In the foreground a mammoth is being hunted by men of the Old Stone Age, while at the right a procession of African and other mammals is followed by the Haida canoe and its strange company of Northwest Coast Indians. The insect world is represented by some giant dragon flies and other forms, and herpetology is symbolized by the serpent. The department of invertebrates is represented only by the lowly starfishes, but the artist could not find room for everything, and the minerals also are neglected.

The picture as a whole is very characteristic of Mr. Christman's joyous outlook on life, and of his devotion to the Museum and its interests.

The Coming Five Years, 1924-28, of the Third Asiatic Expedition

By ROY CHAPMAN ANDREWS

IN September 1923, President Henry Fairfield Osborn inspected the personnel and management of the Third Asiatic Expedition and visited some of the most important fossil deposits in east-central Mongolia. He agreed with the leader and the entire scientific staff that its work could not be completed in the two years which remained of the five-year period, 1921–25, originally planned for the expedition. In every branch of science the results were so gratifying and so profoundly important that it was obvious that at the termination of the original period of five years the work should be continued for an additional three years.

Moreover, the vast collections and the wealth of new scientific data which had been obtained made it highly desirable to bring all the members of the scientific staff to New York where there could be an assembling of the results, with a view to their publication, and where a new perspective of the future work might be gained from what already had been done. The entire staff is now at work in New York and a large part of the collections have reached the American Museum in safety.

Nineteen preliminary papers have appeared in the Museum publications. A series, to be entitled *Mongolia*, is projected and will include the complete scientific results of the expedition in twelve volumes. A certain sum will be set aside each year so that publication may be carried on coincident with the field investigations and the results thus given to the public as rapidly as possible. It is my intention to write a popular account, in two or three volumes, of the general field work and the results attained.

In order that we might plan intelligently for the next five years' work it was necessary to have the funds assured in advance. In the belief that the members and friends of the American Museum would be glad to assist financially if it were brought to their attention, I addressed them a letter which is meeting with a most gratifying response. Already $17,500 has been obtained through this letter alone and pledges are still being received.

To carry out our plans it is necessary to have $50,000 a year. As this issue of NATURAL HISTORY goes to press, a sum equivalent to $40,000 annually has been subscribed, and only $10,000 a year remains to be obtained. I want to take this opportunity to express my personal appreciation of the interest in the expedition which the members of the American Museum have shown. I speak for the entire staff of the Third Asiatic Expedition when I say that we shall do our utmost to carry on the work with the same enthusiasm with which it has been begun.

I shall sail for China on June 10 on the Pacific Mail S.S. "President Cleveland," and shall reach Peking about July 4. Almost immediately I shall have to go to Urga to conclude the diplomatic arrangements for the next summer's work. Then the vast quantity of supplies and equipment must be assembled and packed, for the caravan must start its long march across the desert by January 1 if it is to reach its destination by the time I arrive by automobile in April. The other members of the staff will leave New York for China in February, 1925.

We shall begin work at Chagan Nor, nearly a thousand miles from Kalgan, where we left off at the end of last year. This means that the organization and preparation of the expedition must be more carefully considered than in the past when investigations started almost at the door of Kalgan.

In 1922–23 we worked extensively in strata of the Age of Reptiles and the early part of the Age of Mammals. We plan now to give especial attention to the last part of the Age of Mammals, and to add to the scope of the expedition other branches of science: archæology, anthropology, botany, and ornithology. What the future has in store for us no one can say, but we shall go forth with enthusiasm and high hope to meet the next great adventure.

The names of those who are making possible the continuation of the work of the Third Asiatic Expedition during the coming five years (1924-28) are listed on the opposing page.

The country-wide support that has been

given the expedition is indicated by the fact that the contributors represented no less than twenty-three states, and even from distant Porto Rico a contribution was sent. In addition to the district of Columbia, residents in the following states contributed to the fund that will make possible the continuation of the work of the expedition: Arizona, California, Colorado, Connecticut, Georgia, Illinois, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, Vermont, West Virginia, Wisconsin.

List of Contributors

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"A Mother's Letters to a Schoolmaster"— A Review[1]

A penetrating book on the education of children has appeared under the title, *A Mother's Letters to a Schoolmaster*, the introduction having been written by the author of *Mind in the Making*. Besides being thus earnestly vouched for by James Harvey Robinson, it has been enthusiastically endorsed by other men in the forefront of the educational field—among them G. Stanley Hall, Albion W. Small, Thomas E. Finegan, and John Dewey—and it fully merits the great praise bestowed upon it by these educators.

The book contains a severe criticism of most of our present-day system of education, with definite, practical plans for radically improving the situation. Fads and untried theories are not advocated, but simplified and fundamental things to do are pressed for consideration. The author has that thorough knowledge of child psychology that enables one to express psychological truths in plain language. In this respect her presentation suggests that of Huxley in his biological lectures to working men. Not only is it clear and sound, it is intensely interesting.

The function of museums as educational institutions is appreciated and they are given their proper place in a modern scheme of education, correlating with the idea that natural history should logically take the leadership in a curriculum for elementary schools.

In proposed curricula for children's community centers (which the author of the book would substitute for the traditional type of school) the museum is provided for as a definite adjunct to every one of the child's activities. A "chart of civilization" classifies these activities not after the traditional manner according to academic subjects, but under simple sociological terms readily understood by the child mind and calculated to lead children to an intelligent comprehension of the world they are living in. These terms are shelter, sustenance, clothing, barter, communication, transportation, government or behavior, recreation and the arts, information. It is claimed that children learning to think of knowledge in these terms rather than as "subjects" apart from life and its ordinary activities, will develop breadth, tolerance, and world-mindedness. In this connection it is suggested in the *Letters* that the museum can and should play a vital part, not only in contributing as it now does to the general and especial interests of men, women, and children, through the various aspects of natural science and natural history, but in establishing *special exhibits* in order to emphasize the developmental character of civilization and to create an intelligent interest in the familiar objects and ordinary processes of everyday life. In this connection the author says:

> If we are ever to take hold of education as enlightened beings, with a firm intention to use it definitely as a training-experience for thinking and for life, a generator of social enthusiasm, an uprooter of inherited prejudices, a stabilizer of social attitudes, we must first put the fund of our knowledges in simpler array. We must assimilate it to our best social ideals, to the immenser retrospect which modern historical research has given us, to the new outlook which modern scientific discoveries have disclosed.

A "finding-out" basis of learning, whereby children will "live while they learn, and learn as they are living," is especially pleaded for, and this includes the utilization of every agency that will feed their curiosity and inventiveness and develop their powers of observation and discrimination. The author proposes such "exhibits of man's thought in action" as can be supplied by the museum, the motion picture, and the children's theater, with whatever other agents of dynamic teaching will "effectively broaden, elevate, stimulate and stir the minds and hearts of children."

The following quotations indicate the appreciation of a teacher's spirit and function: "One finds out just what truths base his convictions when he attempts to explain them to a child." "Any one who really loves what she has to impart, who herself finds things *interesting through and through*, will always find ways of imparting which will make her work as inspiring and as individual as any other work of art."

Bernard Shaw's trenchant remark, "He who can, does; he who can not, teaches," does not apply to the one who realizes that teaching is a joyous mission. It has been said that great art invariably conveys a sense that the artist had a superb time over his work, and this is just as true in the art of teaching as in any other.—G. Clyde Fisher.

[1] *A Mother's Letters to a Schoolmaster*, with an Introduction by James Harvey Robinson. Published by Alfred A. Knopf.

Galápagos: World's End—A Review[1]

Galápagos: World's End, the title of Mr. William Beebe's latest book, is well chosen, for this volcanic archipelago, sundered from the rest of the world by more than five hundred linear miles of ocean, has no material riches to attract the covetous, and those who have reached its shores have for the most part been shipwrecked voyagers, buccaneers, exiled revolutionaries, law-breakers, and scientists. More than a dozen scientific expeditions have visited the islands since Darwin's memorable voyage in the "Beagle" nearly a century ago, but none which in so brief a time has accomplished so much as the Harrison Williams Galápagos Expedition of 1923.

While Mr. Beebe's personality dominates the volume, the work is a composite production, affording an insight into the special talents of those who were associated with him in the undertaking. There are vivid pictures in color by Miss Isabel Cooper—superbly reproduced by the publishers—photographs of technical excellence by Mr. John Tee-Van, three chapters written buoyantly as well as informingly by Miss Ruth Rose, a chapter on game fishing by Mr. Robert G. McKay, and a preface by Prof. Henry Fairfield Osborn of the American Museum, who, though not a member of the expedition, is particularly well fitted to weigh its achievements because of his broad interest in zoölogical exploration.

Mr. Beebe is not a closet scientist; his laboratory is the world of out-of-doors. Through his work at Kartabo he has shown what an inexhaustible field for observation even a small patch of jungle affords for seeing eyes. Imagine, then, the bewildering wealth of interest offered by the sixty or more islands and islets of the Galápagos and the necessity for utilizing every precious second when one's total time for observation on land is limited to a hundred hours! Necessarily only a few of the islands could be studied in the time available, yet thanks to the impressions flashed back by Mr. Beebe's many-faceted mind, one gets a picture that years of less inspired study would fail to give. There are accounts of the volcanic clinker fields radiating heat; the cacti that like barbed wire entanglements protect the unpenetrated interior of islands like Indefatigable; the bizarre black sea lizards that in their rugged contour suggest animated blocks of lava; the seabirds that in numbers nest on the floor of the Daphne Crater; and the lone specimen of a giant tortoise that rewarded the search for a reptile at one time among the most abundant in the islands.

Like all of those who have visited the Galápagos, from Fray Tomás de Berlanga, Bishop of Panama, who drifted there in 1535, to the present, Mr. Beebe was impressed with the trustful unconcern of the native creatures in the presence of man. A young mocking bird picked a grain of wet sand from Mr. Beebe's shoe, a little flycatcher alighted on the lens of his Graflex while he was focusing the camera, a short-eared owl sought a perch on his helmet, and on another occasion as Mr. Beebe stood motionless, a *Tropidurus* lizard approached and snatched an ant from his shoe.

A brief passage regarding an octopus must suffice as an example of the author's incisive descriptions:

> Nothing animate is comparable to this sight. The bulging mass of the head or body or both, the round staring eyes, as perfect and expressive as those of a mammal, and the horrible absence of all other bodily parts which such an eyed creature should have,—nothing more but eight horrid, cup-covered, snaky tentacles, reaching out in front, splaying sideways, and pushing behind, while one or more always waved in the air in the direction of suspected danger, as if in some sort of infernal adieu.

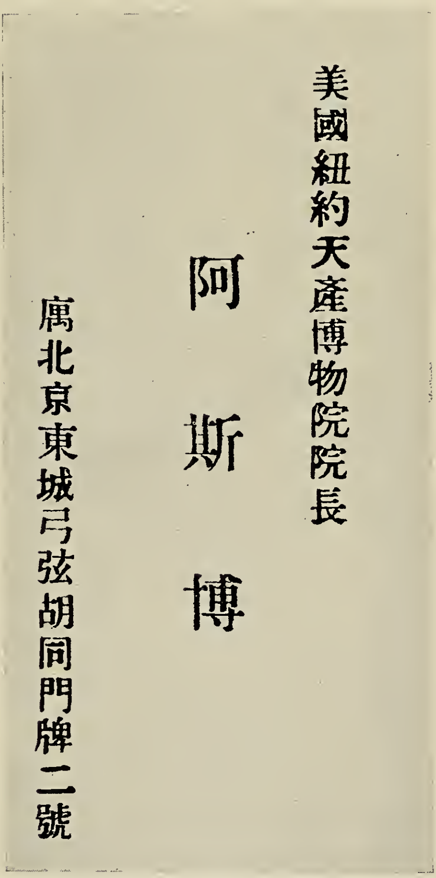
The scientific material gathered by the expedition is being worked up by numerous specialists. Among the 60 species of shore fishes brought back, 20 are new to the Galápagos and 2 are new to science; while, in the case of the insects, an hour's collecting at the head of Tagus Cove yielded 20 forms new to the islands and 10 not previously described. There is promise, therefore, that when the scientific reports make their appearance, they will list a substantial number of species hitherto unknown. But an equally important side of Mr. Beebe's work, well exemplified in *Galápagos: World's End*, is making more fully known the recognized forms of life in a region which because of its inaccessibility, few readers of the book will have an opportunity personally to visit.—H. F. Schwarz.

[1]*Galápagos: World's End* by William Beebe. With 24 colored illustrations by Isabel Cooper, and 83 photographs mostly by John Tee-Van. Published, under the auspices of the New York Zoological Society, by G. P. Putnam's Sons.

NOTES

ASIA

Addresses by Prof. Henry Fairfield Osborn in Peking, September 21 to October 11, 1923.—On his return from Mongolia to Peking, Professor Osborn was besieged by societies and institutions of all kinds in northern China for accounts of the Third Asiatic Expedition. It was agreed between Professor Osborn and Mr. Roy Chapman Andrews, leader of the expedition, that Professor Osborn should do all of the speaking in Peking and in other parts of northern China, while Mr. Andrews would become the spokesman as soon as a landing was made in America. This gave Professor Osborn an opportunity to make a series of highly appreciative addresses on the expedition. These began immediately after his arrival on the evening of Friday, September 21, and ended on Thursday, October 11, the evening before his departure.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The Chinese card of Prof. Henry Fairfield Osborn.—Ah Ssu-po, meaning "Man of wide learning," is the Chinese equivalent for the name Osborn, and the institution of which he is president is quaintly designated "The American Museum of Heavenly Creations"

The first Press conference was held on Sunday morning, September 23, in the headquarters of the American Museum, with a group of very talented newspaper correspondents, representing the Press of the English-speaking world. Among their number were Mr. David Fraser of the *London Times*, Colonel H. St. Clair Smallwood of the *London Daily Telegraph*, Mr. Grover Clark of the *Peking Leader*, Mr. Marshall of the *United Press*, Mr. Bab of the *Associated Press*, also representatives of the *Philadelphia Ledger*, the *Far Eastern News*, the *Shanghai Times*, and other periodicals. This interview lasted three hours and resulted in the dispatch of long, extremely accurate, and well written accounts to the leading London papers and the principal papers in northern China. This publicity gave the Third Asiatic Expedition the world-wide reputation it now enjoys. The cablegrams were prepared with the greatest care to avoid exaggeration, and those by David Fraser in the *London Times* and by Colonel Smallwood in the *London Daily Telegraph* were widely reproduced and syndicated both in the British and American Press.

On Monday morning, September 24, Professor Osborn and Mr. Andrews made their official call at the American legation, where they were most courteously received by the American Minister, Dr. Jacob Gould Schurman. It was there, through the kindness of the assistant Chinese secretary, Mr. Paul Joselyn, that Professor Osborn received his Chinese card, which is reproduced herewith. It proved impossible, even for Mr. Joselyn, who is thoroughly versed in Chinese, to translate literally either Professor Osborn's title or the name of the Museum. The interpretation of the card is as follows. The name Osborn in Chinese reads: Ah Ssu-po, signifying "Man of wide learning." The title reads: "President of the American Museum of Heavenly Creations." Professor Osborn was particularly delighted with the idea that the scope of the Museum's activities and its achievements had earned it the designation, "Museum of Heavenly Creations."

On the same evening, an official dinner to Professor and Mrs. Osborn and to Mr. and Mrs. Andrews was tendered by Minister Schurman at the American legation, representatives of the several foreign governments and leading Americans being invited. In the meantime active preparations were made for a series of public addresses.

As was eminently appropriate, the first scientific addresses were delivered before a large audience assembled in the building of the Geological Survey of the Republic, the meeting being held under the auspices of the Geological Society of China and presided over by Dr. V. K. Ting, honorary director of the Geological Survey. The opening address was made by Professor Osborn on the general scientific results achieved by the Third Asiatic Expedition, and was followed by briefer addresses by Mr. Roy Chapman Andrews, by Mr. Walter Granger on the palæontologic results of the expedition, and by Mr. Frederick K. Morris on the geologic and geographic results. On the evening of the same day, a memorable dinner was given by the Geological Society in honor of Professor Osborn and Mr. Andrews, the principal address being made by Doctor Ting. In clear and elegant English he paid a warm personal tribute to Professor Osborn and made glowing references to the work of the Third Asiatic Expedition.

On Friday evening, September 28, a personal dinner was given to Professor and Mrs. Osborn in the American Museum's headquarters by Mr. and Mrs. Andrews, to which were invited the principal members of the American and British colony. Within a large blue Mongol tent that was suspended from the ceiling of the dining room, were five tables, which seated the forty guests. The occasion happened to be the forty-second wedding anniversary of the principal guests of the evening, Professor and Mrs. Osborn, and the speeches and dinner cards were all of a delightfully humorous and sentimental character.

In the meantime the members of the American Association of North China arranged a luncheon, which was announced in the Press as follows:

A large gathering of the American Association of North China is expected at the Grand Hotel des Wagons Lits for tiffin to-day when Dr. Henry Fairfield Osborn, the famous palæontologist and head of the American Museum of Natural Sciences of New York, which organized the Third Asiatic Expedition, will be the guest of honour. The members are requested to be at the Hotel promptly at twelve thirty.

The most prominent Americans in North China were gathered at this luncheon, as were also some of the British. Being called upon to speak, Professor Osborn chose as his subject "American Science in the Far East," briefly alluding to the rapid extension of exploration in various parts of Asia and the East Indies during the past twenty years by American explorers, geologists, and zoölogists.

On the morning of the same day, Professor Osborn gave an address to the students of the Chinese University of Peking, who were assembled in a large hall under the leadership of Chancellor Li, professor of geology, and Doctor A. W. Grabau, professor of palæontology. Chancellor Li made a beautiful address of introduction and Professor Osborn chose as his subject "Observations and Discoveries," pointing out the long and difficult pathway of preparation for exploration such as had made the Third Asiatic Expedition a brilliant success. This address included a warm acknowledgment of the inspiration that students of the University of Peking were receiving from the talented instructor, Doctor Grabau. A somewhat similar note was taken at the American Association tiffin, namely, that the Third Asiatic Expedition had really been forty-six years in preparation; that young American scientists, having conquered their own continent, were now going beyond into Asia, because "Westward the course of *science* takes its way."

Meanwhile Professor Osborn was preparing by far the most difficult of his series of addresses, namely, that for the Wan Yu Hui, or Friends of Literature. This group of men includes all the leading thinkers and writers in Peking, belonging to no less than thirteen different nations—Chinese, Japanese, Russians, Hungarians, Scandinavians, French, British, Germans, and Americans. For this distinguished and intellectual audience Professor Osborn prepared his most penetrating address, choosing to make a fresh prophecy as to the life of central Asia, under the title "Why Mongolia May Be the Home of the Human Race." In the course of this address, he tried to show that the palæontologic discoveries already made revealed the Mongolian plateau as a savanna country, partly forested, partly open, highly favorable to the most intelligent and resourceful primates of the kind which led to our human ancestors.

A popularized presentation of this same subject under the title "The Prehistory of Man and the Original Home of the Human Race" was set forth the following evening in the Peking Y. M. C. A. building, on the invitation of Mr. Robert Gailey, head of the Princeton-in-Peking movement. The audience was almost purely Chinese and it was necessary to have an interpreter, who repeated sentence by sentence Professor Osborn's address; the meaning was skillfully translated into beautiful and eloquent Chinese and the translator was frequently interrupted with outbursts of applause. The young Chinese listened with the closest attention to this first exposition to them of the principles of evolution as applied to the ancestry of man.

The address before the Wan Yu Hui was published in full in the *Peking Leader* by Grover Clark and was reproduced widely in the press of North China. It will be published in modified form in the not distant future. Professor Osborn wrote for the *China Journal of Science and Arts* another article entitled "Significance of Recent Discoveries in Mongolia." This journal is under the editorship of Mr. Arthur De Carle Sowerby and of Dr. John C. Ferguson, an eminent Sinologist.

On the subject of "Evolution and Religion," Professor Osborn addressed the students of the University of Peking as well as the students of the Woman's College in Peking—a most intelligent and responsive audience. The former institution represents a union of American schools and colleges in North China, starting originally with the educational work of the missionaries. It attracts a very superior class of young Chinese, both men and women. Professor Osborn again chose for his subject "Modern Aspects of the Evolution Question," touching upon the question raised by the fundamentalists at the present time in America.

On Wednesday, October 10, a second luncheon was given at the Wagons Lits Hotel by the Anglo-American Association, another distinguished audience drawn principally from the legations and leading professional and business men of Peking. Professor Osborn chose for his subject "British and American Science in the Far East." He cited many cases of the manner in which Americans and Britishers had worked side by side in various parts of the eastern world, especially of Lord Cromer's aid to his own expedition in the Fayûm in 1907, inspired by a letter from President Theodore Roosevelt. He referred to the coöperation of the British government in India with the two American Museum expeditions there—the Faunthorpe-Vernay Expedition and the Siwalik Hills Indian Expedition under Barnum Brown. He also spoke of the cordial spirit of helpfulness shown to the American Museum parties working in Australia.

Professor Osborn's final address was given on the evening of Thursday, October 11, before a very large and distinguished audience in the beautiful hall of social welfare of the Peking Union Medical College, erected by the Rockefeller Foundation. The speaker was introduced by Dr. Howard Houghton, director of the Peking University Medical College, and spoke on "Recent Discoveries in Mongolia." In the course of this lecture Professor Osborn showed a series of slides illustrating the work in the field. The audience crowded the large hall and even stood in the aisles listening, with occasional outbursts of enthusiastic applause, to the narrative of the second and third seasons of the Third Asiatic Expedition. Doctor Houghton described the results of the expedition as "thrilling," and it may be said without exaggeration that the thrill which the Museum's representatives felt because of the splendid recognition given in North China to the expedition's discoveries and the cordial welcome accorded to Professor Osborn, to Mr. Andrews, and to all the members of his party, helped to start them on their homeward journey to America with bright anticipations of a no less cordial welcome at home.

Mammals Collected by the Museum's Asiatic Expeditions.—In the course of the expeditions conducted by Mr. Roy C. Andrews, collections of mammals have been made that prove to be particularly rich in new forms. Already 21 of the mammals have been described as new to science; 9 of them are bats[1] and 12 insectivores.[2]

In the bat collection, which, by the way, is the largest ever made by any one expedition in China, an unusual opportunity is afforded for comparison of wide-ranging forms. This comprehensiveness is due to the fact that Mr. Andrews and his party have industriously worked the coastal lowlands as well as the

[1] "New Chinese Bats." By Glover M. Allen, 1923, Amer. Mus. *Novitates*, No. 85, pp. 1–8.

[2] "New Chinese Insectivores." By Glover M. Allen, 1923, Amer. Mus. *Novitates*, No. 100, pp. 1–11.

uplands of the interior. Some of the bats were even gathered in Chinese temples.

The series of insectivores contains an especially good representation of rare and interesting types from the Palæarctic as well as from the Indo-Malayan region. These results give a fair idea of the consummate skill of the naturalists in the field, for such animals too often are overlooked, chiefly on account of their small size and elusive ways, most of them being nocturnal or subterranean. Of great scientific interest are the representatives of the genera *Neotetracus*, *Hylomys*, *Scapanulus*, and *Scaptonyx*, and among the Menotyphla the fine series of the squirrel-like *Tupaia chinensis*. *Neotetracus sinensis*, known from only a few specimens, is a small, soft-haired, highland hedgehog with a long slender tail, and resembles in general size and color our common meadow mouse (*Microtus pennsylvanicus*). It was discovered as recently as 1909. *Hylomys peguensis* is another scarce member of the hedgehog family Erinaceidæ. Originally this genus was discovered in the Indian Archipelago, in Sumatra and Java. Its northern distribution in the Chinese highlands furnishes to zoölogists added proof of the probable derivation of the more southern fauna. *Hylomys*, though a short-tailed form, otherwise resembles its close ally *Neotetracus*. Also noteworthy for its rarity is the specimen of *Scapanulus oweni* from Tai-pei-shan, Shensi, the second to be recorded, and of *Scaptonyx fuscicaudatus affinis* from To-mu-lang, Chungtien, the third specimen thus far found. Furthermore, *Scaptonyx* is of more than ordinary scientific interest as it belongs to the Urotrichine series of genera which, with *Uropsilus*, forms the connecting link between the families Soricidæ (shrews) and Talpidæ (moles). Both the *Scapanulus* and *Scaptonyx*, which are included among the moles, were taken in the mountains at an altitude of 10,000 feet.

Dr. Glover M. Allen, of the Museum of Comparative Zoology at Cambridge, Massachusetts, who undertook the working out of this part of the scientific results of the Museum's Asiatic expeditions, has a number of other groups under examination. His preliminary reports on new species are very encouraging.—H. L.

Ancient Eggs.—A spirited editorial that has recently appeared in the London *Times* may be quoted as showing the lively interest that the discovery of the dinosaur eggs has occasioned:

It is some time since curiosity was first piqued, and fancy was stimulated, by the announcement that dinosaur eggs, estimated to be something like ten million years old, had been found fossilized in the Gobi Desert. There has been no underrating of the rare scientific value and importance of the discovery. But it has also, what all things scientifically valuable and important have not, its lighter side, for which a nation in the throes of an election campaign may be duly grateful. The misguided may, indeed, see design, or a strange fatality, in the fact that the discovered relics are now made visible, at any rate on paper, to the people of this country in the midst of their electioneering. The facile humorist will not be restrained from alluding to the traditional connexion between elections and eggs of uncertain age, or the serious-minded from administering to him the rebuke that dinosaur eggs are at once too precious and too hard for his nefarious purpose. If anything more is wanted to complete the jester's discomfiture, doubt may be expressed whether even eggs of a less exaggerated age any longer figure in the armoury of electoral argument, unless as a quaint survival at the election of Lord Rectors; and whether their place has not been taken by the verbal or oratorical egg, surpassing its material prototype in antiquity and yielding little to it in offensiveness, but, unlike it, possessing a resiliency which makes it capable of repeated use.

But the dinosaur eggs have no merely electoral flavour. They also revive, in a new, and therefore attractive, form, the old question, beloved of the schoolmen, whether the hen came before the egg, or the egg before the hen. It is reported that one item of the Mongolian discovery is an egg containing the embryo of an unborn dinosaur. The spirits of the metaphysical advocates of the egg rise in triumph at the news. But the uncompromising upholders of the hen are quick to retort that the complete skeleton of a mature dinosaur was found hard by, and the problem remains to vex us. The interest of the discovery appeals, however, far beyond the world of scientists, electors, and philosophers. It touches children, and many of those who once were children. Few of them will be able to think of the unborn baby dinosaur without conjuring up the picture of that friend of childhood, the missionary who

"... sits him down
To breakfast by the Nile."

Though

"His heart beneath his priestly gown
Is innocent of guile,"

it will be remembered that his saintliness is no defence against the stern decrees of Nature. And so it comes that presently he is seen no longer pursuing a comfortable meal, but scouring "the sandy Libyan plain."

"As one who runs to catch a train,
"Or wrestles with internal pain,

"Because he finds his egg contain,
"Green, hungry, horrible, and plain,
"A baby crocodile."

The connexion between the clerical profession and the ancient egg is indeed so lost in the mists of antiquity that a daring thinker might venture to speculate whether the skeleton of a curate may not yet be unearthed in Mongolia.

Honorary Membership in Geological Society of China.—Honorary Curator Osborn has recently received the following communication from Peking:

The Geological Society of China
9, Ping Ma Ssŭ
W. Peking, China.
January 15, 1924.

Professor Henry Fairfield Osborn, American Museum of Natural History, New York, U. S. A.

Dear Sir:

We have the honor to inform you that you were unanimously elected the first honorary member of Geological Society of China as an appreciation of the great work you have done to further Chinese Geology and Palæontology. We hope to receive your formal acceptance and shall send the Bulletin of the Society to you regularly.

Respectfully,
Wong wenhao, *President.*
Y. C. Sun, *Secretary.*

Professor Osborn has formally accepted this honor in the following letter:

The American Museum of Natural History,
New York.
February 25, 1924.

My dear Sirs:

It is indeed a very great pleasure to learn by your letter of January fifteenth that I have been unanimously elected the first honorary member of the Geological Society of China. I assure you that this is one of the greatest pleasures of my scientific life, and is a very great encouragement for my future research. I am deeply interested in the work which is being done by the Geological Society of China and shall hereafter do my utmost to aid in every way, especially through the coöperation of my colleagues in the Third Asiatic Expedition of the American Museum.

I shall look forward to receiving the Bulletin of the Society with great interest.

In the meantime, I remain
Cordially and respectfully yours,
Henry Fairfield Osborn, *President.*

Smithsonian Collections in China.—Representatives of the Smithsonian Institution have been busy for the past year or so in China making biological collections. In the summer of 1921, Mr. Arthur de C. Sowerby, who had been away from China in connection with the War in Europe since the end of 1917, returned to that country to continue his biological work. Ever since the Clark Expedition in western China, in 1908–09, Mr. Sowerby had been exploring in China, Mongolia, and Manchuria, making extensive biological collections. These were presented to the Smithsonian Institution by the gentleman who financed the collector.

Mr. Sowerby returned to China with a view to exploring the central and southern provinces so as to complete his survey of the country and round out the biological collections.

After making a collection of marine animals at Pei-tai-ho on the northern coast of Chihli Province, Mr. Sowerby established his headquarters at Shanghai, whence he visited Fukien Province in the winter of 1921–22, again in the late spring and early summer of 1922, and once more in the summer of 1923, making very extensive collections of birds, beasts, reptiles, fishes, and invertebrates.

Owing, however, to subsequent political disturbances throughout south and central China, he was prevented from undertaking more extensive journeys, but contented himself in the meanwhile with making collections of birds and fish in the Yangtze Delta.

Early in 1923, the Smithsonian Institution sent Mr. Charles M. Hoy, well known for the fine collections of mammals he made in Australia, to China to carry on collecting work in the Yangtze Valley. This able young American spent a busy time in the late spring and summer in the Tungting Lake district, where in 1914 he discovered the remarkable cetacean popularly known as the "white flag" dolphin, and described by Mr. Gerrit Miller under the name *Lipotes vexillifer*. Late in the summer, Mr. Hoy was taken seriously ill, an operation being necessary. This proved fatal, and the Smithsonian Institution lost one of the most promising young field naturalists and collectors of the day.

Mr. Arthur de Carle Sowerby, f.r.g.s., editor of *The China Journal of Science and Arts*, has expressed his readiness to send to Natural History from time to time Notes of scientific interest concerned with China. We take pleasure in printing below certain paragraphs recently received from him regarding natural-history teaching in the Far East:

The teaching of natural history in China has always remained in the background of Western education for the simple reason that the Chinese have not been able to see its practical value. Foreign languages, mathematics, and such sciences as chemistry, geology, and engineering in all its branches, they have taken up with avidity; but zoölogy and botany—the study of living things—have been neglected.

Nevertheless, steadily during the past decade or so, those responsible for the education of Young China in the large colleges and universities, many of which have been founded by missionary societies, have introduced the study of natural history in all its branches into the curricula of their institutions, and today there are several such institutions where biology forms an important subject of tuition.

Notable among these are Amoy University, Fukien Christian University, Foochow, both in Fukien Province, and Shantung Christian University, Tsinan, Shantung. In the first of these, Professors S. F. Light and Chung are giving extensive instruction in zoölogy and botany respectively, while Prof. C. R. Kellogg is teaching zoölogy in Fukien Christian University, and Prof. A. P. Jacot in the Shantung Christian University.

St. John's University in Shanghai also provides splendid courses in biology, as do the Southeastern University at Nanking and the Union Medical School in Peking.

It is still uphill work, however, to make Chinese students realize the value of biology, and many of them take up the subject half-heartedly, and apparently only to fill in time. This is all the more remarkable, since the Chinese are essentially nature lovers, as witness their art, and are extremely fond of both animals and plants. But the cult of these is looked upon as a pastime and not as part of the serious business of life.

Another contribution from Mr. Sowerby deals with the proposed natural history museum in Shanghai. Regarding this he says:

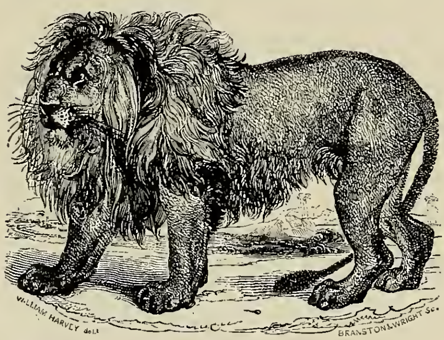
For some time past, agitation has been taking place in Shanghai for the erection of a museum, art gallery, and reference library combined, but so far little support has been given it by those financially able to do so. Up to the present there have been only two museums in Shanghai: that of the Royal Asiatic Society (North China branch), situated in the heart of the International Settlement, and the Zikawei Museum, belonging to the Jesuit Mission, which is situated well outside the town. The former is seriously handicapped for lack of funds and accommodation, while the latter, being a working museum and not open to the public generally, does not fulfill the needs of the town for an institution to which everyone may have access. There is also a lamentable lack of good libraries in Shanghai while such a thing as an art gallery is non-existent. Considering the size to which Shanghai has grown, this is deplorable, and there are many who are working to bring about a change in the right direction. The need of such a museum and art gallery, not to mention the reference library, is very great, for there are a large number of people in China to whom such institutions would be of untold value.

The China Society.—At the eleventh annual dinner of the China Society of America the Third Asiatic Expedition was represented by President Osborn, who spoke on the general purposes of the work in China and Mongolia, and by Curator Roy Chapman Andrews, who gave a brief account of the expedition. Of the several observations Professor Osborn made during his journey in China, the most important is that China is in far more danger from the "White Peril" than America is or ever will be from the Yellow Peril. The bogy of united Japan and China with an army of countless millions sweeping like the ancient forces of Genghis Khan westward across Europe, destroying its civilization and finally engulfing the United States, is fading everywhere. In the opinion of Professor Osborn it is not now nor will it be at any future time to the interests of either China or Japan to form an aggressive military union. On the other hand, both China and Japan are seriously threatened with what may be called the "White Peril," namely, the absorption of certain of the finest of their cultural and æsthetic characteristics by the mechanical and commercial spirit of western Europe and of America. Very slowly American taste in dress, in house decoration, in the smaller articles of household furnishing, tends to invade and replace the impeccable taste of China and Japan, founded upon thousands of years of æsthetic development. More rapidly still American and British advertising methods are invading China, and some of the most picturesque buildings and walls are being covered with advertisements of oil and tobacco. The "White Peril" is also invading the ranks of labor and introducing new economic factors in the form of labor-saving machinery and factory life.

The Chinese are not caring for their religious monuments, their superb temples, gateways, triumphal and memorial arches, their statues and images, which, with some exceptions, are not being protected from the depredations of vandals or from the vicissitudes of the weather. A splendid opportunity for the Archæological Society of America is to establish active branches in more than one city of China and coöperate with the cultured and intellectual classes of China in the preservation of these marvelous monuments. These were some of the ideas which Professor Osborn conveyed in his brief address before the China Society.

THE LION OF INDIA.—In the issue of NATURAL HISTORY for September–October, 1923, Colonel J. C. Faunthorpe presented an interesting note on the "Vanishing Lion of India," stating that while it was once quite abundant in certain parts of India, it now occurs only in the Gir Forest, Kathiawar, Bombay Presidency.

Through the kindness of Lord Lamington the American Museum has obtained a specimen of the Indian lion taken by him, or by one of his party, in this very forest seventeen years ago, when he was Governor of Bombay. Lord Lamington writes that on this same day, Doctor Carnegie, Political Officer, was mauled and killed by a wounded lion.



The lion of India, as it is represented in the volume entitled *The Tower Menagerie*. The picture is based on a specimen that was an inmate of the Tower Menagerie about one hundred years ago

There are practically no examples of the Indian lion preserved in museums—certainly no really good specimen—this being one of the too numerous instances when a species has been exterminated, or reduced almost to the vanishing point, before it was realized that this point had been reached. The process of extermination was indeed rapid in some regions. For example, Major Brown, in 1837, writes that the lion which once "infested" the country about Hurriana (now Hansi) had become extinct south of the Cugar River. This he ascribes to the fact that "Having no secluded dens to retire to during the hot weather, the lions, from necessity, took up their abode where water could be found; and as places of this description were rare, and generally near villages, their retreat was easily beaten up and their entire destruction easily effected."

The specimen received from Lord Lamington is in the form of a rug, but fortunately one that has suffered little from use, so that should the Museum fail to secure a fresh skin, it is possible by modern methods of taxidermy to convert this rug into a mounted specimen—not so satisfactory as could be made from a recently killed animal, but one that fifty years ago would have been looked upon as a triumph of art.

Whether or not the lion of India is distinct from that of Africa is still a debatable question; so far as looks go, there seems to be little or no choice between them: "Perhaps the largest lion ever seen in England was one caught when very young in Hurriana by General Watson and presented to George IV. This was the 'King George' of the Tower collection. Its mane was superbly developed,"[1] as is shown in the illustration reproduced from a beautiful wood cut in the *Tower Menagerie*.—F. A. L.

MINERALS AND GEMS

A FREE COURSE OF SIX POPULAR ILLUSTRATED LECTURES on "Gems and Gem Minerals" is being delivered weekly, on Thursday evenings at 8:15, from February 28 to April 3 inclusive, by Mr. Herbert P. Whitlock, curator of minerals, American Museum, at lecture room 604, 32 Waverly Place, under the auspices of New York University. The subjects considered are "The Diamond and How It is Polished," "Precious Stones Other Than Diamonds," "Some Semiprecious Stones," "The Quartz Gems," "The Opaque Gem Stones," "The Art of the Lapidary."

LONG ISLAND BIOLOGICAL ASSOCIATION

A meeting of the Board of Managers of the Long Island Biological Association was held on February 29, under the chairmanship of Colonel T. S. Williams. Dr. G. Clyde Fisher represents the American Museum on the Board and reports that at the meeting by-laws were formulated, officers elected, and a budget adopted. The appointment of Mr. Reginald G. Harris as director of the biological laboratory of the association was confirmed.

THE MARSH DARIEN EXPEDITION

MR. R. O. MARSH has organized an expedition that will work along the Rio Chucunaque in the San Blas country of southwestern

[1]Quoted from *A Manual of Indian Sport.*

Panama. This region has never been explored scientifically and several white men who in recent years have attempted to penetrate it have not returned. Presumably they were killed by the hostile Indians living there, who resent intrusions into their country. The present expedition will be protected by a detail of soldiers and will undoubtedly secure results of great anthropologic and biologic interest. Representing the Smithsonian Institution on the expedition is the anthropologist Dr. John L. Baer, while Prof. H. L. Fairchild, of the University of Rochester, accompanies the expedition as geologist. The American Museum has been privileged to send as its representative, Mr. C. M. Breder, Jr., who will devote his efforts mainly to the collecting of amphibians, reptiles, and fishes, and to the gathering of life history data. The specimens secured in the course of his anticipated sojourn of three months will become the property of the Museum.

Mr. Breder's letters from the Canal Zone, written on the eve of the expedition's departure for the wilderness, indicate that his work has been well begun, for although seasonal conditions were unpromising for the collecting of frogs and it seemed probable that *Bufo marinus* would be the only amphibian found breeding in the Zone, he collected a large number of small frogs and some well advanced tadpoles "with what appears to be a vibratory tail tip," a peculiarity of the more graceful swimmers among the tadpoles. A semi-arboreal salamander (*Œdipus*) was also secured. Several geckos were shipped to the Museum alive and reached their destination in good condition. Enjoying, as a substitute for the tropical sun, the warmth that comes from the radiator near which they are placed, they bid fair to survive, the more so as they are showing a real relish for the fruit flies with which they are daily fed.

SCIENCE OF MAN

A Collection from the Cañon del Muerto, New Mexico.—One of the most remarkable collections of pre-pueblo material ever made in the Southwest is being assembled in the American Museum by Mr. Earl H. Morris, to whom is due the credit for the discovery of the site in the course of the Third Charles L. Bernheimer Expedition to the Southwest. This expedition was led and financed by Mr. Bernheimer. Later, Mr. Morris, on a regular Museum expedition, returned to the site and made careful excavations.

About seventy miles in an air line from Pueblo Bonito of archæological fame, existed this unsuspected treasure house of ancient things, which, by way of belying its designation Cañon del Muerto (Cañon of the Dead), conferred upon it to commemorate a massacre of Navajos by Mexicans early in the nineteenth century, has yielded data for the resurrection of a vanished period of history. For here, in an unusual condition of preservation, was the record not of a fragment or episode of the past but of a long succession of developmental stages that enables one to visualize how the pre-pueblo people evolved from the "Basket Maker" level to the "Black and White Ware" stage that stands at the very threshold of pueblo history. Sandals with beautiful woven color patterns are among the very oldest material collected. By way of contrast to such articles of apparel, is the box of a medicine man, from the tightly sealed interior of which were taken the feathers of various birds—as fresh and glossy as though they had been purchased but yesterday at a milliner's shop. To give more than a hint of the basketry, pottery, and textiles that compose this collection is premature before the material can be worked up, but it may be stated that among the most exquisite of the objects collected are two ornaments of wood with beautiful turquoise inlay, belonging to the "Basket Maker" period. Most interesting of all, however, is the instance of a turkey—to the Pueblo Indians and apparently to their forebears a bird of sacred significance—that had a broken leg carefully placed between splints to enable recovery. This, it is believed, is the first discovered instance of an attempt by the Indians to set the bone of an animal and, taken in connection with the examples of trepanned skulls from Peru, is a not unworthy indication of Indian surgery.

CAUSES OF EVOLUTION

Doctor Kammerer Explains His Experiments.—On January 7, Dr. Paul Kammerer, the well-known experimental zoölogist of the Biologische Versuchsanstalt, Vienna, was the guest of the Journal Club, in the Osborn Library, American Museum, and gave a very interesting resumé of his experiments of the last twenty years, which he interprets as demonstrating that characters acquired in the course of the lifetime of parents are transmitted to their offspring. The types he used with illustrations and photographs were the following: *Salamandra maculosa*, *S. atra*, *Alytes obstetricans*, *Proteus anguinus*, *Ciona intestinalis*. The paper was followed by a discussion in which President Osborn, Doctors W. D. Matthew, R. W. Miner, G. K. Noble, and Mr. William Beebe, a guest on the occasion, took part. All the zoölogical departments in the Museum were represented in the meeting. The general impression created by Doctor Kammerer's address and personality was very favorable. Although few members of the Journal Club are convinced as to the conclusiveness of his interpretations, all were impressed with his sincerity and directness, with the beauty and precision of many of his experiments, and with his courtesy and moderation toward those zoölogists who have more or less violently opposed his theories and attacked his evidence.

CONSERVATION

The "Report of the Director of the National Park Service" for 1923 is of interest not only for the survey it gives of the work of the year but as an index of the recent growth of public interest in the scenic splendors of our land. It is more than fifty years since the Yellowstone was created a national park; but for decades, only an insignificant fraction of our population visited the great aggregate of marvels represented by that region. Nearly twenty years went by before a second national park, the Sequoia, was set aside for the benefit of the nation, and approximately another decade elapsed before the third link in the national park system was forged through the establishment of Mount Rainier National Park. By the middle of 1916, the year when the National Park Service was created, the national parks had increased to 14 and the national monuments to 18. In the eight years that have since elapsed 5 additional national parks and no less than 10 additional national monuments have come under the administration of the Service. Although this is an impressive growth, it is the figures of attendance that are of particular interest as an indication of the success of the publicity work of the Service and of the reorganization of the tourist facilities in the parks that has taken place during the directorship of Mr. Stephen T. Mather. The number of individuals visiting the parks last year totaled 1,493,712 in contrast to an aggregate of 356,097 in 1916.

During 1923 four new national monuments have been established: the Fossil Cycad National Monument in South Dakota, the Aztec Ruin National Monument in New Mexico (generously donated to the government by Mr. Archer M. Huntington of the Board of Trustees of the American Museum), the Hovenweep National Monument, Utah-Colorado, and the Pipe Spring National Monument in Arizona.

The setting aside as national parks of areas of commanding interest has been of such immeasurable educational, recreational, and inspirational value that it is eminently desirable that the park system be extended to include those spots of outstanding scenic or scientific significance that are still independent of that system. Among places of this type that Director Mather has at this time in mind are the Mammoth Cave area in Kentucky, the territory in New Mexico included in the so-called Bandelier National Monument, the Bryce Cañon region in Utah, already proposed as the Utah National Park, areas along the Great Lakes showing typical sections of inland lake and dunes, the redwood section of upper and central California, a typical portion of the Appalachian Mountains in the East, an example of the Everglades of Florida, or of the forested lands and hills of the South.

One notes with pleasure that during the year there was an increase among all the species in the Yellowstone National Park, especially marked in the case of the elk, pronghorn, and deer. By way of offset to this feeling of satisfaction is the indication that there has been a wanton disregard of the limitations under which hunting was now and then to be permitted in Mount McKinley National Park, in Alaska. As one of the principal objects in establishing this park was to accord a degree of protection to its vast herds of caribou, mountain sheep, and other game, the killing of large numbers of these animals by visiting prospectors calls for an adequate patrol service that will be possible only if the present annual appropriation of $8000 granted for the park is increased.

Museums exhibiting local specimens are an important factor in the educational program of the Service. During the past season the museum established in the Yosemite proved an attraction to 55,811 individuals. In the Mesa Verde National Park a museum building is under construction to house objects found in the ruins of that area. The museum in the Yellowstone is outgrowing its present quarters and it is hoped that the old barracks may be available for its purposes. In the Casa Grande National Monument a small museum has been constructed during the past year, and is being filled little by little with pertinent exhibition material. The nature guide service offered in some of the parks has been of great value to those who want to know more about the natural forces that have been or are still operative in the several areas, or about the wild creatures that make these areas their habitat.

The Game Birds of the United States.—The title, "Can We Save the Mammals?" selected by Prof. Henry Fairfield Osborn for the article which he prepared, with the collaboration of Mr. H. E. Anthony, and published in Natural History for September–October, 1922, is paralleled in the heading, "Can We Save Our Game Birds?" which Mr. T. Gilbert Pearson, president of the National Association of Audubon Societies, has chosen for his contribution to *The World's Work*, November, 1923. The similarity of the wording of these titles serves to emphasize the common danger to which the mammals and the game birds of our country are exposed. The wild turkey, once so characteristic of America that it might fittingly have served as our national emblem instead of the eagle, is today found in only a few out-of-the-way places; the heath hen, formerly an important source of food supply, is dwindling in numbers in its last place of refuge, Martha's Vineyard; the partridge is being persistently hunted and the reduction of its numbers to a dangerous level is rapidly being brought about; even the quail, exempt from persecution in some states on the ground that it is a songster—and who that has heard the cheery call "bob-white" in some meadow, could fail to love the bird that utters it?—is still hunted in others. The draining of our swamp lands has deprived the ducks and geese of breeding places but, due to the fact that the summer home of most of them is in the north, they have escaped the ravages to which they would have been subjected in more settled areas.

What is the solution? Can we indeed save our game birds? Over large areas in Europe, Mr. Pearson points out, the land is more densely populated than in America, yet upland game birds are in relatively greater abundance. There the land owner does not permit the birds on his property to be reduced to the danger point; the "poacher" is severely dealt with. By way of contrast Mr. Pearson cites New York State, where any one having a state shooting license may wander over his neighbor's fields in search of game birds unless restrained from doing so by "no trespass" signs of prescribed dimensions or through the official establishment of the area as a bird sanctuary, and not every land owner has the initiative, or will go to the expense, to secure such protection for his wild fowl. A public campaign of education, in which newspapers and public-spirited private agencies, as well as the federal and state authorities, are called upon to participate, is urgently needed if our game birds are not to follow the great auk and the dodo to extinction.

The Waterfowl of Back Bay, Virginia.—Back Bay, Virginia, is a gratifying illustration of what conservation can accomplish when public sentiment is squarely behind the law. Mr. Ludlow Griscom, assistant curator of birds in the American Museum, has recently returned from a trip to this famous winter resort for wild fowl, made in the company of Mr. M. S. Crosby, and reports that ducks of all kinds are, if anything, more abundant there than they were ten years ago. In one day nineteen species were counted; canvasback, baldpate, Canada geese, and whistling swan were present in thousands, and many other species were common. Mr. Griscom in his analysis of the situation says:

When we consider that this state of affairs exists in spite of the fact that every marsh is owned by a gun club, every little island is a prized shooting ground, that the bay is covered with floating blinds and batteries, that one is never out of sight of houses and villages, and that these conditions have prevailed for many years, it will be apparent that the continued abundance of waterfowl requires some explanation in addition to the natural advantages of the territory. Primarily, of course, the abolition of market hunting—that great scourge of conservation—and of spring shooting is a necessity before waterfowl can be maintained in a settled district. Next, wise and proper game laws must exist, and in this respect Back Bay has the best and the most restrictive I know of in eastern America. Laws, however, are of little benefit unless public sentiment and respect are back of them, for at present neither the federal nor any state government has sufficient funds to employ a staff of game wardens adequate to enforce the law in localities where public sentiment is against it.

The most gratifying feature of hunting in Back Bay is this: that particularly restrictive laws have the approval of sportsman and layman alike. The latter has outgrown his bitterness over the abolition of market hunting, which deprived him of a living, as steady employment with the hunting clubs has given him a better one. While the public cannot shoot from the shore marshes or islands, as they are all private property, the bay shooting is not to be despised by anyone, and consequently there is no feeling against the clubs, as is the case, for instance, on Long Island. The natives realize that these clubs bring money and employment, that they do not spoil the shooting, and that people who are not millionaires and cannot afford a share in the property-owning clubs still flock to Back Bay during the hunting season, bringing more money and more employment. The majority unquestionably realize that the decrease of the ducks means inevitably a decrease in income and employment, and see that the game laws insure a goodly supply of game.

In three visits of several days each to this region over a period of ten years, I have never seen a violation of the law. In hundreds of trips to duck fields in central New York, and to scattered localities from Labrador to Florida, and from Florida to Texas, I have never spent a similar amount of time in any one place without seeing some violation of the law, or finding it held in contempt and disregard if the game warden's presence elsewhere was definitely established. This unfortunately is particularly true of the Gulf Coast and the prairies of southern Texas. Although in variety of species and abundance of individuals these regions still exceed Back Bay, a depletion of the waterfowl, inevitable unless public sentiment is aroused and educated, will result along the Gulf coast and in southern Texas when the population increases and natural conditions are destroyed through the encroachments of civilization.

The American Scenic and Historic Preservation Society held its twenty-ninth annual meeting in the auditorium of the American Museum on January 28. The part that this society has played in New York State and in the nation at large deserves more than casual mention, for, as Dr. George F. Kunz, its president, pointed out in his address, it was one of the first societies to arouse public interest in the preservation of sites that appeal on the score of their beauty or their historic significance, and throughout the three decades of its existence it has given forceful aid to the movement that has resulted in the establishment of national and state parks. In New York State alone there are today more than seven times the number of scenic and historic reservations that existed when the society first began its campaign. The administration in the public interest of no less than nine properties—three belonging to the society and six to New York State—has claimed a large part of the attention of the society during the past year, but the scope of its work has by no means been limited to this group.

A feature of the annual meeting was an illustrated address on "The Scenic Beauties and Engineering Difficulties of the Grand Cañon of the Colorado River," delivered by Mr. E. C. LaRue, hydraulic engineer and photographer of the party of eleven men of the United States Geological Survey, that surveyed 1800 miles of the Colorado River and its affluents from Wyoming to the Gulf of California. The perils faced by the party while their boats, as helpless seemingly as wisps of straw, were swept along by the tumultuous waters of the rapids, were realistically presented in the motion-pictures. The adventurous character of the survey and the importance of its results had attracted a large audience,—so large indeed that the lecture had to be repeated for the benefit of those who still packed the approaches to the auditorium after the doors had been closed for the delivery of the first address. On the platform, in addition to the trustees of the society, were a number of distinguished guests, including Mr. Frederick S. Dellenbaugh, who accompanied Major Powell on his second expedition through the Cañon, Mr. W. H. Jackson, the photographer of the Hayden Survey, and the Rev. Robert E. Jones, who was associated with the Geological Survey in the Grand Cañon region in 1880–82 as topographer.

The American Bison Society.—So fruitful in results has been the work of the American Bison Society that whereas in 1903 there were in the United States but 41 herds with a total of 969 animals, in 1923 according to the census for that year there were 147 herds, comprising 3878 head. Twenty years ago there were but 24 states in which bison were to be found, today all but eight states of the Union have examples of this animal. It is in Canada, however, that the bison is preponderant, with a resulting total for North America of 12,457 animals.

With the perpetuation of the bison fairly well assured, the society is earnestly devoting its energies to saving the pronghorn,—a much more difficult undertaking due to the fact that the animal is more delicate by nature and is today beset by many agencies that threaten its existence. The annual report of the society for 1922–23 contains the first census of living pronghorn, compiled by the secretary of the society, Mr. Martin S. Garretson. It shows a total of 10,099 of these animals within the United States and of 11,749 within the United States and Canada combined. Although this aggregate is comparable to that of the bison, the forces of destruction arrayed against the pronghorn call for unrelaxed vigilance on the part of those who would safeguard this animal. Driven from its natural habitat on the plains and foothills, it is today subjected to the attack of the sheepherder and the homesteader, while the wolf and the bobcat take their toll of the antelope when it is helpless in the deep snow. In the Guano Valley, Lake County, Oregon, seventy-five of these animals were wantonly shot by Basque sheepherders, and during Mr. Garretson's trip through southwestern Idaho, made with a view to ascertaining the suitability of the region as a sanctuary, indubitable evidences presented themselves that the Basque sheepherders of that section too are spelling the doom of these fine animals. In the report for 1922–23 Mr. Edmund Seymour, president of the society, alludes to the purchase of six antelopes in Canada and their successful transportation to the Wichita National Preserve in Oklahoma as the most notable achievement of the society during the year, but in many other ways the society has given evidence of its devotion to the cause of our disappearing wild life.

HISTORY OF THE EARTH

Mr. Edward J. Foyles, of the department of geology and vertebrate palæontology, American Museum, has recently issued in the *Thirteenth Report of the Vermont State Geologist* his "Preliminary Report on the Ordovician Formations of Vermont." The report is based on a study of the Fort Cassin rocks and fossils in the American Museum, as well as on field work undertaken in the Lake Champlain region during the summers of 1921 and 1922. Two of the principal localities, Shoreham and Fort Cassin, lie to the east of the lake; the third, Providence Island, is located somewhat north of these points in the lake itself. The purpose of the papers, as announced in the introduction and worked out in the text, "is to suggest the limits of the Beekmantown formation of the Lower Ordovician as it occurs in the Champlain valley of Vermont; to show that the Fort Cassin rocks constitute, not a single formation known as the Beekmantown, but a terrane consisting of two formations, neither of which is Beekmantown; and to demonstrate that the Providence Island rocks, which have mostly been assigned to the Beekmantown, have very few if any beds of Beekmantown age, but belong to higher horizons."

WILLIAMS GALÁPAGOS EXPEDITION

Many New Species of Moths Obtained in the Archipelago.—In his résumé of the Williams Galápagos Expedition (*Zoologica*, Vol. V, No. 1) Mr. William Beebe reports that the insects taken by the expedition totaled 3000, of which no less than 626 were moths (exclusive of Microlepidoptera). For the most part these had been lured to their doom by a powerful searchlight which nightly bored a tunnel of radiance through the darkness. Of the moths of the Galápagos Archipelago comparatively little was known prior to the working-up of this collection, evidenced by the fact that of the 52 species into which Mr. William Schaus, honorary assistant curator in the United States National Museum, divided the material, exactly one half are new to science, while only 4 of the remaining 26 species had hitherto been reported from the archipelago. There were 38 Microlepidoptera, which, as determined by Messrs. A. Busck and C. Heinrich, added 9 species to the total. Of the new species 2 have been named for Mr. Harrison Williams, who initiated the undertaking and generously placed at the disposal of Mr. Beebe's party the steam yacht "Noma" in which the cruise was made, 2 for Miss Isabel Cooper, and 2 for Miss Ruth Rose, who participated in the expedition, while the name of Mr. Beebe has been associated with a specimen representing a new genus. Mr. Schaus's study of the material—with a classified list of the species, the number of specimens of each, the date and locality of capture, and, where the species are new to science, the detailed description—has been published in *Zoologica*, Vol. V, No. 2; field observations regarding the material collected are graphically presented by Mr. Beebe in *Zoologica*, Vol. V, No. 3. Among the most striking of Mr. Beebe's observations are those relating to the remarkable partiality shown by birds of the islands for butterflies and moths, a phenomenon not to be explained by an absence of other insect food, for grasshoppers were present in abundance.

NEW YORK ZOOLOGICAL SOCIETY

Tropical Research Station.—On February 11 Mr. William Beebe and his staff of assistants sailed on the "Mayuro" to undertake another season's work at Kartabo, British Guiana, the Tropical Research Station of the New York Zoological Society. In addition to the director, the party included Dr. Alfred Emerson, assistant director; Mr. John Tee-Van, research assistant and cinematographer; Mr. William Merriam, assistant in field work; Mr. Harold Tappin, assistant in entomology; Mr. Herman Rogers, assistant in photography; Mr. Harry Hoffman, artist; Miss Isabel Cooper, scientific artist; Mrs. Helen Tee-Van, assistant scientific artist; Miss Ruth Rose, historian and technicist; and Mrs. Katherine Rogers, assistant microscopist, and Mr. Serge Chetyrkin, assistant field naturalist. Among the objects Mr. Beebe has in view is the rounding out of his notes on the ecology of the quarter of a square mile of jungle to which he has been giving intensive study during his previous sojourns. He plans, also, if possible, to bring back to New York living specimens of the hoactzin, a bird that in the young stage has two toes on each wing as aids in climbing and literally moves about on all fours. Finally Mr. Beebe is completing plans for a trip to Mt. Roraima, to be made either on this or on his next trip to British Guiana.

BIRDS

Mr. Ludlow Griscom, assistant curator of birds, American Museum, sailed on February 5 on an expedition to Veragua, western Panama. He is taking three assistants: Mr. Rudyerd Boulton of the University of Pittsburgh, Mr. George Albert Seaman, field collector, and Mr. J. Manson Valentine of the Peabody Museum, Yale University, volunteer assistant. The party hopes to reach the subtropical or cloud-forest zone in the unexplored mountains of the interior, to determine its extent and ascertain whether it is disconnected from the high mountains of Chiriquí. Little is known about this region, and no collection of its birds exists in America. Somewhere in Veragua the tropical lowland fauna of eastern Panama meets a limited fauna known only from southwestern Costa Rica and Chiriquí, but the location of the barrier separating them and the factors causing it await determination. Mr. Griscom expects to leave Mr. Seaman in the field to make thorough collections at all desirable localities. Still as well as motion pictures will be taken to illustrate the ecology, topography, scenery, and natives.

The Paradise Racquet-Tailed Humming Bird.—Through an exchange of material with Mr. A. L. Butler the department of birds, American Museum, has secured four specimens (2 mature males, 1 immature male, and 1 female) of the unusually interesting and rare humming bird (*Loddigesiornis mirabilis*), known as the paradise racquet-tail.

This bird has several claims to distinction. Known only from the Chachapoyas Valley of Peru and obtainable there only when a certain shrub on which it is dependent for its food is in flower, it is a species much coveted because of its rarity. Excepting an immature female in the collections of the Museum of Comparative Zoölogy in Cambridge, the four specimens mentioned are the first to come into the possession of a scientific institution in America.

Yet its interest on the score of rarity is subordinate to that which it has as one of the few cases among birds of marked sexual dimorphism. All other humming birds have not less than ten tail feathers; but the male of *Loddigesiornis mirabilis* has but four. Yet the striking elongation of two of these feathers in the male bird is compensation, from the æsthetic standpoint at least, for the reduced number. Only the racquet-shaped end of the tail feather is visible in the immature specimen but in the mature male this appears as a culminating ornament at the end of a long thin upward-curved feather-shaft of graceful sweep. The shape of the elongated tail feathers of the female is, on the other hand, strikingly different and less spectacular, and, in contrast to the male, she has the normal number of tail feathers (ten). The glittering blue crown of the male, which shows purple in certain lights, and its shimmering emerald throat are other points of beauty.

The four specimens originally found place in the collection of Count von Berlepsch, having been obtained by his collector, O. T. Baron. In addition to *Loddigesiornis*, four other species of humming birds new to the collections of the American Museum were obtained through exchange, as well as several specimens of species which exist in America only in this Museum. The collection of humming birds in this Museum is now the most nearly complete in the world.

The paradise racquet-tailed humming bird, an interesting case of sexual dimorphism.—The specimen in the upper right-hand corner is an immature male, in which only the racquet-shaped end of the tail is visible. The ornamental elongation of the tail is a conspicuous feature of the two adult males (at the left and at the base of the picture respectively). The female (center) differs strikingly in appearance from her mate. The specimens were recently acquired by the American Museum

MUSEUM LIBRARY

A Valued Gift to the Museum Library.—Through the generosity of Mr. Ogden Mills the library of the American Museum has obtained a set of Lord Lilford's sumptuous work, *Colored Figures of the Birds of the British Isles*. This gift from one who has enriched the Museum by many volumes of great rarity, beauty, and scientific interest, is particularly valued for the magnificent series of 421 plates which it contains, contributed by such artists as A. Thorburn and J. G. Keulemans. Lord Lilford was for many years president of the British Ornithologists' Union, of which he was one of the founders, and the monumental work presented by Mr. Mills is one of the standard contributions to ornithology.

EXTINCT ANIMALS

Ape of the Western World Restudied.—It would seem that *Hesperopithecus* is a name well chosen by Honorary Curator Henry Fairfield Osborn for the genus of anthropoid apes, known from two fossil teeth (one of which is very much worn) discovered in Nebraska in 1922. The actual discovery had been made some time before but the type fossil tooth actually reached the Museum only two weeks after Professor Osborn had advised William Jennings Bryan to study the fossils themselves and not the disputations of the doctors about them. This advice was summed up in the Scriptural verse, "Speak to the earth and it shall teach thee," and by way of showing the pertinence of this counsel there arrived at the Museum the first recognized anthropoid ape tooth found in America.

As in the case of numerous other discoveries of this kind, authenticity was challenged by many scientists. While the American Museum staff agreed that the tooth represented an upper molar of an anthropoid ape, other palæontologists, both in America and Great Britain, questioned this conclusion. Several authors sought to relate it to the fossil type of bear known as *Hyænarctos;* others thought it had affinities with the Carnivora, especially the panda of Asia or the raccoon-like *Potos* of South America; some suggested that it was not an anthropoid but related to the South American monkeys; it was even intimated that the tooth belonged to one of the ancestral horses.

In view of these striking differences of opinion, the American Museum specialists, Dr. W. K. Gregory and Dr. Milo Hellman, subjected the tooth to a more searching analysis and finally reached the following conclusions, published in the *Bulletin* of the Museum, December 4, 1923: first, the tooth in all probability belongs among the higher Primates known as anthropoid apes; second, the greater number of resemblances of the tooth appear to be with the gorilla and the chimpanzee rather than with the orang. Doctor Gregory leans toward the view that the anthropoid ape affinities of the type predominate while Doctor Hellman still regards resemblances to a human tooth as being of considerable significance, and they state that the range of variation in the crown and root characters of the molars both in the human family and the anthropoid ape family is great enough to warrant either viewpoint. The type tooth is probably a second upper molar, as originally decided by Professor Osborn, while the second very much worn tooth found in the same locality is pretty surely an upper molar and probably the third or back molar of *Hesperopithecus.*

In the meantime the leading anatomists of the world have been given an opportunity to study this question for themselves through beautifully prepared casts. Among the authorities who have received replicas of the tooth are distinguished anthropologists and palæontologists of Europe, such as Boule, Depéret, Dollo, Abel, Forster Cooper, Smith Woodward, Elliot Smith, Keith, Pompeckj, Broili, Capellini, Plate, Leche, von Huene, Sergi, Dubois, and Martin, and in this country, Hrdlička, Miller, Boas, Merriam, Lull, and Sinclair. This reciprocity and interchange of facsimile casts of original materials enable, in this case, twenty-six different institutions in various parts of the world to examine for themselves and to form their own opinion as to the possible relationship, or lack of relationship, of the find to human ancestry.

FISHES

Sea Dragons from Australia.—Through the courtesy of Dr. C. Anderson, director of the Australian Museum, the American Museum has recently come into possession of a most wonderful example of nature's handiwork, in the shape of a little sea horse or sea dragon, known scientifically as *Phyllopteryx eques.* As the Rev. Tenison Woods writes in *Fishes and Fisheries of New South Wales,* "One step more, in evolution, and it would have been a bunch of kelp." If this be not mimicry, there is no such thing.

If the reader will imagine a small child clipping off bits of kelp, sticking them here and there on a good-sized sea horse, adding a few tufts of sea weed, and finally inserting a number of spines for good measure, he will have a pretty good idea of this extraordinary little creature.

Accompanying it were three specimens of a relative of this sea dragon,—less elaborately decorated, though to make up for this deficiency, they were in life brightly colored. These strange fishes are seldom seen: as Mr. McCulloch writes in the *Australian Museum Magazine,* for April, 1923: "Whenever the winds blow harder than is usual from the sea, the waves churn up the animals and plants which live just below the lowest limits of the tides. Our ocean beaches at such times become strewn with an assemblage of marine

Kelplike in appearance but a fish in reality, the sea dragon (*Phyllopteryx eques*) is one of the examples in nature which one is tempted to ascribe to protective mimicry. On the left is another sea horse (*Phyllopteryx foliatus*) from Australia. The specimens were obtained by the American Museum through the courtesy of Dr. C. Anderson, director of the Australian Museum

organisms which are rarely exhibited to our view under any other circumstances." And this flotsam and jetsam now and then includes examples of these strange little sea horses.

In view of the rarity of these fishes, it is somewhat surprising to find that one of them, *Phyllopteryx foliatus*, was described as early as 1804, and the other, *Phyllopteryx eques*, in

1865. The name *Phyllopteryx*, leaf-finned, in allusion to the flowing appendages with which these fish are decorated, is very appropriate, but it is a pity that the term *foliatus*, bearing-foliage, could not have been applied to the species described in 1865, which is far more like an animated bit of kelp than is its relative. Scientific names, once given, must not be changed, even though they cease to be fitting, but it is a pity the names cannot be transposed.

This recalls the case of the great eggs from Madagascar which were christened *Æpyornis maximus*, though later discoveries have shown that while the eggs are still *maximus*, the bird that laid them was surpassed in size by some of her relatives; science is sometimes in too much of a hurry in applying adjectives.—F. A. L.

EUROPEAN ARCHÆOLOGY

A Gift from M. Zacharie Le Rouzic.—Through the active interest of Mrs. Henry Fairfield Osborn, the department of anthropology, American Museum, recently received a collection of archæological objects recovered by excavation in the region of the great megalithic monuments of Brittany or, to be more specific, that part of Brittany known at present as the Department Morbihan. The specimens came as a gift from M. Zacharie Le Rouzic, curator of the Musée J. Miln, situated in the village of Carnac in the midst of some of the most wonderful of the Late Stone Age antiquities. It will be recalled that President and Mrs. Osborn visited this locality in 1921 and that President Osborn published an illustrated article in Natural History for May–June, 1922, giving an account of his observations.

The collection appears to include specimens typical of both the Early and Late Neolithic periods and comprises roughly worked flints—cores, flakes, and scrapers; several mealing stones, hammer stones, rubbing stones, and polished celts; pottery fragments, and some minute bits of bone—perhaps human bones from a burial urn. Included in the collection are also a number of glass beads of various types belonging evidently to a much later period of culture and possibly buried for magical purposes in the vicinity of the great stone monuments, which are still held in awe and veneration by the surviving Bretons.—N. C. N.

The Iron Age of La Tène.—A notable recent addition to the Osborn Library is a monograph by Professor Paul Vouga (1923) on La Tène, the famous Swiss type station on Lake Neuchâtel. Originally intended as a detailed account of the results of excavations pursued from 1907 to 1917, the author extended the scope of his work to include an account of all the known discoveries belonging to the Helvetian site of La Tène, and has produced an invaluable work of reference. Associated from early youth with the pioneers of Swiss archæology—among them his father, Emile Vouga, to whom the work is dedicated—Professor Vouga is singularly fitted to give an authoritative account of the various explorations at La Tène since its discovery in 1858. His book is lavishly illustrated with two excellent maps and several cross sections, a few well-chosen text figures, and no less than fifty plates picturing over 600 of the various articles found at La Tène during the excavations of recent years, in which the author took part. Not only are all these articles drawn to scale, but the plate descriptions give page references to the text concerning every specimen pictured. The text is a model of clearness and brevity, and scrupulously observes a fine distinction between the record of facts in regard to the specimens described, and the advancement of hypotheses which might conceivably explain those facts.

The volume opens with a description of the geographic situation of La Tène and a brief historic sketch recounting all the various excavations made from its discovery down to the present time. Then comes a detailed account of the topography and geology of the site by Professor Auguste Dubois. In less than three pages Professor Vouga outlines the causes which led to the wide dispersal of specimens from La Tène, and to much confusion in identifying them. The first part closes with a classified inventory of all the articles found at La Tène, indicating the thirteen different institutions where seventy different kinds of artefacts may be found, represented by more than 2500 specimens. The main body of the work is devoted to describing the specimens discovered from 1907 to 1917, and these are grouped with such excellent judgment that the very chapter titles supply a vivid picture of the life of prehistoric man in the settlement of La Tène. The weapons, or fragments of weapons, include swords, lances, pikes, javelins, bows and arrows, the metal scales for coats of mail, and the bosses and hand-grips of wooden shields. Toilet articles are represented by shears, razors, and tweezers, and ornaments by fibulæ, bracelets, torques, pins, beads, etc. The fisherman's activities are represented by fishhooks, harpoons, tridents, and boat hooks, and the agriculturist's by sickles, scythes, and pruning hooks—perhaps harrows as well. Then there are mills for grinding meal, mortars or presses for extracting the juice of fruits, kettles of bronze reinforced with iron, jars of pottery, and various wooden dishes. A knowledge of basketry or weaving is indicated by fragments of fabrics made of woven or plaited straw. The wheelwright's work is shown in the fragmentary remains of vehicles—among them a perfect wheel illustrated *in situ*, while bits and spurs, and some fragments which may possibly be the remains of a pack-saddle testify to the work of the harness-maker. Carpenters and joiners left their mark on slabs of wood, notched or bored for use as piles, beams, and other purposes which can only be conjectured. Spikes and braces for fastening wooden structures, and many wood-working tools are found, as well as tools for working leather and metal. Among several bizarre objects figured, which may have been used in games of some sort, it is quite a shock to find two fairly recognizable dice, one of bone and one of bronze. Is it possible that prehistoric man played a primitive game of craps? Some degree of commercial activity is inferred from the presence of gold coins, weights, and balances.

There are three supplementary chapters—one by R. Forrer on the gold coins, one by C. Keller on the fauna, and one by E. Pittard on the human remains found at La Tène. In summing up the evidence which he has been so largely instrumental in collecting, Professor Vouga reaches the conclusion that La Tène was a fortified, garrisoned trade depot, that the remains found there represent only one cultural phase, that of La Tène II, and that its occupation may be dated approximately as lasting from 250 B.C. to 100 B.C.—C. D. M.

Aurignacian Skeletons Discovered at Solutré, France.—Reports lately received give particulars in regard to a recent discovery of the greatest interest, made by MM. Deperet, Arcelin, and Mayet at the famous type station of Solutré—namely, the skeletal remains of no less than five individuals associated with implements of Aurignacian type and embedded in the deposits immediately beneath the great horse magma, which is also of Aurignacian age. Three complete skeletons, two male and one female, were laid out as for ceremonial burial, each placed with the body lying in a west to east direction, and each burial place marked by two large slabs of limestone, which must have stood well above ground at the time of sepulture. Close to the woman's skeleton were found skeletal fragments belonging to two very young children. One of the male skeletons was embedded in an extensive "hearth," or layer of ashes and calcined bones, in which there were also found 316 flint implements of very indifferent workmanship. Inside the bones of the other male skull, embedded in earth, there was found a flint arrow point. Particular interest attaches to the anatomical features of these skeletons which show some marked deviations from the Crô-Magnon type as observed in the human remains from the type station in the Vézère Valley, and those of similar type more recently discovered in the Grottes de Grimaldi and described by Verneau. The general proportions of upper and lower limbs, as well as the peculiar features of their several bones which are characteristic of all Crô-Magnon types of Aurignacian age, are not found in these Aurignacian skeletons of Solutré.

The height estimated for the two male skeletons is considerable (6 feet, and 5 feet, 9 inches respectively), and in this regard, as also in certain characters of the skull—namely, the large cranial capacity, the outlines of the sagittal and horizontal curves, and the shape of orbits, nose, and lower jaw—they resemble the established Crô-Magnon type. But in two important points they differ widely. In the Crô-Magnon type the cheek bones are high and prominent and project laterally in such manner as to add very considerably to the breadth of the face, which thus becomes "disharmonic" with the long and narrow, or dolichocephalic, skull. In the skull figured from Solutré (No. 2) the cheek bones show no pronounced projection, but lie very smooth and close to the side of the face. The latter is broad but not disharmonic with the skull, as that also is decidedly broad. In fact, perhaps the most striking anatomical feature of these Aurignacian skeletons of Solutré is the mesaticephalic, almost sub-brachycephalic, shape of the skull, since all the Aurignacian skulls hitherto known are invariably dolichocephalic.

These are by no means the first human remains to be discovered in the great prehistoric deposits of Solutré, as a number are recorded from earlier times. Unfortunately the present exact methods of determining stratigraphy had not then been developed, nor was the surpassing importance of these human documents fully realized. Consequently there is now no means of determining the stratigraphic position of many of these remains, while others—such as the complete human skeleton interred with Solutrean leaf points, reindeer bones, and a figurine of a reindeer, discovered in 1868 by the Abbé Ducrost—have been lost beyond recall. It is a great satisfaction to know that the further excavation of the great type station of Solutré is now being prosecuted so vigorously, and that it is in such expert hands. We may confidently hope for further discoveries to increase our knowledge of the fossil men of Solutré.—C. D. M.

MAMMALS OF THE WORLD

Monkeys from British East Africa.—Recently the American Museum received a valued accession to its great primate collection, which through the efforts and personal attention of Dr. Frederic A. Lucas has been steadily increased in recent years and put in such fine condition that the exhibits are now, it is believed, the best in any museum.

The gift consisted of five skins, three skeletons, and two skulls of British East African monkeys, presented through the generosity of Captain Neite Caldwell of Nairobi.

Colobus rufomitratus, Peter's red-capped *Colobus*, represented by three of the skins, belongs to the reddish, generally more short-haired group of the Colobinæ, ranging across equatorial Africa. Its bright rufous crown, bordered with black, and erect bunches of hair give it a distinctive appearance. The seal brown, nearly black, fine hair of the upper parts and tail contrasts with the gray of the under side and limbs. It was discovered as early as 1879 but for many decades was known only from a single specimen preserved in the Berlin Museum.

This is also true of the second species presented, the crested mangabey, *Cercocebus galeritus*, to which the other two skins refer. It is the easternmost representative of the mangabeys, a group really West African in distribution. Some forms show a remarkable variety in the arrangement of the lengthened hair forming the head crest and shoulder patches. The general color of this species is grayish brown with darker hands, feet, and tail. The hair of the eyebrows and crown is much lengthened and together with that of the nape forms a conspicuous crest.

Probably these are the first skins of these monkeys to arrive in this country. This may appear strange considering that in the wake of Colonel Roosevelt's successful African explorations, so many Americans made collections in British East Africa. But these Primates are very local in their distribution, being confined to the forest galleries along the few water-courses near the east coast north of Mombasa, chiefly along the Tana River.—H. L.

The Sixth Annual Meeting of the American Society of Mammalogists is scheduled to take place in Cambridge and Boston, April 15–17. The sessions during the first two days will be held in the Museum of Comparative Zoology and will be devoted to the reading of papers, discussions, and business. As a part of the general program a symposium has been planned on "The Scientific and Economic Importance of Predatory Animals." On the evening of April 15 the society will hold a session in the building of the Boston Society of Natural History, and on the last day of the session, thanks to the kind invitation of Prof. W. E. Castle, a visit will be made to the Genetics Laboratories at Bussey Institution, Forest Hills, Massachusetts.

A New Volume by Ernest Harold Baynes.—*Jimmie, the Story of a Black Bear Cub*, by Ernest Harold Baynes, has recently been put into book form by the Macmillan Company. It is a companion volume to *Polaris, the Story of an Eskimo Dog*, and is one of the author's most fascinating narratives. Mr. Baynes's admirers and friends, especially those who have heard him tell about Jimmie, will be delighted to know that the story is now set down, so that they may have it permanently available. The book is copiously illustrated with photographs by Mr. and Mrs. Baynes, and these appealing pictures make the narrative doubly telling. It is hoped that Mr. Baynes's stories of "Sprite, the Red Fox," and "The Little Wild Boar," and others will also be put into book form.—G. C. F.

The Elephant in War.—There has always been some question in the minds of historians as to the source of Hannibal's elephants, those which he took into Spain and used in the conquest of northern Italy. We are indebted to a member of the Board of Trustees of the American Museum, Mr. Madison Grant, for an informing Note on this subject and we shall be glad to have further data from others who are interested:

The animals used by the Carthaginians could not have come from Asia without having left some record of their progress across Syria, Egypt, and Cyrene on their way to Carthage. The only possible way of getting the Sudan or Abyssinian elephants was to float them down the Nile as was done by the Romans much later. As we have no record that this was done, I am convinced that we must look to the west or south of Carthage for the source of supply.

Hannibal brought his elephants into Italy through Spain in the year 218 B.C. Pyrrhus, at an earlier date, about 281 B.C., brought elephants across the Adriatic from Epirus, and this was the first time the Romans met the elephant in war. The source of these elephants was Asiatic and their origin is definitely known. After Alexander's death his successor in the extreme eastern part of his empire obtained by war and as tribute Indian elephants from Indian rulers in the neighborhood of the Indus River. A certain number of these are known to have been sent across Asia Minor to Macedonia and hence to Epirus.

In a later communication Mr. Madison Grant supplies additional information regarding the elephant in war and in domestication:

The Indian elephant, so far as we know, is the only one that has ever been domesticated. The elephants the Romans had in their circuses were, like the rhinoceroses and other bulky animals, floated down the Nile from what is now the Sudan, and nothing of this sort seems to have occurred to supply the Carthaginian army with its numerous elephants.

All this is a matter of fairly definite record. If elephants at this time or earlier had been transported across the Arabian and Syrian deserts, from Egypt and eastern Libya to Carthage, there would have undoubtedly been some record, especially as we know the history of Egypt under the Ptolemys in detail.

Hannibal's elephants, it will be recalled, started from Spain and it would seem as though they had been drawn from the northwestern corner of Africa. India or the Sudan would have been too remote a source. Some years ago, a "pygmy elephant" was discovered in the Congo—in fact, the New York Zoological Park had the type specimen, and at the present time there is a small specimen on exhibition in the park. This is the species of elephant now living nearest the northwestern corner of Africa.

It appears that a Roman general, Suetonius Paulinus, about 45 A.D. reached the high Atlas range in Morocco and on the south side of the range found "swarms of elephants in the Atlas forests." These may have been the same species as the "pygmy elephant" or they may have been a larger species but, at all events, we have there a definite record of the occurrence of African elephants in Morocco and, personally, I believe that this is the source from which Hannibal drew his supplies.

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'ol. XXIV MAY-JUNE No. 3

NATURAL HISTORY

AFRICA

MARTIN JOHNSON AND HIS EXPEDITION TO LAKE PARADISE BY CARL E. AKELEY—SCENES OF AFRICAN WILD LIFE THAT EXEMPLIFY THE PHOTOGRAPHIC ART OF MARTIN JOHNSON—THE HIGHLANDS OF THE GREAT CRATERS BY JAMES L. CLARK—THE VANISHING WILD LIFE OF AFRICA BY HERBERT LANG—AN AFRICAN BIRD THAT GUIDES MEN TO HONEY BY JAMES P. CHAPIN

AMATEUR ENTOMOLOGISTS AND THE AMERICAN MUSEUM—A BEAVER COLONY OF YELLOWSTONE PARK—THE AMERICAN MEN OF THE DRAGON BONES—WINTERING OVER A FIRE BASKET IN SZECHUAN—NATURE PHOTOGRAPHY IN THE MOUNTAINS OF WASHINGTON—DINOSAUR TRACKS IN THE ROOFS OF COAL MINES—DEAN'S "BIBLIOGRAPHY OF FISHES"

The American Museum takes this opportunity of expressing its hearty appreciation for the friendly assistance accorded its expeditions over a period of many years by government officials and others in the several sections of Africa, and for the collections from that continent which have been presented to it by interested individuals.

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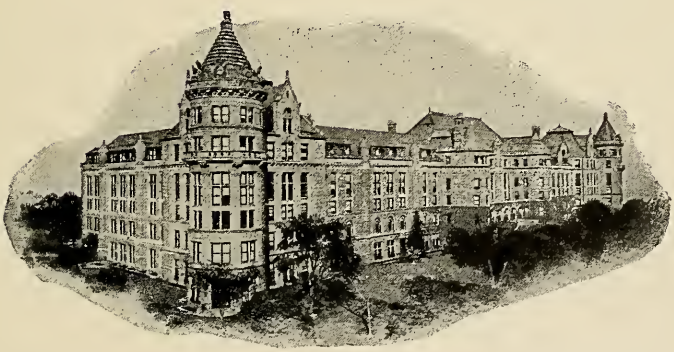

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South America

South America, the continent to which the July-August issue of Natural History is to be devoted, has long been a favorite field of zoölogical exploration, thanks to the diversity of animal life that such contrasted environments as tropical jungle, Andean height, and desert coast afford. Dr. Frank M. Chapman, who has but recently returned from the tip end of the continent, where he has been pursuing his study of the South American birds, will contribute an entertaining description of some of his experiences in that part of the world. The heart of the Andes of Ecuador has been explored by Mr. H. E. Anthony, in charge of the department of mammals, American Museum, who will tell through his beautiful pictures and his no less vivid text some of the attractions of the region. A feature of interest will be reproductions of several of the inspiring landscapes of Frederic E. Church, painter of the high Andes, and excerpts from the journal of his travels. From the snow line the next contributor, Mr. Herbert Lang, associate curator in the department of mammals, invites the reader to descend to the tropics and journey with him along the forest-flanked Mazaruni River into the heart of British Guiana, the interest of which he reveals in a well-illustrated article. Articles by contributors connected with institutions other than the American Museum are promised, and the magazine is glad to have the opportunity of giving recognition to the important work they are doing. Mr. Wilson Popenoe, of the United States Department of Agriculture, will describe some of the fruits that he has studied in Ecuador with a view to their introduction and cultivation in the United States, and Mrs. Edmund Heller will give an account, full of sprightly incidents, regarding some of the wild animals which became important members of the expedition that Mr. Heller and she made through Peru on behalf of the Field Museum.

Panama is a region that has affiliations with South as well as North America notwithstanding the fact that a masterpiece of engineering has consigned it to the latter. To Panama the American Museum has sent several expeditions. Dr. Frank E. Lutz, recently returned from the region, will tell, with delightful touches of humor, about his field studies of the stingless bees,—studies which have contributed to the knowledge of these interesting insects. Mr. Ludlow Griscom, who ventured into a portion of Panama that is forbidden territory to the white man, will contribute an account of his adventures and observations.

MARTIN JOHNSON GETTING READY FOR ACTION

With an equipment such as no photographic expert has previously carried into Africa, Martin Johnson should bring back from his five years' sojourn at Lake Paradise pictures that will eclipse even the superb series he has secured in the past

NATURAL HISTORY

VOLUME XXIV MAY-JUNE NUMBER 4

Martin Johnson and His Expedition to Lake Paradise

A CULMINATING CHAPTER IN THE HISTORY OF WILD-LIFE PHOTOGRAPHY, WITH A SURVEY OF SOME OF THE EARLIER STAGES IN THE DEVELOPMENT OF ITS TECHNIQUE

BY CARL E. AKELEY

WE of today have but a faint conception of the Africa of fifty years ago. South Africa was then known to the world as a land teeming with game. On the veldt occupied by the Boers the game was being used for food and clothing. The "hinterland" was untouched except by missionaries, ivory hunters, and traders. Equatorial Africa was almost unknown. Only in recent years when the game of the south had been killed off and driven back and some of the species had been exterminated, were the game fields of the equatorial region explored —and exploited. And now the great game fields of the past are but a memory. Here and there are "game pockets" where, in a congested area, may be seen what appears to be an inexhaustible number of animals, but once one of these pockets is "discovered" and made known to the world, the slaughter begins, the pocket is emptied. Such a pocket was Stewart Edward White's "Undiscovered Territory;" Ngorongoro, the great crater of Tanganyika Territory, and Lake Paradise, referred to later in this article, are similar teeming centers of game. Others will be located, each one doomed in its turn, unless Herculean efforts be made to arrest the progress of destruction. Where there is one individual eager to conserve, there are a dozen bent on slaughter—for gain, "sport," or some one of many pretexts. Hardest of all to combat is the claim that the game animals carry and spread the diseases of domestic stock. The perennial cry, "The game must go; this is no longer the world's zoo but an agricultural country," is heard throughout Africa. There is just one relieving circumstance in this doleful prospect: what man seems bent upon destroying with his gun can at least be rescued from complete oblivion and given the illusion of reality through the camera operated by the right kind of individual.

Forty years ago, shortly after George Eastman had put the first dry plates on the market, no one, perhaps, dreamed of the possibility of making a photograph of a live wild animal. Even twenty-seven years ago, when I started on my first African journey, there was much discussion as to the advisability of encumbering the expedition with a camera, fortunately decided in favor of the camera. Compared with those used at the present time, photographic lenses were slow, and plates and films likewise. Telephoto lenses were in their infancy. We made practically no attempt to photograph live animals.

But few pictures of wild game had come out of Africa at the close of the nineteenth century, and most of these were of dead or wounded animals that could not escape the camera man. A few photographs of free live animals had been made by Lord Delamere, Mr. E. N. Buxton, and others, that were interesting in their suggestion of further possibilities.

Toward the close of the nineteenth century C. G. Schillings began the work in German East Africa which, after about seven years of arduous effort, resulted in his book, *Flashlights in the Jungle.* This was the greatest contribution of wild-life photographs that until then had been made by any one man. Before that, wild life was recorded for the most part with pen and pencil—too often combined with hearsay and imagination. In *A Breath from the Veldt* by J. G. Millais, published in 1895, we have the finest example of pen and pencil records of African wild life. Few indeed have combined the keen powers of observation and pictorial skill of Millais. *A Breath from the Veldt* is a work of enduring value and charm. The serial sketches, such as "Springbuck Crossing a Road," "Evening Play of the Bush Khoorhan," are real "motion pictures," convincing and pleasing. Dugmore gave us a wonderful record of several months of strenuous work with flashlight and camera in British East Africa. In 1908, with James L. Clark as a bodyguard, he secured material for a book replete with remarkable photographs.

The first of the noteworthy motion pictures of African game to come to this country were those brought by Paul Rainey. The waterhole pictures were a revelation, although technically they were far from good. They were made by Mr. Lydford of Nairobi, who had not previously taken motion pictures and whose photographic equipment was inferior. The waterholes have been photographed frequently and with better results since, and last and best by Martin Johnson. In the interval between Rainey and Johnson, James Barnes with Cherry Kearton gave us a good impression of the waterholes in their photographic journey across Africa from the east coast to the mouth of the Congo. Bengt Berg made a beautiful series of pictures of the birds of the Nile. Dugmore and Harris came back a year ago with a good film of East African game. There are many fine bits of film scattered about in the collections of a score or more of others who, as sportsmen or travelers, have made conventional trips to Africa in recent years.

In the forty or more years that have elapsed since the achievement of Eastman above alluded to, photographic equipment has been devised that, placed in the right hands, assures results formerly unattainable. With the roll film and the kodak amateur photography was launched. Development of the flashlight photograph, made possible by the magnesium flash powder, fast lenses, and highly sensitive film, stimulated interest still more. In 1892, after several years of experimenting, George Shiras 3d, a pioneer in wild-life flashlight photography, advanced its technique to a degree of efficiency that resulted not only in the beautiful examples that he produced, but also in a great popularization of that form of photography. Today, as a result of the development of the celluloid gelatin film of high sensitiveness, fast lenses, telephoto lenses, and motion picture, it is possible to make records of wild life that are of infinite scientific value and popular interest. I say possible. At the present time all the necessary tools are available, but a complete outfit of cameras, lenses, and necessary equipment for making general wild-life studies costs many thousands of dollars, and when such an equipment has been assembled, it is not of much use except in the hands of a man of vast experience, gained of necessity through years of hard work prompted by an unquenchable desire to carry on. The rare elements of this combination required to secure the priceless records of a fast-vanishing wild life are an "A" man to do the work and a man, or men, with vision and idealism to see that he is backed financially.

To make a life-history picture of an animal such as the elephant, for instance, is a tremendous undertaking. It involves photographing the animal in its various moods and under conditions that are as varied as the types of country it inhabits, from the low-lying coast lands to the snow fields of the equatorial mountains; pursuing the animal as it travels over thirst lands where at times for water it is dependent on the moisture contained in aloes or other plants of the arid regions, or the seepage that results when the powerful beast digs holes in the sand of the dry stream beds. At other times the photographer may be half-submerged in swamps and marshes, or trekking the grass lands of the high plateaus or the bush veldt, or lost in the somber shadows of the great forests, or clambering up steep cliffs, or "tobogganing" down a greasy slope. He will have to seek out the mother elephant with her new-born babe in her retreat away from the trails of her kind, where she remains until the youngster is strong enough to join in the treks of its elders. To make such a life-history picture requires a great deal of time, infinite patience and enthusiasm, and a willingness to dice with death; and the elephant is but one of hundreds of species of animals that await the man with the skill, perseverance, and backing to record their fascinating life stories for science and the world at large.

Martin Johnson, the American Museum believes, is a man who measures up to these standards. Through years of hard but joyous work "on his own" he has gained the experience and demonstrated to the world his ability to meet the most exacting requirements as the "man behind the camera." Seventeen years ago he was with Jack London, voyaging in the "Snark" through the South Seas. There he came in contact with a motion-picture camera that was in the hands of some men who were tired of their job, and took it over; ever since that time he has devoted all his energies to the production of motion-picture films. He made splendid records of primitive life in Polynesia, the New Hebrides, Borneo, and Africa. Much of this material is of inestimable value. Because of rapidly changing conditions in these lands some of it could not now be duplicated, and its preservation for all time for the benefit of the world is assured, for Johnson with characteristic generosity has turned over all his negatives, still as well as motion, to the American Museum.

A year ago Mr. and Mrs. Johnson returned from their first journey to Africa and gave to the world a photographic record of African game that was of greater interest and beauty than any that had been brought out of Africa before.

As a result of the American Museum's appreciation of the importance of Johnson's work, a group of men, headed by Mr. Daniel E. Pomeroy and including two of the Trustees of the American Museum, Mr. F. Trubee Davison and Mr. A. Perry Osborn, undertook to send him back to Africa for a period of five years to do the things he wanted to do: to make pictorial life-history records of the people and the wild animals of the jungle, plain, and forest, unhampered by the necessity of paying tribute or of catering to purely financial interests. To Mr. Pomeroy and his associates the Museum and the public owe much, not only for making possible the work that lies ahead but for that already accomplished.

Mr. and Mrs. Johnson have reached the spot that will be the scene of their activities during the next five years. It has been named by them Lake Paradise and is a small crater lake somewhere near the northern border of Kenya Colony. To them it is a veritable paradise, for it is a region that has not been invaded by the sportsman, where animal life is abundant and unfrightened—an ideal place for Johnson's work. And what he proposes to do there cannot be better indicated than in his own words.[1]

For seventeen years I have been wandering here and there in the tropics, and for fourteen years Mrs. Johnson has been with me, photographing the strange and interesting things we have seen. But neither of us is content with thinking of the things we've seen or the pictures we've taken. What we've done is done, and while we feel that we have done something to create a better understanding of the out-of-the-way spots we have visited, we are not satisfied that we have done our best. To us what we have done seems now as if it were a course of training, and now we want to do something better, something more valuable, and more permanent. If it is not done now, it will never be done, and so it is that this expedition is being financed.

We will bring back with us a vivid portrayal of untouched Africa—a picture of the beauties of the last of the great continents to be explored—a picture of the natives and the animals as they live their lives all but untouched by civilization—unaffected by the worries of the outside world. We will get a picture that will be a record for a thousand years to come, of Africa as God made it, before the white man penetrates further into its beautiful wilds, and before the natives and the wild animals have disappeared.

Our prime purpose is to photograph Africa and the inhabitants of Africa—to photograph them as they normally exist—to photograph them in their wanderings, in their play, in their migrations and their congregations—in their natural relations to each other and to the world in which they live. Thrills in plenty we will have—and I hope we'll photograph many of them—but they are incidental to our main purpose, which is to secure a truthful, accurate, complete, and interesting picture of Africa as it is—not a picture of "The Adventures of Mr. and Mrs. Martin Johnson."

There is no question that Martin Johnson is the man to do the work that has just been outlined. The American Museum is seeing to it that he has the moral support and Mr. Pomeroy and his associates are generously supplying the financial backing to make the great undertaking possible. The negatives of the pictures, both still and motion, that the expedition secures, will become the property of the American Museum, to be held as a permanent record of African wild life, and the films before passing into the regular channels of distribution will be edited by members of the scientific staff of the Museum, with a view to making them error-proof and of as great educational value as possible. Public appreciation of what has been done already, and of the importance of the undertaking, should be such as to guarantee that the work of Johnson may go on indefinitely.

[1]The passage that follows is taken from *World's Work* for August, 1923, but the order of the paragraphs has been changed somewhat to meet the present requirements.

Scenes from the Plains and Jungles of Africa

REPRODUCTIONS IN DUOTONE FROM PHOTOGRAPHS

By MARTIN JOHNSON

Leader of the Martin Johnson African Expedition

THE AFRICAN BUFFALO

The buffalo is better equipped to take care of itself under adverse conditions than are most animals. Several decades ago the rinderpest swept off vast numbers, but the isolated small herds that escaped this scourge were apparently sufficient to restock the country.

The animal shown in the picture is probably a straggler from a herd. Lone bulls and small bands of old bulls often wander about independent of the main herds, which may consist of as many as 500 individuals. Some herds habitually live in swamps, rarely moving far afield on the hard ground; others live in bush country and go to swamps and streams only for water; and still others roam over the open plains but promptly take to the bush if hunted

ELANDS

The eland, the largest of the antelopes, is easily domesticated. Young ones will sometimes join herds of domestic cattle, being adopted by them

GIRAFFES AT THE EDGE OF A SWAMPY WATER HOLE

The giraffe is one of the most picturesque animals of Africa. It is inoffensive, inflicting injury neither on man nor his crops

THE ATTRACTION OF THE WATER HOLE

From the left a herd of impalla is making its approach; at the hole itself are several oryx, distinguished by their rapier-like horns; in the background zebra are loafing about; and in the far distance a small group of game is distinguishable

BURCHELL'S ZEBRA AND THE BRINDLED GNU

Burchell's zebra is one of the most abundant of the wild animals of equatorial Africa. It is a favorite food of the lion. Although sometimes domesticated, the zebra has not proved very useful as a beast of burden

NATIVES WITH THEIR FLOCKS

In arid regions the natives frequently travel long distances to obtain their water supply, filling the fiber vessels which they bring for the purpose

IN FULL REGALIA

Although these natives bear shields and are armed with spears, their intent is pacific, indicated by the pompons of ostrich feathers carried on the spear points and known as "peace balls." Feasting and dancing are features of the tribal gatherings

ELEPHANTS IN FORESTED COUNTRY

Martin Johnson intends among other things to record in motion picture the life history of the elephant. Lake Paradise, where he is encamped, offers exceptional opportunities for the study of this animal.

One of the elephants in the picture is raising his flexible trunk to pull down a branch,—one of the many functions that this adaptable organ performs. As Mr. Akeley has pointed out, an elephant "drinks with it, feeds himself with it, smells with it, works with it, and at times fights with it"

"Lone Tree Camp," on the crater floor near the northeast wall, looking southwest across the crater, with Oldeani at the left

The Highlands of the Great Craters[1]

WITH SPECIAL REFERENCE TO THE VAST CRATER OF NGORONGORO

By JAMES L. CLARK

Assistant Director (In Charge of Preparation), American Museum

NEARLY due south and less than 150 miles from the well-known and active little town of Nairobi, and just within the northern border of Tanganyika Territory—formerly German East Africa—lies one of those isolated bits of interesting and beautiful country that are so characteristic of Africa. It is known as the Highlands of the Great Craters, so named on account of the many interesting craters that break its great surface into an almost continuous series of immense basins, splintered peaks, and deep ravines. Resting like a crown on the peak of this wonderful stretch of mountainous highland country, that rises green as an oasis in the center of a great expanse of arid African plains, are the perfect remains of the largest crater in the world—Ngorongoro or, as the natives call it, Ngoro.

In 1909 I spent months hunting along the border that separates the Highlands of the Great Craters from British East Africa, yet I heard nothing that even indicated the existence of this place, and to my many queries, addressed to men who should have known, as to what lay beyond, I received only one answer: "A God-forsaken, low, hot country, where there is nothing except bush and fever."

For the past fifteen years big safaris have been radiating from Nairobi all through this East African section in all

[1]The photographs accompanying this article were taken by the author with the one exception noted.

Phot graph by Captain Hurst

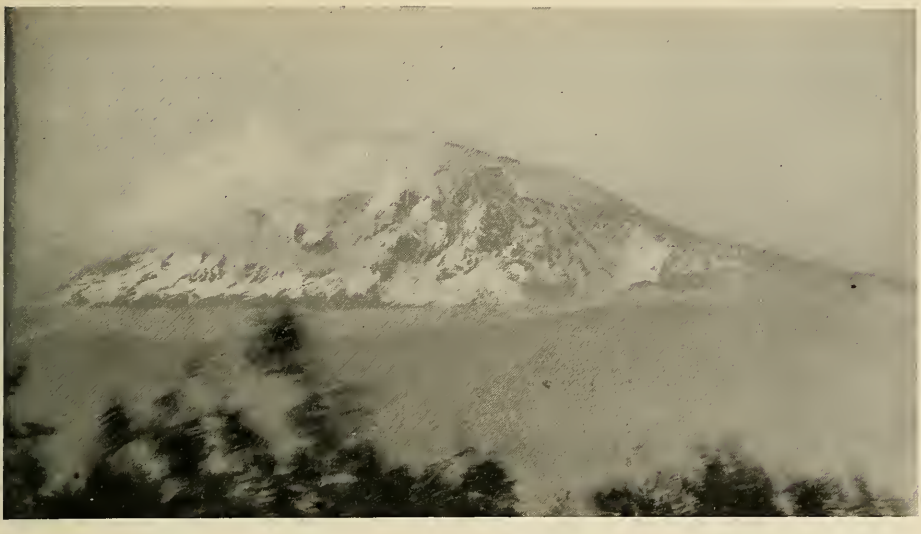
Oldonyo Lengai, "The Mountain of God" in the language of the Masai.—This peak in the group of the great craters lies about fifty miles north of Ngoro. It erupted twice during the late war, the last time being in 1917, and still lies barren for the most part in its cloak of colored muds. Only here and there a bit of vegetation is doing its best to get a start

directions, shooting and reshooting over the same ground and trekking far north for possible new and less-disturbed fields, yet this beautiful spot with its unmolested herds of game lay untouched—safe, for a time at least, from the onslaughts of the sportsman.

During my sojourn at this time, I was perhaps less than a hundred miles from this locality, being then in the the great southern preserve of British East Africa, which on account of its great abundance of game was set aside as a source of replenishment for all outlying districts. The general ignorance of this wonderland's existence seems somewhat surprising when account is taken of the fact that in 1894 there had appeared a publication in German by a Dr. Oscar Baumann, in which reference is made to it. It had also been explored by Dr. Fritz Jaeger in 1906–07, who conferred upon it the name of the Highlands of the Great Craters (Das Hochland der Reisenkrater) in the monograph that he issued in 1913.

Geographically there is no barrier to the region: the great Athi Plains roll south through the southern game preserve, over the border, and far beyond. Way to the east stands the great mountain of Kilimanjaro and its smaller but more rugged companion, Mt. Meru. This section was fairly well known, as the fertile slopes, fed by the melting snows that flow from these peaks, drew adventurers and settlers to this land of promise. But to the west and between was still a blank so far as the English-speaking world was aware.

After the War a few scattered reports began to be circulated of a wonderful country that lay in the center of this supposedly barren area. The first English-speaking party to enter the Highlands of the Great Craters was that of Sir Charles Ross, who in the winter of 1921–22, accompanied by Mr. T. Alexander Barnes, made the



Kilimanjaro photographed with a seventeen-inch telephoto lens from Moshi, about fifteen miles distant. An extinct volcano, 19,456 feet high and 3° 40′ south of the equator, it is the highest of all the mountains of Africa and with Mt. Kenia (17,040 feet) and Elgon (14,140 feet) forms one of the three great landmarks of the East African section. Its blanket of snow, estimated to be 200 feet thick on the top, extends down its slopes for 6000 feet

trip and brought out information regarding their marvels. That fall, equipped with the maps and information Sir Charles had given me, I made the same trip, being a member of what, I believe, is the first American party that has visited the region. The fact that it is located as it is, away from the beaten routes of the trading and hunting safaris, and with the uninviting, arid plains about it, explains perhaps why it has enjoyed its years of secluded peace.

Our route started from railhead at the little town of Moshi, that nestles on the southeast slope of Kilimanjaro, at about 2800 feet, and proceeded thence to the delightful little post of Arusha on the slopes of Mt. Meru, where the climate bids one linger as long as his time will permit.

From Kilimanjaro west the country rolls along in rather hot arid plains, only occasionally relieved by small broken hills, which are the eroded remains of small volcanoes, until it reaches its lowest level in a hot flat bush country, about a hundred miles from the mountain. Confronting us at this point an escarpment 2000 feet in height rises sheer; it is the western wall of the great Rift Valley, which runs north and south, more or less distinctly traceable for a thousand miles, and is the result of a great slump that took place in some prehistoric time. At the base of this lies Lake Manyara, which today has shrunk to a fraction of its former size, and in its retreat has left a floor as flat as a table and miles in extent. Around the shores of this lake extends a great tsetse fly belt, which for safety's sake is traversed at night, and as there is no camping ground until the top is reached, the precipitous wall is climbed in darkness by following a native trail. In the morning one looks down on a great relief map, over which he has been trekking for days. The climate has changed, and the traveler finds himself in a rich green rolling country—the

Looking northwest from the floor of the Rift, the old bed of the receded Lake Manyara to the left with the shore line showing distinctly on the right.—The clean-cut western escarpment of the Rift is clearly seen running north and south. Ngoro is the great bulk in the background that rises from the escarpment into the clouds that obscure it. The distance from the point where the picture was taken to the crater is about thirty miles. The three elevations are well defined: floor of the Rift, 3000 feet; escarpment, 5000 feet; crater edge of Ngoro, 8000 feet

After leaving Mbulu the safari trekked northward over the rolling upland shelf

Looking north from "World's View."—The great sweep downward between "World's View" and Ngoro mountain is indicated in this picture

land of the Wabulu (the People of the Mist),—which supports fine, well-fed herds of cattle, sheep, and goats, is well supplied with water, and is covered with great patches of forest.

Emergence into such a delightful environment after the trek over the heated plains below, has an invigorating effect, and at this elevation of about 5000 feet, one gets a more refreshing sleep in the cool of the night air.

Turning northward and traveling through these rolling highlands for three or four days, one nears the Great Crater. A height of land is reached on the third day, and after the ascent to its great ridge, we stand on what is justly named "World's View." Looking back over the green upland shelf just traversed, the traveler sees far below and beyond the expanse of yellow plains, obscured in the haze of heat.

To the north the country makes a great sweep downward, retaining its olive green tinge except in the lowest valleys, where it becomes a bit parched, and terminates in the great mountain of Ngorongoro. One sees the crater's southern edge, rising to 8000 feet elevation, extending far to the east and west. It appears like an unbroken mountain ridge stretched between two higher volcanic mountains (Ololmoti and Oldeani), the crater edges of which show sharp against the sky, but these are indeed merely blowholes on its sides. These peaks rise to 10,000 feet each, and although great mountains in themselves, they are dwarfed into insignificance when viewed later as protuberances upon the crater ridge.

To the east the descending slopes make their way unbroken until they terminate abruptly at the edge of the great rift; then there is a sheer drop

Oldeani as it appears to one approaching from the southeast.—The ridge to the right is the start of the crater edge of Ngoro, which continues unbroken to the east. Viewed from this point of observation, the crater seems to extend for a distance about four times that of the width of Oldeani mountain. To the west the slope is gradual. In the foreground is the great sweep of rolling country between "World's View" and the crater. From the point of observation to the crater the ground rises steadily until it approaches that formation, when it makes a rather steep grade to form the outer wall. One does not enter dense forest until this outer wall is reached

into the plains far below that lets one's vision range on and on over the rolling country that ripples off to the horizon.

To the west the slopes descend gradually to arid plains of scattered bush lost in the distance. So it is that one stands almost in the center of this immense oasis and views the great dry plains that have been the barrier to its penetration.

We descend and trek toward the Great Crater, to make camp at the edge of the forest that enshrouds its rim. As we make our way down and are shut in by the rolling hills, we lose its form, and ahead there seems nothing but hilly country. We camp for the night and obtain a good rest, for the morrow means a stiff climb up the steep grade of the outer slopes, through the winding trails of a jungle forest.

Our guns are always ready: we may encounter a rhino or a buffalo, or even an elephant moving about on the morning feeding grounds. The vegetation is so dense that man and beast may meet unexpectedly at close quarters.

The whole morning is consumed in this uphill jungle trek, with frequent rests for our safari, for the altitude of about 8000 feet is beginning to make itself felt. The top is reached by noon. There the open glades become larger and more frequent. Finally we discover a level spot, and halt for a noonday rest. There is an opening in the trees beyond; going to this and making our way forward through some bushes, we find ourselves on the brink of the crater, and gaze over.

A feeling of awe grips one upon looking for the first time into this great basin. Can it be possible? Was

Looking north toward the outer edge of Ngorongoro crater.—This picture is virtually a panoramic continuation of the one on the opposing page, there being only a slight break in the vista. The horizon line is the crater edge proper, which extends nearly as far again to the right. Its outer wall, blanketed in dark green, is well defined from the rolling plains that rise very gradually to meet it.

Hartebeest, gnu, eland, and some of the smaller antelope, zebra, and lions roam these plains, while occasional rhino and elephant trek across them on their way to and from the forests of Ngoro

this tremendous hollow once a great volcano of molten lava and seething fire?

I leaned forward, still clinging tightly to the bushes; below me the forest-covered wall seemed to drop almost straight. I could view the entire inner wall of the crater with one sweeping glance: it seemed almost a perfect circle, its slight irregularity lost sight of in its magnitude. The two volcanoes, Ololmoti and Oldeani, rested like sentinels on its sides, just back from the rim. The rim itself is remarkably even, maintaining its almost perfect edge without a single break or outlet. The floor, which totals about 110 square miles in area, lay perfectly flat and treeless, except for two small forests near the south and east walls.

The areas of differently colored grasses made a patch-work quilt that spread over the entire floor. Way to the west was a shallow mirror-like rain pan bordered by white shores of volcanic earth that dried and baked in the hot sun wherever the waters had receded through evaporation. The floor, which is 6000 feet above sea level, lay 2000 feet below us. Everything was dwarfed: the rain pan, which seemed so small, is miles in circumference; and the tiny acacia forests, that hardly intrude on this great surface, are so large that in them one could easily get lost. Dense forests that cover the outer slopes and rim jut down in great spurs through the steep valleys of the inner walls of the crater until their apices nearly reach the base. Mirror-like patches, fringed with vivid green, told where the level floor held smaller pans of water that nestled in beds of reeds. Way to the western side lay a small flat parasitic

RELIEF MODEL OF NGORO

The model, which was made by the author of the article, is orientated to the north. Ololmoti rests on the northern rim and Oldeani a little to the southwest. The rain pan, known as Lake Magad, in the southwestern area varies considerably in size, depending on the rains, which quickly swell it. The only parasitic cone within the crater is shown just beyond the lake. In the northern section can be seen the rounded hills that blend into the rim.

The large reed bed that shelters the hippopotamuses is seen to the right as a dark area, which also includes one of the acacia forests. The other forest is seen as a dark area just over the southern rim. With the exception of these, and a reed-bed area between the rain pan and the parasitic cone, the crater floor is a great, flat plain cone—the only one within the crater walls.

Local showers and morning mists above the forests are the main source of water supply, if a gusher spring be excepted that comes boiling from the ground on the eastern side and feeds a large swamp in which a herd of hippos make their home. No streams flow in or out of the crater except two minor ones that come hidden through deep ravines, more as a percolation from the rain forests above than as an outflow from any reservoir of supply.

Minute specks that covered the floor of the crater like pepper sprinkled on a plate, proved to be—through the glasses—its sheltered herds of game, that extended more or less concentrated, yet unbroken, over its entire area, suggesting a great zoo, or an immense cattle ranch, where there is room and feed for all.

From where I stood to the opposite rim was about twelve miles; the rim itself is some thirty-five miles in circumference. I gazed and wondered,—wondered at this, probably the greatest crater in the world, until I fancied I could picture it a great molten mass of crackling, moving lava. What a fire pot it must have been! And at night how dazzling must have been its uncanny beauty, with great clouds hanging over the molten mass, blazing reds and pinks reflected on their billow forms, lighting the sky for miles around, and, when seen from great distances, appearing like a floating setting sun in the blackness of the firmament!

After feasting upon the sights from above, we descended by a broken path that went zig-zag down the precipitous rocky walls as best it could, winding in and around big trees that clung to the sides with difficulty by their tenacious roots. Stepping down over the uneven rocks was tiresome indeed, and it was a relief to arrive finally at the base, where there was level going.

As one looked up from the bottom, the walls seemed even higher than they did from above, and the expanse within greater than ever. Even then its size was not fully appreciated; something like an adequate conception of it was formed only as we trekked across one little corner of the floor. We walked and walked, and apparently were getting nowhere—making no impression on the great expanse. A given point seemed to stay right by us in spite of steady plodding. The more we walked, the larger the area seemed to grow. The floor lay remarkably flat; only occasionally was there the slightest undulation.

We marched to the southern side not far from the wall, and began to go upgrade over the broken ground of an old lava flow that had come down from Oldeani, resting near the southwestern rim. Farther along, almost at the base of the wall, we camped on a little flat table-land by a small stream of fine cool water. Here we obtained a clear view of the whole crater floor from within: just in front was one of the two acacia forests. We looked right over this and could see how little it really is when compared with the great expanse of the crater.

Straight across to the north, the wall is less distinct: it rises in a series of low rounded hills that blend into the slopes of the volcano Ololmoti. These hills appear to be the results of a series of lava flows from this outlet or, again, they may originally have been smaller cones that through long erosion in time took on the form of hills. Over the floor to the northeast and the northwest are scattered a few volcanic rocks that break the otherwise

First view of the crater basin obtained from the southeast wall.—The lighter areas are the dried mud flats left exposed by the receding water. Darker areas in the foreground are the grass patches and reed beds. The opposite rim is twelve miles distant

Looking north across the crater floor from the author's camp at the south side.—Ololmoti is visible in the distance. One of the two acacia forests is seen in the foreground

Game within the crater.—It is estimated that there are 50,000 or more wild animals in this great natural zoo

Scattered volcanic rocks on the crater floor.—The one in the foreground is well worn, having long been used as a "rub rock" by the animals

Northeastern wall of the crater

Looking from the northern rim of Ngoro up the southeastern slope of Ololmoti exceptionally smooth surface.

The slopes that extend upward from the crater floor are covered with a rank bush growth, which gives way to forests as the upper edge is approached. On the top, open glades and grassy rolling country are interspersed with patches of acacia and other big timber until the slopes of the two big volcanoes are reached. There the tree growth is suddenly replaced by a solid thicket of small bamboos, from fifteen to twenty feet high, that extends clear to the peaks. These bamboos are the home of buffaloes, rhinoceroses, and bush antelopes, as well as of many monkeys.

The sides of the crater are very steep and even when entering or leaving by one of the three or four possible routes of approach, a stiff zig-zag climb is not to be avoided. The inner surface of the wall is so eroded that only in one place, and there very faintly, can one discern through the growth of vegetation that covers it, any sign of stratification of the old overflowing lava.

On the floor the grass, growing luxuriantly from the volcanic soil, has been cropped short by the countless herds of wildebeest, gazelle, and many other kinds of antelope as well as zebra that move about on every side. Occasional beds of reed, like our cat-o'-nine tails, are the only vegetation breaking the even landscape. At only a short distance the dancing heat rays as they rise make these growths inconspicuous and one passes through them, only to continue over the undifferentiated plain with its herds of game.

There were not the usual series of game trails going definitely to various feeding grounds or water; instead the terrain was tramped over like a barnyard by the herds that tread it aimlessly as they feed in all directions.

A Thompson's gazelle fawn "in hiding" on the open plains.—Left by its mother while she goes off to feed, it instinctively lies perfectly flat and without the slightest movement. Its immobility and color make detection of the animal difficult. Only the fact that Mr. Clark came very near stepping on it revealed its presence to him.

The photograph was taken at about three feet distance but the fawn made no attempt to run away, trusting to the last moment in the possibility of escaping detection

The author's safari trekking across the level crater floor with the northeastern wall rising in the distant background

The reed beds, with the bush and long grass that border the forest, just off the floor's edge, are the haunts by day of the many lions that steal forth at night to prey upon the abundant herds. These retreats also shelter the reedbuck and the little duikers as well as the numerous hyenas and jackals, that finish up the leavings of the lion's kill and pick up the scraps that lie strewn about.

Herds of hundreds of the little Thompson's gazelle that blend so well into the color of the ground, suddenly appear right before you as if they had been conjured out of the air, and scatter, on your approach, only to blend and disappear again right before your eyes. Eddies of wind pick up the light volcanic dust and carry it along in tall vertical twisted columns across the level ground or blow it up in dust clouds and silhouette black wildebeest that had escaped your notice.

It is the exceptional natural conditions that have made possible such a great concentration of game and that have assured its perpetuation. Into this perfectly sheltered basin with its high rocky walls—where the nights are cool and the days warm, where the grazing is perfect and water is relatively plentiful—game has drifted from the more arid country around. It is undoubtedly from the surrounding great plains that these animals have come, lured by the scent of sweet grass and waters, drifting in a few at a time and increasing under ideal conditions; while others less fortunate in their selection, drift northward to the grassy but less-watered area of the Athi Plains and pass leisurely through the great southern game preserve and into the hunting fields of British East Africa.

The expanse of the crater is great, and the animals have no reason to leave. More come from without while there is a natural increase within. Estimates give the game within the walls of this

One hundred fifty blacks of the Mbugwea tribe were used in the transportation of the supplies

great natural zoo as 50,000—personally, I believe there are more—but what difference do a few thousands make when there are so many animals that you cannot even estimate them, and the great herds are so big that the distant ones fade into the "blue" before your vision can reach the end!

Birds of many kinds abound in the pools of still water, that remind one of the great aviaries of the zoos into which have been crowded the birds of the world.

Perhaps nowhere in Africa is there such a concentration of lions: on one morning, just at the break of day, a pack of seventeen was seen making its way back to cover after a night of raiding, and at another time eleven were observed entering a bed of reeds for their daytime nap. Leopards and cheetahs, and the smaller beasts of prey, gorge themselves and live in contentment until their next mealtime, yet make no impression on the great herds that breed faster than their enemies can take toll. Elephants and their bush companions, the treacherous buffalo and the powerful rhino, are present in moderate numbers in the virgin forests that clothe the crater walls. Even the little animals contribute their share to the multitude, and in great areas the ground moles are so numerous that they honeycomb the earth, so that with every other step one breaks through into their tunnels, or stumbles over their little mounds.

Ngorongoro is the greatest extant natural zoo, and should be set aside as a preserve. To see this—probably the greatest of all craters in the world—is a wonderful privilege, and to see it in association with its thousands of beautiful birds and beasts, for the protection and perpetuation of which one would like to believe it was created, is something that seems almost too marvelous in these days when the world is being stripped of wild life.

Photograph by Irving K. Taylor

A HERD OF MORE THAN TWO HUNDRED ELEPHANTS

This snapshot was obtained in March, 1921, in the Nile-sudd south of Lake No. One can hardly imagine the impressiveness and awe of such a spectacle in the wild. For ages vast herds have assembled toward the end of dry seasons to migrate from scorched, arid places and devastating grass fires into regions offering safety and more abundant fodder. The bulk of the herds is made up of young animals, often very aggressive and high-spirited. This has given rise to tales of the distribution of the pygmy elephant over the greater part of western Africa and about the edges of the West African rain forest.

No more stately and venturesome rovers could be imagined. Their favorite haunts are undoubtedly the wooded parklands, but luxuriant forests and tree-dotted plains prove equally attractive and like the edges of deserts, the snowfields of equatorial peaks also tempt them. The African elephant, unlike the Indian, is intractable, and there is no chance that it will survive as the servant of man

The Vanishing Wild Life of Africa[1]

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EVER since white man set foot upon African soil to make his own trails across the trackless jungles, the world has been astonished by tales of an apparently inexhaustible wealth of game.

As one of the oldest of the large land masses Africa is remarkable for its compactness and the lack of indentation in its coast line. A comparatively great stability, with relatively slight fluctuations of the land area since Tertiary times, must have assured an exceptional continuity of favorable breeding grounds for its marvelous array of beasts. Here was the ideal setting for the evolution of a unique fauna, which fossil records indicate was essentially vigorous and more truly African than had formerly been believed.

Furthermore, as a result of its practical isolation, Africa offered unwelcome competitors among the mammals little chance for invasion. Except in the Mediterranean regions man himself was not able to people successfully the vastnesses which proved so inhospitable to him. Only after the introduction of satisfactory staple foods from other continents—an accomplishment credited chiefly to the Arabs and the Portuguese—did his scattered settlements in the wilderness of the great forests flourish.

Thus for many centuries Africa remained a paradise for vast herds of game. In no land has nature offered such an impressive aggregtee of mammals. Countless indeed were their numbers. Gigantic brutes, ungainly and cumbersome, mingled with the most graceful and fleet of tropical wanderers. Stubborn brutishness and unexcelled virility in some were contrasted with defenselessness in others. Beasts of prey, powerful, strong, and stealthy, singled out the weaklings and the careless, to whom less chance was thus given to dispute the leadership of those that alone would insure a vigorous race.

When the Roman triumphs had achieved the acme of cruelty and fastidiousness, the victorious leaders of stalwart legions could still add to their glory by displaying in the arena African beasts either so wild or so imposing as to drown the popular dissatisfaction. To think of five hundred lions and twenty elephants in a single orgy of savage destruction almost surpasses the capacity of our later-day imagination, yet that is the inauguration record of Pompey's theater in 52 B.C.

Hundreds of years have passed, exacting their heavy toll. Northern Africa, long the part most accessible to Europe, has lost its gigantic mammals. The hordes of despoilers would find much of it a desolate wilderness today. With this in mind, the admirers of nature at her best and other right-thinking men and women now look with alarm upon the rapid decimation and threatened extinction of the game animals in the remainder of Africa.

South of that fiery furnace, the Sahara—the greatest continuous desert in the world— lies the Ethiopian region of zoölogists. It extends more than three thousand miles from the north

[1]Photographs, with the exception noted, by the author

to the Cape of Good Hope in the south, and even for a greater distance from west to east across Senegal to the Somali coast. The fairly uniform warmth of the climate throughout virtually the entire length and breadth of this region favored the development of free-roaming animals. The margins of the raging sea and the desert wastes were the only limits to their realm. No bleak high mountain chains barred the way. Only four glacier-bearing peaks arise like snow-capped islands from the blue equatorial haze. At certain seasons their foothills offered a welcome change from the torrid sun that scorched the plains. Equally welcome were the lofty hills and the invigorating freshness of the high plateaus in the south, east, and north. Thus nature extended a matchless domain to the throngs of grazing and browsing creatures.

Roughly speaking, there are but two kinds of abode in all the land: the grass-covered regions, or savannas, and the tropical forests. Both offer an ample variety of food and shelter: their differences depend chiefly on the amount of rainfall and humidity. Some animals, like the elephant and the buffalo, can live in the dry savanna as well as in the humid forest. Others, like the rhinoceros, the giraffe, and the zebra, and most of the antelopes are at home chiefly in the grasslands, which include about two-thirds of the entire Ethiopian region. On these open, sunny spaces, sprinkled over more or less with bushes or trees and dotted with park lands between the hills and ravines, Africa's chief wealth of game had its stamping ground. Of the nearly one hundred kinds of antelopes, varying from the size of a hare to that of a bull, each lived in its peculiar sphere.

A vitally different area is the West African rain forest, an equatorial belt about 400 miles in width and 1800 miles in length. In this steaming hot complex, with its lofty canopies mostly one hundred fifty feet above the ground, seasonal changes are but slight. The dense vegetation makes gregariousness here as impracticable as it is advantageous on the plains.

For days and weeks one might travel in these forests and catch but few glimpses of its wild denizens. In striking contrast with the level plains, the hiding places in the tall and luxuriant forest are multiplied beyond measure. Elephants and buffaloes in small troops, the huge, black, forest boar, and the most beautiful of all pigs, the red river hog, though lost to the eye, can be heard as they seek safety in the depth of the jungle. Of the bands of monkeys, occasionally chattering and gamboling, only an inquisitive old male dares to scrutinize the intruder. With a saucy, cocksure air he puckers his face and contemptuously dismisses the idea of escape. There are antelopes, great and small, porcupines, squirrels, and an array of smaller mammals. Chimpanzees herald the morning with loud calls and shrieks.

On the whole, however, these forests are a far too unsatisfactory scene of operation for the white hunter, who must linger long to reap his reward. The uncongenial climate and the difficulty of getting about rob the sport of any enjoyment. In such a retreat wild life in general would long be safe if gun and powder were not distributed among the natives.

But in spite of all these impediments nature is in danger of losing a few of her rarest mammals. In vain has she been able to hide and shelter them through untold ages. The white man has set about rudely wrenching from her the last remnants that have survived from bygone days. Foremost among them are the okapi (*Okapia johnstoni*), the pigmy hippopotamus (*Chœropsis liberiensis*), the gorilla (*Gorilla*), and the chimpanzee (*Pan*).

The okapi is as rare as it is inoffensive, and being nocturnal is seldom seen. Its haunts are confined to a small portion of the gloomy West African forest, a narrow strip about 700 miles long and 140 miles broad, in the hilly regions of the headwaters of the northeastern affluents of the Congo.[1] In spite of its relatively large size, about that of a mule, the okapi was not known to the outside world until 1901 when it was discovered by that distinguished African explorer, Sir Harry Johnston. Instead of being a forest zebra—as was for a while the impression, based on the striped pieces of skin secured—it proved to be a short-necked giraffe, small-eyed, and with a delicately modeled deerlike head. Its dark brown velvety coat, with whitish stripes chiefly across the limbs, was highly prized by the natives for superstitious reasons, and the skin of its hind limb, with the striking pattern, would purchase a wife. Only a powerful chief was permitted to sit upon the hide or use the pretty parts as ornaments.

So elusive a quarry was in no danger of being successfully hunted by the white man. Its rarity, however, and its peculiar fame made him place so high a premium upon a good skin that the magnificent hermit creature has been hounded by the natives into its most distant retreats. If equally enticing rewards were made to the chiefs to protect the okapi in their sphere, the most remarkable of large African mammals might be able to hold its own. Policing its habitat is quite out of the question, but the characteristically marked skin is so easily recognized that confiscation would not be difficult and would help in assuring the survival of this interesting creature. It seems a pity that an animal that has weathered the storm through probably millions of years should be wiped out within a few decades after being recorded in the annals of science.

A young male okapi (*Okapia johnstoni*) at Niapu, northeastern Belgian Congo.—Just captured, he is bleating like a sheep for his mother, disproving the belief that muteness is the unalterable fate of the giraffe family

Were it not that the pigmy hippopotamus has been able to hide in the depths of miasmal swamps in Liberia, it might long ago have followed in the footsteps of the Madagascan form, now known only as a fossil. Major Schomburgk was the first white man to study a pigmy hippopotamus in its haunts. This was in July, 1911, and he subsequently captured several specimens alive. Three of these fine examples, exhibited in the New York Zoological Park, responded to the excellent care received there by adding to their number.

[1]Lang, Herbert. 1918. "In Quest of the Rare Okapi." *Zool. Soc. Bull.*, New York, XXI, pp. 1601–14, 11 photos, map of distribution.

From Schomburgk we learn that instead of making good its escape by continuous diving, the animal seeks refuge in the dense forests bordering the river. It is fortunate that the inhabitants of Liberia hold it in high fear, and its rather ugly hide is not a desired trophy. These circumstances have perhaps contributed as much toward its preservation in the past as legal regulations made in its behalf will, it is hoped, aid it in the future.

The gorilla, the largest of the manlike apes, is fortunate in having lately been championed by those interested in its protection. Of the two widely separated areas in which the animal is still to be found, that of the western race (*Gorilla gorilla*) is by far the larger. It extends from the hilly sections of Cameroon southward along the coast into the northern border of the Belgian Congo and eastward to the Sanga River. The last remnants of the central African mountain race (*Gorilla beringeri*) have been holding out in the forested volcanic peaks north of Lake Kivu and northwest of Lake Tanganyika. The reopening of the Daressalaam-Tanganyika railroad in recent years, together with the introduction of Ford automobiles, has made access to that country so easy that the gorillas have been placed in danger of rapid extermination. Mr. Carl E. Akeley, who made valuable observations and took the first moving pictures of these apes in the wild state, has made persistent efforts to have the Belgian authorities set aside the gorilla haunts as a sanctuary, and these efforts should pave the way for their eventual survival.[1]

Consolation is found in the fact that some of the huge primates, like the chimpanzees, appear to be of a rather vigorous race, as the family groups of from eight to twenty or more members would indicate. Contrary to general statements, they reach maturity rather early, somewhat in conformity with the natives living in the same regions. Parenthood is assumed apparently at ten years of age or less. According to data published by Doctor Blair, of the New York Zoological Society, in the case of the first chimpanzee born there, the mother Suzette was then in about her tenth year, weighing 130 pounds; the father, Boma, in about his eighth, weighing 145 pounds. Other most important observations in this respect have been made on chimpanzees at the home of Senora Rosalie Abreu, owner of the "Quinta Palatino" estate at Havana, Cuba, where they have been raised to the third generation. There the apes seem to have a pronounced preference for monogamy.

It is highly gratifying that the French government has now issued ordinances prohibiting the capture, sale, and exportation of live chimpanzees in Africa. Should the Belgian and English authorities join them, and extend this policy to include the gorilla, and stop the shooting and exportation of dead specimens as well, it should save from a speedy death warrant the great African apes in which man has a deep and justified interest.

One might think the smaller monkeys would be safe from wholesale destruction except in the neighborhood of settlements, where they frequently cause havoc among crops. But the power of the clink of gold spurs man on. In the year 1892, no less than 188,000 skins of the *Colobus* monkey were exported from the Gold Coast.[2]

[1]Akeley, Carl E. 1923. "Gorillas—Real and Mythical." Natural History, Vol. XXIII, pp. 428–47.

[2]Buxton, E. N. 1903. "The Preservation of Big Game in Africa." *Journ. Soc. Arts*, London, Vol. LI, p. 576.

How mercilessly their annihilation was carried on is best proved by the fact that five years later only 1067 skins figured in the records. The silky-haired, black-and-white mantled skins had become the fashion. Thus two of the most strikingly beautiful forms of West African forest monkeys (*Colobus satanas* and *C. vellerosus*) were cruelly hunted down. In Eastern Africa their near relatives with the magnificent, generally white tail brush would probably have been wiped out completely had legal protection not come to their assistance in the nick of time.

Often it happens that relatively small and obscure nocturnal forms, hardly represented in any museum, become the object of intense pursuit. From a range of high hills along the Gold Coast, with deep gorges and ravines covered with almost impenetrable bush, no less than 200 pelts of the rare spiny-tailed flying squirrel (*Anomalurodon pelii*) were brought down by two native hunters in about a month's time.[1] Yet their silky, chinchilla-like fur is absolutely worthless, the skin being extraordinarily thin and fragile.

To return to the real hunting grounds of big game, the savanna country and wooded patches bordering the great forests, there sad havoc has been wrought. Attractions beckoned from so many sides that, the climate permitting, the white man was not slow in heeding the invitation. However, the influx of settler and hunter is not to be held solely responsible. India furnished a splendid example of the survival of herds of game during centuries in the midst of a dense population. But now transportation facilities have lessened the hazards of travel

A young female *Colobus abyssinicus ituricus* from Faradje, northeastern Uele, Belgian Congo. On account of the beauty and consequent market value of the long silky black-and-white pelt these monkeys were slain by the thousands until protective measures were taken in their interest

and the frightful advance in the construction of firearms has made even the most dangerous hunting a sport to be carried on recklessly.

In one of the previous numbers of this journal[2] citation is made of a paragraph by the author to the effect that at least two of the larger African mammals have been completely done away with. The last of the quaggas (*Hippotigris quagga*), a nearly unstriped South African zebra, was killed in 1878 in Orange Free State. Of the blaubuck (*Egocerus leucophæus*), apparently always scarce, the last record dates from about 1800, when the animal was reported from the Swellendam district of Cape Colony. Only a dozen specimens of the quagga and five of the blaubuck have been preserved in the museums of the world.

There is a long list of hard-pressed sufferers in South Africa which deserve to be kept alive. Perhaps the same pride South Africans take in their

[1]Adams, W. H. 1894. "On the Habits of the Flying-Squirrels of the Genus *Anomalurus*." *Proc. Zool. Soc. London*, pp. 243–46.

[2]Osborn, H. F., and Anthony, H. E. 1922. "Can We Save the Mammals?" NATURAL HISTORY, Vol. XXII, pp. 398–402.

Taken at the New York Zoological Park

THE WHITE-TAILED GNU (*CONNOCHÆTES GNU*)

The "wildebeest" of the Boers is the strangest-looking of all the antelopes. Among the ruminants, that large class of shiftless wanderers, none has excited more admiration than this animal with its equine body, menacing buffalo head, shaggy mane, and long white horselike tail. Yet in less than fifty years the apparently inexhaustible herds that formerly populated the plains of Cape Colony have been reduced to a few troops achievements in developing the country will manifest itself in granting the remnants of big game a definite leasehold, free from all future encroachments. The four hundred mountain zebras (*Hippotigris zebra*), the few bontebuck (*Damaliscus pygargus*), blesbuck (*D. albifrons*), and the white-tailed gnu (*Connochætes gnu*) are on the verge of extinction. But the most magnificent of all antelopes are those pursued hardest. The larger kudu (*Strepsiceros strepsiceros*), the nyala (*Nyala angasi*), the sable antelope (*Hippotragus niger*), the roan (*H. equinus*), and a few others in different regions, need more adequate protection, especially when they answer the requirements of a sportsman's trophy. A case in point is the newly discovered Angolan race of sable antelope (*H. niger variani*) with horns measuring on their front curve as much as sixty-four inches.

The abundance of the beautiful springbuck (*Antidorcas marsupialis*), at the beginning of the last century would seem well-nigh unbelievable were it not for Gordon Cumming's account, amply corroborated by others. For two hours he saw vast legions of these animals streaming through a neck of the hills in unbroken phalanx. The hillsides were covered "not with herds but with one mass of springboks." As far as the eye could strain, the landscape was alive with them. "Some hundreds of thousands were within the compass of my vision" until they faded into a dim red mass of living creatures. Flocks of sheep becoming intermingled with them were swept along without hope of escape. Even the lion may thus be entrapped. Such inspiring sights are of the past. Springbuck can still be shot for sport, but so typical a South African animal deserves pastures offering a secure refuge.

One of the worst of fates has been meted out to the square-lipped or "white" rhinoceros (*Ceratotherium simum*). Extremely common in suitable sections of South Africa in 1817, when it was first made known by Burchell, this rather stupid, quiet beast was recklessly butchered from the very beginning. During the course of a day's trek from fifty to one hundred could be sighted. The shooting of ninety rhinoceroses, most of them of the square-lipped kind, in one journey, was an event to be proudly heralded by two famous sportsmen; another game hog killed sixty, considering it a feat to be recorded in the annals of hunting. Today perhaps not a dozen are left, the very preserve set aside for them having been opened to slaughter. Between the two Umfolozi rivers in Zululand, their last stand, they have little rest, for the farmer covets the land and their ultimate survival seems extremely doubtful at the present time.

Of the Upper Nile race of white rhinoceroses (*Ceratotherium simum cottoni*) several thousand were still left in 1910.[1] But recent reports as to their status give cause for alarm. Unless drastic measures are soon taken to prevent traffic in the hides and horns, this huge representative of the Pleistocene age will shortly be extinct.

In former days it ranged to the extreme north of Africa as shown by fossil records and was even contemporaneous with Neolithic man, who engraved its image on the rocks.[2] It is difficult to understand how such splendid examples of nature, practically harmless though possessed of formidable weapons, should suddenly be brought to the verge of extinction.

[1]Lang, Herbert. 1920. "The White Rhinoceros of the Belgian Congo." *Zool. Soc. Bull.*, New York. Vol. XXIII, pp. 66–92, 31 photos, 1 map, 1 text figure.

[2]Lang, Herbert. 1923. "Recent and Historical Notes on the Square-Lipped Rhinoceros (Ceratotherium simum)." *Journ. Mammalogy*, Vol. IV, p. 159.

Among the bigger game the most distressing losses have been inflicted upon the elephant and the hippopotamus. A continuous toll has been exacted by armies of hunters. Literally hundreds of sportsmen annually visit Africa from every point of the globe. They will no longer find the great tuskers nor the thousands of river horses. Elephants have no opportunity to grow old. Governments have reaped the benefits of increased income derived from taxes on permits and the exportation of ivory, and have thus consented to their doom. And this has gone on in spite of all assurances to the contrary.

Young bull of the square-lipped or "white" rhinoceros (*Ceratotherium simum cottoni*) near Vankerckhovenville, northeastern Belgian Congo.—Close approach arouses in even so stolid an adversary the signs of a charge, usually preceded by the twisting of the tail. The value of the horns and the relative lack of danger with which so large an amount of meat could be secured brought about the doom of the South African race of this giant even before civilization reached the fields it roamed

Among the causes of destruction of wild life in Africa the natural agencies, however severe, have proved to be relatively unimportant, chiefly because of the infrequency of their occurrence. The uniformly mild climate is accompanied by no such seasonal inclemencies as the habitual wintry rigor of colder regions. Even violent tornadoes and destructive hailstorms are few and far between. In ordinary dry seasons, the game is wont to repair in great numbers to more satisfactory pasturage or to a few isolated waterholes. The yearning of the animals at such times to quench their thirst eliminates much of their habitual wariness. On such occasions game photographers, hiding in "blinds," have made the most successful pictures. True it is that destruction of thousands upon thousands of game animals by drought has been recorded, but only as extremely rare occurrences during a period of consecutive dry years. Such a calamity, being local at most, does not influence the general status of the continental herds, though, judging from Gregory's account,[1] acres may be covered with the bleached bones of the victims.

The increase of drier areas in Africa, especially in the north and south, as a result of gradual desiccation, has been frequently cited as an important factor limiting the distribution of some of the mammalian fauna. The data so far advanced seem to point toward a change of climate causing drier conditions and especially a more intensive drainage. The result is well exemplified by the dry areas formerly covered by lakes Chad and Ngami. Perhaps many of the migrations of great herds of game, as described by the earliest explorers, were due to the setting in of such modifications in the regions cited.

A very encouraging contribution toward the preservation of game animals in Africa is the long list of scientific achievements in curbing the rapid spread of various diseases. The successful use of immunizing sera is one of the noteworthy results. Rinderpest, formerly considered the most deadly of the infectious scourges, filled with dismay and terror those interested in wild life, but it is now fairly well under control. Apparently of Asiatic origin, it reached Africa by way of Egypt. As usual it was introduced by infected live stock and proved to be extraordinarily virulent in its swift progress. In about fifteen years it traversed the entire length and breadth of the continent. From 1886 to 1898 it caused the most frightful losses in game and cattle alike, generally ninety per cent of the animals attacked succumbing within a week. The difficulty and uncertainty of diagnosis is chiefly due to the fact that incubation is latent for the first few days. Intense fever, swollen mucous membranes, the development of small papular ulcers, and extreme prostration are common indications. In the early days rinderpest raged unchecked, but future

Taken at the New York Zoological Park

Formerly found in astounding numbers on the plains in the southern parts of Africa, the blesbuck (*Damaliscus albifrons*) now exists only on certain farms in the Orange Free State, Transvaal, and Bechuanaland

catastrophies are improbable as its occasional outbreaks are now quickly localized and the heavy mortality much reduced. The most hopeful point of all is that in less than fifteen years African game without exception recuperated, especially in those regions where organized slaughter was stemmed.

In 1891, when the ravages of rinderpest were greatest in East Africa,[2] buffaloes came down to the Tana River literally in thousands to die. A gruesome sight were the attending vultures and marabout storks gorged to reple-

[1]Gregory, J. S. 1896. *The Great Rift Valley.* London (John Murray), p. 268.

[2]Hobley, C. W. 1922. "The Fauna of East Africa and its Future." *Proc. Zool. Soc. London*, Vol. I, p. 2.

Taken at the Dresden Zoological Garden

Burchell's zebra (*Equus quagga burchelli*), the closest relative of the extinct quagga. This magnificent stallion was considered one of the last of its kind living in captivity in 1905

tion. Hardly any of the game animals escaped. Giraffes, and most of the antelopes, including waterbuck, eland, kudu, and bushbuck, as well as pigs and rhinoceroses, were victims. Apparently zebras, oryx, sable, roan, wildebeest, and hartebeest did not suffer in such numbers. Elephants and hippopotamuses apparently escaped unscathed.

Twenty-odd beasts were the sole survivors of many thousand head of cattle in northeast Kitui. The desiccated carcasses of those which fell were piled up like a wall outside the villages. Famine was the natural consequence for cattle-herding tribes such as the Somali, Suk, Masai, and Dinka. Rinderpest apparently reached the northeastern Uele in the early nineties, according to information supplied by Maruka, an intelligent native chief of the Logo tribe at Faradje. He told me in 1911 that when the disease reached his country and killed nearly all the cattle, the hook-lipped, black rhinoceros (*Diceros bicornis*) that feeds on bushes died out and never appeared again. The square-lipped, or white, rhinoceros (*Ceratotherium simum*), however, though greatly decimated like the buffaloes, elands, wart hogs, and other game, became sufficiently numerous once more, and for a time held its own, only to be nearly wiped out subsequently as the result of a native uprising during the war. From this it might appear that the two kinds of rhinoceroses formerly shared the range in the Uele, where now only the square-lipped one is known. The black rhinoceros is still common in the Shari-Chad region.

Anthrax, another of the sporadic infectious diseases often fatal to game and marked by nasty ulcers and intense prostration, is to a large extent deprived of its danger nowadays by Pasteur's method of protective inoculation through anthrax serum, which offers an immunity lasting nearly a year. The last serious outbreak[1] occurred in 1905, killing several thousand head of game, chiefly Coke's hartebeest on the Athi Plains in Kenya Colony. Formerly such disastrous visitations aroused the hostility of the settlers against the game, which they held responsible for the spread of the disease among their own live stock. In the face of such opposition one can realize what a boon it has been to the game that the disease is at last well in hand.

Strange to say, there are scourges which have really served Africa's game as a protection. The formidable diseases borne by tsetse flies, in conjunction with malarial fever and a host of other afflictions, have hindered most of the white man's efforts to establish his home and take over large tracts of the country. There is no underestimating the really important rôle played by tsetse flies, chiefly *Glossina palpalis* and *G. morsitans*, which occur in a broad belt across most of tropical Africa.[2] They are the well-known carriers of a fatal virus, the former species transmitting the dreaded human sleeping sickness, the latter that of "nagana," or trypanosomiasis, a similar infection in cattle. Inoculation generally takes place as an incidental result of the flies feeding on or sucking the blood. Whenever they sink their mouthparts into the blood vessels of their victim, the trypanosomes or flagellate protozoan parasites they carry may enter its system and cause terrible ravages there. At present two of these parasites are known to infect man in Africa—*Trypanosoma gambiense* and *T. rhodesiense*—but several others produce disease in animals. Apparently all African game, including the zebras, though not free from the germ, have become immune to it. It has been held that, acting as the chief reservoir of the virus, the game may indirectly become the most dangerous source of infection. But judging from experiments and observations the probability is great that there are other channels assisting the spread of these diseases. Unfortunately the cattle, though as a rule not affected by the parasites causing human sleeping sickness, readily succumb to those causing "nagana." The impossibility of raising live stock in all regions so infested becomes a well-nigh insurmountable obstacle to effective colonization by the white man, inasmuch as it prevents any extensive agricultural exploitation. Of domestic animals, only goats and chickens are able to thrive under such conditions, though in the northeastern Congo dogs also appear to be immune.

Some years ago in certain of the regions most concerned, the indiscriminate destruction of all the bigger game was urged for the eradication of diseases due to trypanosomes. Only by so drastic a method, it was argued, could man and cattle be freed from the dreadful scourges borne by tsetse flies. For the game, the reign of terror came with overwhelming force. A cause that was apparently in the interests of humanity was able to enlist the frenzied support of the fanatic. The big game was done away with, but all to no avail. At present it does not seem possible to prove that no other repositories of the virus, for instance among the smaller mammals, exist.

[1]Hobley, C. W. 1922. "The Fauna of East Africa and Its Future." *Proc. Zool. Soc. London*, Vol. I, p. 2.
[2]Chapin, James P. 1922. "A Naturalist on Lake Victoria: A Review." NATURAL HISTORY, XXII, map of distribution and text figs. of tsetse flies (pp. 60 and 61).

A CARAVAN LADEN WITH EXCEPTIONALLY FINE ELEPHANT TUSKS

Hundreds of caravans like this one, that was organized by a well-known Hindu trader in Uganda, travel across Africa in every direction to the nearest shipping center. In fact, there are so many tusks taken each year that they would make loads for more than 40,000 porters. No better proof of the relentless and appalling slaughter of African elephants could be cited than the records of the importation of ivory in parts of Europe. In 1913 alone, Great Britain, Germany, and Belgium received tusks weighing 2,592,073 pounds at a value of about $10,368,292. This one year's massacre amounted thus to about 63,220 elephants, allowing 41 pounds of ivory apiece. The figures are practically the same for each year of the decade preceding.

As a matter of accuracy it should be stated that the above computation contains also Asia's contribution of ivory, which, however, totals less than 2 per cent; and that certain limited amounts of ivory may figure more than once in the import records, owing to sales between the three countries under consideration. But this is more than compensated for by the fact that much larger amounts of ivory for which no exportation figures are available go direct from Africa to the United States, France, Italy, Spain, Turkey, Persia, India, China, and Japan

It may be interesting to state that Doctor Roubaud of the Pasteur Institute in Paris, one of the foremost investigators of human sleeping sickness, was led, as a result of his exhaustive studies in the field, to propose, as a means of combating the disease, the increasing of the number of domestic animals about the village. These would then attract the tsetse flies in preference to man, who might thus more easily escape infection.

One of the latest outbreaks of savage and utterly useless carnage of game occurred in 1920 in Zululand, its object being to make the country "fly-proof" for the cattle. Like the massacre of the Addo Bush elephants in 1919, this wholesale butchery was officially authorized. Since the drive included many inexperienced hunters, much game was wounded and some scattered over all the country, without accomplishing the result desired.

The many discussions as to the possibility of eliminating tsetse flies by the removal of big game seemed to have found satisfactory support when conditions were examined in regions where rinderpest had been most severe. But many experienced observers, among them Sir Alfred Sharpe, maintain that in certain parts of Africa the "nagana" tsetse fly (*Glossina morsitans*) is found where there is absolutely no game.[1]

We cannot help but admire nature's peculiar ways. Had it not been for such diseases, much of eastern Africa and parts of Angola and the Sudan might long ago have become a white man's country. Of course it would then have been swept as clean of game as the populated parts of South Africa.

The most hopeful agencies in protecting wild life in Africa are the game preserves. They should be set aside as permanent sanctuaries, free from all tampering through political whims. Inclusion of suitable and sufficiently large areas that border on the natural range of wild animals is also imperative to ward off inbreeding. The interest and beauty of such preserves would in the future attract admiring visitors in as great numbers as hunters have been attracted in the past. Were there a united great nation in Africa, with all people acting in concert, perhaps the problems would not be so difficult.

It is encouraging that twenty game preserves, comprising nearly 200,000 square miles, are to be found scattered all over the continent, mainly in British territory. But the status of even perhaps the most important one, the Southern Game Reserve of Kenya Colony, is woefully unsatisfactory. It is used as a reservation not only for the wild animals but for the Masai natives, and their herds of cattle have preference over the game, large numbers of which, when a drought comes, have to move outside and are foredoomed. In 1910, according to Hobley, the zebra and hartebeest from this reservation, in their frantic search for water, marched into the town of Nairobi, regardless of man. The lions followed close in their wake and killed them nightly in the public square.

It is on such occasions that as many as twenty-three lions, as at Lukenya, and even more than thirty, as at Simba, have been seen together, as vouched for by Sir Frederic Jackson and Bronsart von Schellendorff respectively.[2] These huge felines do not ordinarily come together to hunt in packs, but do so in smaller family parties. Such large gatherings are exceptional and

[1]Selous, F. C. 1908. "Big Game in South Africa and its Relation to the Tsetse Fly." *Journ. African Soc.*, Vol. VIII, p. 129.

[2]The reader is referred to the article by Mr. Clark in this issue, who records seeing a pack of seventeen lions at Ngorongoro.

usually occur in connection with the shifting of game from one region to another.

How difficult it is to regulate abnormal conditions after man has disturbed the balance of nature becomes clear again when we read that Tanganyika Territory in the first half of the year 1923 paid a bounty for three hundred lions and eight hundred leopards. In one district alone the lions killed sixty-seven natives. During the war there was wholesale slaughter of game as food for the contending parties. Cartridges were not to be spent upon carnivores, unfit as provisions. The scarcity of game undoubtedly drove these carnivores, left unchecked for years, to attack the natives.

So dangerous were they in 1898 that they held up the building of the Uganda Railroad, but how many are there left today in the localities of their former abundance? During the Pleistocene the lions reached as far north as Great Britain and eastward over a large part of western Asia. Glacial conditions forced them southward with the herds upon which they preyed. Babylonian art points to their relative abundance and suggests that even then lion-hunting was a sport practised by the reigning class to secure the plaudits of the masses. In Africa the lion was once common everywhere except in actual deserts and heavily forested areas. Now it is extinct in South Africa south of the Orange River, throughout North Africa including most of Egypt, also along the mouth of the Congo and the coast of northern Angola. Needless to say, it is greatly decimated wherever the white man has established himself. The lion went even before the game on which it preyed. In Asia it is nearing actual extinction; it is said that only a few are left in the Gir Forest, Kathiawar, Bombay Presidency.[1]

The success that attended the sport of hounding lions, as practised by the late Paul J. Rainey in East Africa, was too far-reaching. Thereafter packs of dogs were not allowed to help in the decimation of the big feline. Kenya Colony could not afford to lose its lions by such swift proceedings, for they are its great attraction, making the country a Mecca for sportsmen, who spend thousands of pounds in the country. Powder and rifle, traps, poison, firebrands, and electric flashlights harassed these huge carnivores. From behind impregnable fences and walls, or from the security of trees or other lofty perches blazed the shots that spelled the doom of the prowling lions. These animals ran the risk of being trailed even when they dragged their kill under cover to hide it from vultures, marabout storks, and the rest of the hungry horde. They were not the raging despoilers. Any kind of meat, even of its own kin, the carcass of an elephant, as well as carrion, is palatable to the king of beasts. The same is true of leopards. Under the greatest difficulties they sometimes drag their kill up trees, not merely out of reach of famished hyenas and jackals but even out of that of the lion.

The international organization for safeguarding African game was definitely initiated by the convention of 1900, attended by all the powers owning territory in that continent. The essential features of efficient protection were thus passed upon. Game sanctuaries; closed seasons; the sparing of females, young, and the rare species; restricted export of the skins, horns, and tusks of certain forms; prohibition

[1]Faunthorpe, Colonel. 1923. "The Vanishing Lion of India." Natural History, Vol. XXIII, p. 524.

of particularly destructive methods, such as grass fires, pits, snares, and game traps, made up the list. These regulations were all designed to limit or prevent unjustifiable slaughter of game or otherwise to foster its welfare.

As elsewhere, however, conditions in Africa have changed since the war. The tide of destruction is far from ebbing. The sheer impossibility of policing such immense territories, often without the slightest financial aid, woefully lames all such legislative measures. Recent decades have furnished decisive proof that real results in African game preservation largely depend on winning active support for the cause among those living in and visiting Africa. The negro population is not, as a rule, as dangerous as one might expect from general reports. Their traps, snares, and mongrel dogs do much less damage than the iron heel of civilization.

The gigantic size of some of the animals and the uncertainty of their temper is one of the biggest obstacles the movement for African game preservation has to deal with. Besides devastating crops, elephants by merely walking over wooden bridges may cripple traffic, and giraffes may interrupt communication by breaking telegraph wires. Zebras stampede through the strongest fencing and endanger both crops and domestic stock. Rhinoceroses and buffaloes may become dangerous by their numbers. But all such local difficulties will find easy adjustment by wise and moderate regulations.

Posterity will be grateful to those

Taken at the New York Zoological Park

The wild dog (*Lycaon pictus*) is distributed over the major part of the savanna region, where it hunts in packs of as many as sixty and is very destructive

who have helped create a sentiment in behalf of the preservation of Africa's wild animals. Prof. Henry Fairfield Osborn, president of the American Museum, espoused the cause many years ago. By his influence and encouragement much has been done, crystallizing into definite results. Dr. William T. Hornaday, director of the New York Zoological Park, has launched many forceful pleas. Lately, in coöperation with Dr. A. K. Haagner, president of the Transvaal Game Protective Association, he has sent out to the South African people a handsome and well illustrated pamphlet[1] on the vanishing game of that region, in which an eloquent appeal is made for safeguarding what still remains,—an appeal which one would like to see heeded not only in South Africa but throughout the continent.

[1]Hornaday, W. T., and Haagner, Alwin K. 1922. "The Vanishing Game of South Africa. A Warning and an Appeal." New York and Pretoria.

Photograph by Herbert Lang

ONE OF THE STRANGEST CHARACTERS OF THE BIRD WORLD

The common African honey guide (*Indicator indicator*) performs a useful but not unselfish service in conducting man to some hive it has previously located. How this bird came to know that man could be of help in obtaining the food it prefers is still a subject for conjecture, but through his willing aid the honey guide is often enabled to feast upon the bee larvæ, which it probably covets more than the honey. Whether the wax that *Indicator indicator* so often swallows also serves as food seems very doubtful. That the substance is beeswax is apparent from the way it melts on a hot knife blade, only to congeal again as the blade cools.

Birds of both sexes act as honey guides, but the female, in addition to this rather commendable habit, has the more questionable one of laying her eggs in the nests of other birds and thus of avoiding the responsibilities of motherhood. Although resembling our cowbird in this practise, *Indicator indicator* is a near relative not of this malefactor but of the woodpeckers. Nevertheless, it rarely if ever climbs about on the trunks of trees, preferring to perch on twigs and boughs. As in the case of the woodpeckers, only two toes of each foot are directed forward, two being pointed to the rear.

The picture is that of a female and was obtained in the northeastern corner of the Belgian Congo. It is about two thirds natural size. The female lacks the throat patch of pure black by which the male is readily distinguished

Profiteers of the Busy Bee

OBSERVATIONS ON THE HONEY GUIDES OF AFRICA

BY JAMES P. CHAPIN

Associate Curator of Birds of the Eastern Hemisphere, American Museum

WERE a facetious journalist to attempt to endow a mythical bird with some startling but imaginary instinct, he would hardly be likely to go to the lengths to which nature has gone in the case of the common honey guide of Africa. The strange behavior of this bird has so long been known, moreover, that it surprises one to find how little has been written about it beyond simple accounts of the way the bird attracts the attention of men and reveals to them the location of beehives. Sparrman, who traveled in South Africa as long ago as 1775, gave one of the best descriptions from his personal observations, and was able to quote a still earlier account of the bird, accurate in the main, by Father Jerome Lobo, who had gone as a missionary to Abyssinia in 1625. As Sparrman concluded, the *moroc*, or honey bird, of the Abyssinians could be none other than the common honey guide. This testimony has been confirmed by a great number of travelers, sportsmen, and trained ornithologists who have since visited the open grassy regions of Africa, over which the bird is so widely distributed.

Avoiding the heavy forests of the Congo basin and other parts of western Africa, the common honey guide (*Indicator indicator*) ranges from Cape Colony to northeast Africa, and then across the Sudan to Senegal. It is a plain-colored, brownish-gray bird, scarcely larger than our American bluebird, but much more stockily built, with short dense plumage, and a skin so tough that it has often been considered a cuirass against the stings of bees. When fully grown, both sexes have half-concealed epaulets of yellow; and the male bird is then distinguished by a large black throat patch. The immature birds are somewhat greener and until a few years ago were regarded as a distinct species. The nearest relatives of the honey guides, in our North American fauna, are the woodpeckers; yet the honey guides have neither stiffened tail feathers nor an extensile tongue.

How well the honey guide is known and esteemed by the natives of the countries where it dwells may easily be imagined. By the Azande tribe of the northeastern Congo the bird is called *turubwa*, and I was told that before the arrival of Europeans an Azande chief would have cut off the ear of any man so stupid as to have killed a honey guide. Mr. Herbert Lang and I had many experiences with honey guides attracted by our caravans or hunting parties. It is the habit of the bird to locate one or more bee colonies and then wait for the passing of men, whose attention it attracts by a persistent chattering. At such times it is relatively tame and will alight in small trees only a few yards off. If a man wishes to learn where the hive is, he follows the bird, whistling occasionally to it.

Here I may quote an instance from my own notes. One afternoon in November, 1911, in a small wooded swamp near Faradje, a post in the

A beehive placed in a tree by members of the Logo tribe.—Perhaps the general scarcity of large hollow trees in the region renders an artificial hive attractive to the bees. It is so constructed that it can be pulled apart at the middle and put together again without entirely discouraging the occupants. The latter enter through a hole in the earthen partition at the larger end, to the left

northeastern corner of the Congo, we came upon a male bird, who at once started his chatter, and then flew off to some distance, returning shortly as though to assure himself that we were in earnest. We replied with low whistles, and following him through the tall grass and scrub, were led out on to higher ground. Now our feathered guide would fly noisily ahead about fifty yards until out of sight, perching on top of a bush and repeating the performance as soon as we came up. Presently another male bird joined him.

We had gone about six hundred yards when both birds stopped in a tree too small to harbor bees in its trunk. Yet by their short aimless flights and repeated returns to the tree, the honey guides impressed upon us that this was the spot. The buzzing of passing bees now was heard and the insects were traced to a small hole in the ground close by. During these proceedings the birds allowed us to approach within ten or fifteen feet of them.

We prepared to make a fire, and our birds retired noiselessly for the time. A little later I saw them again, sitting with puffed-out breasts and open bills, uttering a low *chwee-r-r*, which I had not heard before. They seemed to be quarreling, and one soon chased his rival off at top speed.

With the aid of some burning grass two of my black helpers quickly had the hive unearthed, paying a penalty of only six stings. The comb contained no honey, only pollen and bee larvæ. It was in a cavity previously occupied by termites. We placed some of the comb in the forks of a tree and went off to escape an impending shower. An hour or two later we found that the two birds had returned to peck at the comb; and the following morning I watched them come silently, the one after the other, to seize a piece of the comb and fly off with it. Without crediting the birds with actual foresight or intelligence, I do not hesitate to say that it is for this reward that they have worked.

It is said that in sections where the negroes have artificial hives hanging in trees for the use of bees the honey guide makes no distinction and will lead to occupied hives established through man's agency as readily as to natural cavities housing wild bee colonies. This I believe, though I have not had occasion to verify it even among the Logo of the eastern Uelle District, who attract bees with hives made of reeds.

The assertion has also been made that the honey guide will sometimes lead a man up to a snake or a leopard, but this has been vigorously denied by experienced naturalists. A story far better founded is that of the honey badger (*Mellivora capensis*) following the honey guide. Major Stevenson-Hamilton[1] describes it as though he had often observed it himself. "You may be resting in the bush in the cool of the afternoon, or on some cloudy day, when your attention is arrested by the persistent and approaching chatter of one of these feathered spies. Presently the bird itself comes fluttering on to a branch some thirty yards distant, where it perches, flapping its wings, and displaying every sign of impatience. For a moment it is silent, and then a less familiar sound strikes the ear: a light sibilant hissing and chuckling, which at first you find yourself unable to identify... The honey-guide understands, and having, with undulating flight, sought another tree some thirty yards further on, renews his invitation. Keeping quite still, and looking steadily, you presently spy a little gray and black form, moving along at a steady jog-trot; the tail is carried slightly above the level of the back, and the head, except when raised to glance up at the guide, is held a little low. Every time the bird utters his monotonous refrain, which, translated into feathered language, means 'Come along, come along, don't be so slow,' the follower replies, 'All right, my friend, don't be alarmed, I am coming.' And thus the strange procession passes on out of sight to the hollow

[1] *Animal Life in Africa*, 1912, pp. 247–48.

log where the unlucky insects are industriously slaving, only ultimately to satisfy the appetites of bird and beast." The favorite food of this badger is honeycomb, and it has powerful claws with which to tear open the hive.

Map showing the distribution of two African honey guides, one (*Indicator indicator*) an inhabitant of the open grass country, or savanna, the other (*Melichneutes robustus*) restricted to the equatorial forest

The instinct of the honey guide is unique among birds. It is far more complex than the "guarding" of buffaloes and rhinos by the oxpeckers (*Buphaga*). There the birds have come to feed on the ticks that cling to the animal's hide, and they merely alarm their hosts by their cries when they take flight at the approach of an enemy. The honey guide, on the other hand, recalls the action of a dog in leading a stranger to a spot where its master lies in distress, although the motive is, of course, entirely different. It brings to mind also the story so widely circulated by the newspapers a year or two ago, of a gander on a farm in Alabama which used to lead a blind ox to the watering trough every day by its cackling. I cannot vouch for the truth of this narrative, though photographs of the strangely assorted couple appeared in a New York paper of good repute.

No doubt the specialists in animal behavior have an explanation that does not require any reasoning on the part of the honey guide. The guiding is instinctive, for it has become hereditary with at least one species of

Indicator, and is practised by old birds of both sexes, and apparently by immature birds as well. The fact that it is a characteristic form of behavior throughout the whole range of the species argues for its remote origin and leads us to believe that the instinct grew up slowly with the evolution of the family, though man is not always the beneficiary. The honey guides must have preyed on bees long before savage man reached Africa, and we may speculate, quite properly, as to the origin of the guiding instinct.

The honey guide family (Indicatoridæ) is not a large one; it comprises, nevertheless, five genera[1] and about twelve species, of which two are found in the Oriental region, the remainder in Africa south of the Sahara. None of them exceeds seven and a half inches in length. I myself have secured specimens of six species for the American Museum and may thus claim a speaking acquaintance with four of the genera. Yet none save *Indicator indicator* ever offered to guide me to a beehive. A patient search of books and articles dealing with African birds reveals only one other species, *Indicator variegatus* of East and South Africa, which according to reliable authority,[2] renders the same service to mankind. Sir John Kirk[3] seems to have used the name *Indicator minor* in his oft-quoted account through mere accident, this being the only species in the collection upon which he was reporting. His description of the habits is quite clearly based upon *I. indicator*.

It is entirely safe to say that the majority of honey guides do not guide, or at least do not guide men. Nevertheless, I have noted in examining their stomachs in the Congo, as has Mr. G. L. Bates in the Cameroon, that more often than not these other species have swallowed beeswax, just as does the common honey guide, which has hives opened for it by men. Other insects, such as winged termites and perhaps adult bees in the open, are also preyed upon occasionally, but bee comb and bee larvæ seem to be preferred. The stomach contents not infrequently smell of honey, and we may suppose that the wax is swallowed incidentally—not by preference.

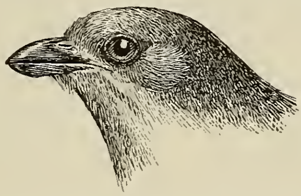
The one evident exception to these tastes is seen in the genus *Prodotiscus*, which differs in many respects—the bill and plumage especially—from all the other genera of the family. It does not eat bee larvæ, and one of the species frequents, it is said, trees of the genus *Sterculia* when they are in flower.

How then do the normal honey guides procure their favorite food? The only bees in Africa from which the wax could come are the common honeybee, *Apis mellifera* (represented by a somewhat smaller African race), and the much smaller species of *Trigona*, which are stingless. The honeybees, we know, nearly always store their sweets in a secure place,—a cavity in a tree, among rocks, or in the ground, where the birds unaided have little chance of stealing them. The nests of *Trigona* are usually in hollow trees, and are if anything harder to get at. Had the honey guides the strong chisel-shaped beak of their allies, the woodpeckers, they might hew their way through the wood; but, as it is, they are without any tools for use in such a direct attack. Birds of the genus *Melignothes*, for example, have an exceptionally blunt beak.

Thus all the typical honey guides eat honeycomb and yet are apparently un-

[1] *Melignothes, Melignomon, Indicator, Melichneutes,* and *Prodotiscus.*
[2] Ivy, *Ibis*, 1901, p. 21.
[3] *Ibis*, 1864, pp. 327–28.

able to secure it without help. What else can we conclude save that they adopt some method similar to that reported from South Africa, of enlisting the aid of the honey badger? In the forests of western equatorial Africa this mammal is extremely rare or



The head of the lesser honey guide, *Melignothes minor*, natural size.—Note the extremely blunt beak, serviceable perhaps for tearing honeycomb apart, but of little use in pecking open the tree where it is hidden. Drawn from a specimen by W. E. Belanske

wanting, and therefore we may only guess that squirrels, small carnivores, lemurs, or monkeys, are the creatures with which the honey guides carry on this commensal existence. This seems a bold assumption, but it is the best explanation I can offer of what we know to be their food habits. An alternative would be to suppose that the honey guides simply happen upon the hives after they have been robbed by some other animal. I doubt if they would get as much plunder in this manner as we know they secure.

It seems credible that the partnership began in such a way, but that sooner or later the birds took to accompanying bee-hunting mammals until finally the bird became the leader. The theoretic bearing of observations on the honey badger and its bird guide is now evident. Once the method had been well worked out with certain lower mammals, man would have been admitted into the association as a matter of course.

The breeding habits of the Indicatoridæ are bizarre, and similar to those of the parasitic cuckoos of the Old World or of our North American cowbird. Each white egg is deposited in the nest of some other bird, preferably that of a barbet, which is hewn out like a woodpecker's hole. Where possible, the adult honey guide breaks the legitimate eggs, it is said, and when the young is found, it is always the sole occupant of the nest. In the two species which lead men to hives, *Indicator indicator* and *Indicator variegatus*, Dr. Alwin Haagner[1] has found that the nestling has both upper and lower mandibles armed with a sharp, curved hook, as though for seizing any competitors and ejecting them from the nest it has usurped. It is said that these hooks are shed at about the time of leaving the nest. In two other members of the family, *Melignothes conirostris* and *Melichneutes robustus*, I have examined skins of nestlings partly fledged, but found only the usual egg-tooth on the upper mandible.

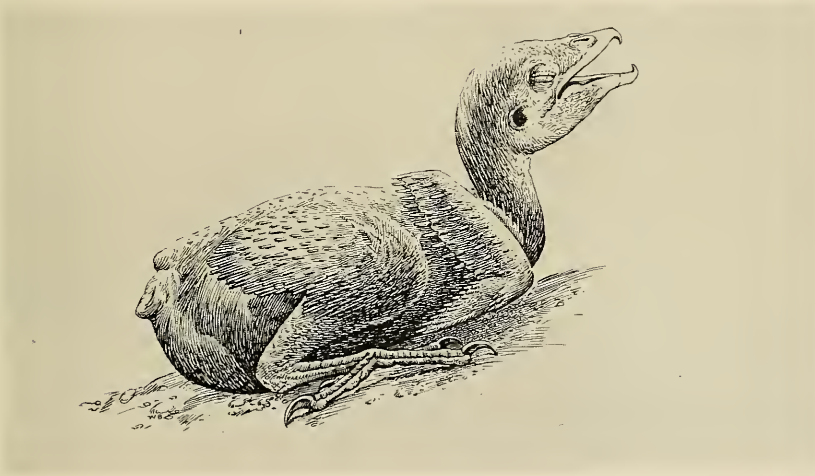
Among the honey guides of the West African forests, from the Cameroon to the upper Congo, there is one with a most unusual development of the tail, *Melichneutes robustus*. The four middle tail feathers are curved outward at the tip, and the three outermost on each side are greatly narrowed and shortened, reminding one of the outer rectrices of some snipe. This lyrate tail of *Melichneutes* has been compared to that of the black cock of Europe, but it is the small snipelike feathers that prove most interesting.

In this forest region of the upper Congo one may hear throughout a large portion of the year a reiterated note of tin-horn quality, the double syllables rising slowly in pitch, then dropping off, and repeated from twelve

[1] *Journ. S. Afr. Orn. Union*, Vol. III, 1907, p. 3, Pl. 1.

to thirty times. It may be heard afar, certainly at a quarter of a mile, and seems to come from above the forest canopy. The natives I consulted were all ignorant of the common honey guides of the grasslands and could not tell me what kind of bird we were listening to. Some ventured the opinion that it might be a woodpecker; but all were familiar with the sound and had a name for its author, the Azande of the southern border of the Uelle District calling it *nyĕté* in imitation of its voice. From 1910 to 1914 I wondered what the bird could be; and then, on the occasion when I secured my only specimen of *Melichneutes*, I heard the strange noise given after a second bird of the species had flown off from the same high tree in the forest. It is almost certain that the *nyĕté* is none other than our lyre-tailed honey guide. The "bleating" of certain species of snipe, it has been shown, is produced by their narrowed outer tail feathers during flight, by vibration of the webs as the air passes between them.[1] Is it not likely, too, that the nasal, tooting call of *Melich-*

[1]Bahr, *Proc. Zool. Soc. London*, 1907, pp. 12–35.



A young honey guide of the genus *Indicator*, only a few days old.—This drawing, about natural size, was made by W. E. Belanske from a photograph by Dr. Alwin Haagner, director of the Pretoria Zoological Garden. The young bird, the feathers of which are beginning to sprout, was found in the nest hole of a diamond sparrow, *Petronia superciliaris;* and from the fact that an adult of the scaly-throated honey guide (*Indicator variegatus*) had previously been seen in the tree, it was inferred that the young bird was also of that species.

The extraordinary hooks at the tips of both mandibles may be homologous with the extensive calcareous cap which at first covers the entire tip of the upper mandible of young woodpeckers, although the latter have nothing of the sort on the end of the lower mandible.

Doctor Haagner later received a live nestling of the common honey guide (*Indicator indicator*) almost fully fledged, which still retained both hooks on its beak. After a few days that on the tip of the lower mandible was shed, and the upper one would doubtless soon have followed suit, had the bird survived.

The foot was not shown in the photograph, but has been introduced in the drawing from a somewhat older nestling of *Indicator* in the American Museum collection. Note the roughened heel-pad, which recalls those of young barbets and toucans—neither of them very distant relatives *neutes* is made by the air rushing past the edges of the same feathers? We know that *Melichneutes,* while perching, emits a hoarse chattering vocal note, which is entirely different. For future field naturalists in equatorial Africa I would suggest a thorough investigation, though it will be anything but easy. For I suspect that when the life history of this most remarkable of honey guides is more fully known, it will be found that it summons by its curious note some mammalian accomplice to aid it in robbing the hoard of an industrious colony of bees.

Adult male of the lyre-tailed honey guide, *Melichneutes robustus,* about seven-tenths natural size; drawn by W. E. Belanske from the single individual secured by the American Museum Congo Expedition.—Only three adult specimens and two young are preserved thus far in museums. There is very little difference between the sexes, even in respect to the curious modifications of the tail feathers; and the tail of the young foreshadows clearly that of the adult, though the young in first plumage differs in having the head and breast blackish instead of olive and gray.

The feathers here seen extending out beneath the middle of the tail are merely coverts, the true middle tail feathers are somewhat lyrate. If, as the writer suggests, the tail serves as an æolian sound-producer, the "strings" are placed outside instead of between the arms of the lyre, in the form of narrow, relatively stiff feathers on each side.

This specimen was shot by the writer from its perch in the top of a tall tree in the Ituri forest, after he had scrutinized the extraordinary tail through a binocular

Amateur Entomologists and the Museum[1]

A SURVEY, FROM THE HALF-CENTURY MARK, OF THE DEPARTMENT OF ENTOMOLOGY, AMERICAN MUSEUM

By FRANK E. LUTZ

Curator of Entomology, American Museum

ONE of the very pleasant features of the work on insects in the American Museum during recent years has been the cordial coöperation of amateur entomologists. I have recognized and warmly appreciated this aid but not until I had reviewed the steps by which the Museum's collections of insects advanced in fifty years from nothing to a place near the front rank did I realize how important such aid from amateurs had really been.

Baron Osten Sacken was Russian consul general in New York City from 1862 to 1871. Doubtless he did his diplomatic work well but his fame rests upon his recreation, the study of insects. His particular interest was Diptera, the group to which flies and mosquitoes belong, and of these he described nearly four hundred new species from North America alone. He was evidently much interested in the newly established American Museum of Natural History, for in 1870 he presented to it specimens representing about a thousand species of insects.

At about the same time Mr. Coleman T. Robinson presented his collection of about 3000 species and served as curator without salary until his death two years later. Mr. Robinson's hobby was butterflies and moths and he collaborated with Mr. August R. Grote, one of the foremost authorities on Lepidoptera at that time. These two collections, supplemented in 1874 by a collection of about 2000 species presented by Mr. R. A. Whitthaus with the wish that it should be set aside exclusively for the use of persons especially interested in entomology—in other words, that it should be a study collection—were the start of our work in this field.

Apparently, however, these splendid foundations were not built upon speedily. Little seems to have been done until in 1884 Mr. Joseph W. Drexel, a Trustee of the Museum, presented some butterflies and moths, which, together with the previous gifts (except for types and rare species) were exhibited in newly constructed cases and, according to the *Annual Report* for that year, formed one of the most attractive features of the "main hall."

No one in particular seems to have been in charge of insects after Mr. Robinson's death until the appointment of Mr. E. B. Southwick in 1886. The following year the collections were placed in charge of Mr. L. P. Gratacap, then assistant curator of the department of geology, and in 1888 Mr. William Beutenmüller was engaged to give his whole time to entomological work in the Museum. Naturally, much of the valuable material received in the seventies had been destroyed by "moths" and other misfortunes during the time when no one was in special

[1]The author is indebted to Mr. A. J. Mutchler, assistant curator in charge of Coleoptera and the oldest member, in point of Museum service, in the department of entomology, for bringing together the facts connected with the history of entomology in the Museum.

INSECTS AS ALLIES AND AS ENEMIES OF MAN

Insects are frequently set down in the mass as man's enemies and, indeed, certain injurious species are among the most irrepressible of his foes, devastating his crops as aggressively as an invading army. But the damage wrought by such insects is more than outweighed by the good done by others. A vast number of plants upon which we depend for food, or which bring cheer into our lives through the beauty of their blossoms, would disappear from the earth if they were not visited by insect pollinators.

In the upper picture is shown the codling moth, *Carpocapsa pomonella*, which annually takes a heavy toll of our apple crop; but there would have been no crop at all if other insects had not coöperated.

Below is an old-fashioned straw beehive, suggesting the activities of one of the most useful of insects, *Apis mellifera*, which was domesticated by man centuries ago and has been introduced by him into America, where it is today so well established that the uninitiated are apt to look upon it as one of our native insects charge, and many of the specimens that had survived were in poor condition, but a sufficient number of them are still in existence to show what a splendid start had been made.

With the appointment of a regular curator and thanks to the keen interest of Mr. Morris K. Jesup, then president of the Museum, entomological activities were briskly revived. Exhibition work along new lines was begun, the life history and other phases of insect biology being shown and made more valuable by the use of artificial leaves as accessories. Reflecting one of Mr. Jesup's particular interests, these new exhibits were largely concerned with insects injurious to trees.

The next few years brought several notable accessions, all the work of amateurs. Mrs. M. Schuyler Elliot presented the butterfly and moth collection that had been made by her son, Dr. S. Lowell Elliot. It is chiefly remarkable for the large number of reared specimens, many of the rarer forms being represented by entire broods showing the variation within a species. The collection of Mr. James Angus, a resident of West Farms, New York City, contained a large number of local species and was also a gift. But the most notable accession was that in 1892 of the widely known "Harry Edwards Collection," containing about 250,000 specimens from all parts of the globe.

Mr. Edwards was an actor and had been connected with various companies in the United States, Central and South America, and Australia. He went to Australia as a manager for A. M. Palmer's *Little Lord Fauntleroy* organization, returning in 1890 to join Austin Daly's company. During his travels he personally collected many specimens and purchased others. For three years he was the editor of *Papilio,* a journal devoted exclusively to butterflies and moths, and he was also the author of a large number of valuable papers on these beautiful creatures, his last contribution to entomology being a *Bibliographical Catalogue of the Described Transformations of North American Lepidoptera.* His last appearance on the stage was in New York as Sir Oliver Surface in *The School for Scandal.* After his death his collection was purchased, nearly $10,000 having been given by friends of Mr. Edwards in response to appeals from Mr. Palmer and other members of the stage. Though once noted in his profession, he will be remembered, like Baron Osten Sacken, as long as science exists for the things which he did as recreation.

In 1897 The Very Reverend E. A. Hoffman became interested in the Museum's entomological work, generously contributing to its support until his death in 1902, and his son, Mr. Samuel V. Hoffman, continued this support for several years thereafter. The results of this financial aid were a large collection of butterflies, each in a plaster mount, and a number of field trips by Mr. Beutenmüller to the Black Mountains, North Carolina. The butterflies were put on exhibition, but recently we felt that most of them were more valuable as scientific specimens than as exhibition material and, as they were fading because of their exposure to light, we have placed them in light-proof cases in the study collection. They are safe there and may be seen by anyone sufficiently interested to ask permission.

In 1903, Prof. William M. Wheeler became curator of invertebrate zoölogy, a department separate from entomology, but Professor Wheeler was then, as now, one of the leading entomologists

Although spiders are not insects, they rival them in interest, and in the popular mind are grouped with them. The webs spun by spiders are usually of so fine a texture that we are unable to trace them in detail unless they are sprinkled over with dew or powdered with dust, and even then only inadequately. Webs mounted on a dark background, with their strands thickened so that they are distinctly visible—a process devised by Mr. C. H. L. Gebfert—are among the striking exhibits of the department, as the accompanying picture of the web of *Eustala anastera* gives evidence

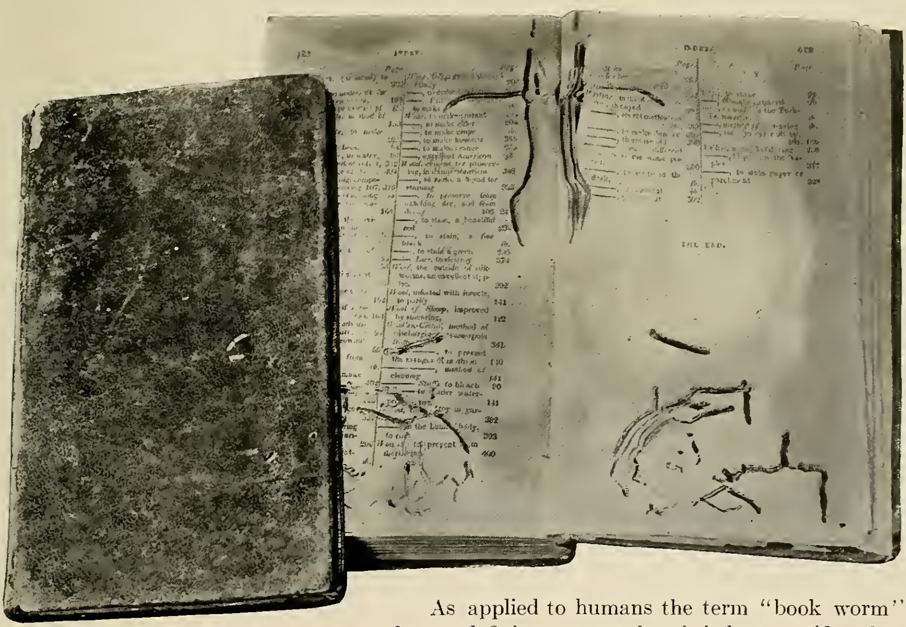
of the world. Although not officially connected with the department of entomology, he continued his most valuable studies on ants and presented to the department his collection of more than a thousand species of Diptera, including about two hundred type specimens of species which had been described by Wheeler, Melander, and Brues. On his resignation in 1908 to become professor of economic entomology at Harvard he presented to the Museum his wonderful collection of ants but took it with him as a loan in order that he might continue his studies. Fortunately, as research associate of social insects, he still retains his interest in and connection with the Museum.

Prof. Henry E. Crampton succeeded Professor Wheeler as curator of invertebrate zoölogy and the hitherto independent department of entomology was put in his charge with Mr. Beutenmüller as associate curator of Lepidoptera. The writer was appointed assistant curator of invertebrate zoölogy and given charge of insects other than Lepidoptera. Mr. A. J. Mutchler remained, as he had been for six years, Mr. Beutenmüller's assistant, and Mr. Charles Wunder was engaged to help with the other insects.

In the twenty years that had elapsed

Aphids—those pests of the gardener—are beloved of the ants, which protect them as sedulously as man destroys them. The aphid gives forth a sweet secretion—the "honey dew" of the ancients—and it is because of this that they are favored by a group of insects notable for having a "sweet tooth." Some species of ants even stroke the aphids with their antennæ to induce them to void the honey dew, a procedure suggestive of milking. Hence Linnæus appropriately referred to aphids as ants' cows. A forward step in the domestication of the aphid is shown in this photograph, taken by the author at Ramsey, New Jersey. It represents a "cow shed," or protective structure built about the aphids. So that the "cattle" might be revealed, the roof was partly demolished before the photograph was taken. Field work forms an important part of the activities of the department of entomology and, as this photograph indicates, one does not have to stroll far from home in order to see matters of interest

Photograph by the author



As applied to humans the term "book worm" has a definite connotation; it is less specific when used in describing insects. Certain members of a family of beetles (*Ptinidæ*) are among the principal destroyers of literature. One member of this family has a record of having "penetrated directly through twenty-seven large quarto volumes in so straight a line that a string could be passed through the opening and the whole series of volumes suspended." In the tropics termites rival the Chinese emperor of old who made a holocaust of the then-existing literature, in ruthlessly attacking books as well as many other things. The retardation of knowledge in some countries has been ascribed in part to the lack of respect of these insects for the printed word

THE POLISTES EXHIBIT IN THE AMERICAN MUSEUM

The genus *Polistes*, like *Vespa*, is made up of social wasps but, in contrast to *Vespa*, the nests of which are enveloped with a wrapping of "paper," *Polistes* builds nests consisting of an exposed comb. The nest is started by an over-wintered queen, who may select as her building site the under side of a porch roof, the eaves of a house, or any other protected place. In the exhibit pictured above, an old shoe was chosen; but the *Polistes* mother, unlike the old woman who chose a similar domicile, finds a use for the numerous daughters that constitute her family, to whom is entrusted the care of the larvæ and the enlargement of the nest. In the can is shown a nest that was started but subsequently abandoned

A NEST OF VESPA EXHIBITED IN THE AMERICAN MUSEUM

Although nests built in the open by social wasps of the genus *Vespa,* which includes the hornets and the yellow jackets, are frequently noticed, those built under ground are revealed only to him who has the enterprise to excavate them,—a somewhat hazardous undertaking if attempted before the wasp colony dies out in the fall. The "paper" that surrounds these protected nests is not nearly so tough as that made by species which build above ground. Moreover, in Europe and North America it is the short-cheeked species of *Vespa* that for the most part build in burrows in the ground, the long-cheeked forms constructing as a rule aërial nests. This exhibit shows a nest of yellow jackets that was started by the mother wasp in a mouse burrow, the cavity being enlarged as the needs of the colony grew

A more uncomfortable position in which to take one's rest than that here illustrated would be hard to imagine. While this *Sphex* wasp dozes, its jaws do not relax their hold on the support. Its attitude suggests an acrobatic performance, but it is the way the insect takes its ease. The exhibit was arranged by Mr. Henry Bird

since the first appointment of a regular curator of entomology the collections had grown immensely. I have mentioned only a few of the larger steps in this growth, for to do more is impossible at this time. Not at all as a criticism but as a statement of fact, it may be said that the collection of insects had been enlarged out of all proportion to the staff (a curator and one assistant) that had it in charge. Mr. Wunder and I were confronted with a total of more than 300,000 specimens most of which required labeling and few of which were classified even as to order. These were exclusive of Lepidoptera and the "arranged" collection of other insects. That this condition of affairs does not now exist and that, although our collection of insects has had since then an average growth of about 50,000 specimens a year, practically every specimen is labeled and ready for study is due to the conscientious work of Mr. Wunder and the coöperation of the entomological assistants, Mr. Mutchler (appointed assistant curator in 1922), Mr. John A. Grossbeck (deceased), and Mr. F. E. Watson, aided, as other work permitted, by the entomological typist. The splendid and welcome accessions to the collections since 1908 are matters of such recent record that they will not be repeated here.

In 1921 entomology was again made a separate department, the staff consisting of a curator, two scientific assistants (Mr. Mutchler and Mr. Watson), a general assistant (Mr. Wunder), a typist and three research associates (Prof. Wheeler in social insects, Mr. Charles W. Leng in Coleoptera, and Mr. Herbert F. Schwarz in Hymenoptera) who serve without pay. In addition, I am most happy to say, the department is aided by a number of amateur entomologists, members of the New York Entomological Society and others, who liberally give us time and specimens—money many of them do not have to give—receiving no other reward than the pleasure of helping the institution help others to learn about the creatures which are of so much interest to them.

Some indication of the amount of scientific work accomplished may be had from the amount of publication. It is of interest to note that in the last fifteen years the Museum's entomological activities have contributed approximately 5500 pages to the *Bulletin*—about one-third of the total number of pages of that publication. Other papers have appeared elsewhere. This relatively large contribution could not have been made solely by the Museum's small entomological staff and, as a matter of fact, more than half of the articles, although based upon Museum material, were written by outside workers, either amateur entomologists or members of the staff of some sister institution.

We feel that the Museum owes a great debt to amateur entomologists and to the public from which the amateurs of the future are to be recruited. One of our rooms has been fitted out as a meeting place for the New York Entomological Society and a collection of insects found within fifty miles of New York City has been placed in charge of that society. This collection is freely open to amateurs for study. In the exhibition hall we are trying to present insects not as often beautiful and sometimes curious creatures, but as having most interesting habits,—a fascinating group the study of which many lifetimes will not exhaust, a group, moreover, that is represented on every hand as is shown by the exhibit (now being arranged) of hundreds of different kinds found in a town lot only 75×200 feet in extent.

Recently an enclosed space within the exhibition hall has been set aside

The auditory organs of insects are located in unexpected places. Grasshoppers have on the first segment of their abdomen a membrane that serves as an ear. The male mosquito *Culex*, on the other hand, uses its antennæ to detect sound. The antennal hairs vibrate sympathetically to certain tones, and their response is greatest to the note represented by the female's hum. No stranger location for a hearing organ suggests itself, however, than the leg. Yet a number of insects, including crickets, long-horned grasshoppers, ants, termites, and stone flies have their auditory organs situated on the forelegs. The model of a cricket's foreleg, prepared by Mr. Ignaz Matausch, illustrates clearly the light-colored membrane that probably functions much as does our ear drum

Adjoining the insect exhibits on the third floor of the American Museum, is an enclosed space that has been reserved for the exclusive use of Boy Scouts. Here they may keep their working materials and their specimens, which include not only dead insects to be mounted but live insects in the larval, pupal, and adult stages, also formicaries, and even animals other than insects that are being studied by the Scouts. Here Mr. B. T. B. Hyde, educational director, Kanohwahke Scout camps, Palisades Interstate Park, has established his winter headquarters, and the picture shows him and a number of his Scouts engaged in their indoor activities

for the use of Boy Scouts interested in entomology. Here they may mount insects they have collected and watch the development of live specimens they have captured in the larval stage; here too they may get that wider acquaintance with the insect world which is offered by the exhibition collections.

Our scientific work, including the field trips, is not being directed primarily toward studies of any particular orders of insects but centers about the problems concerning evolution, particularly those of geographic distribution and the interrelations of insects and their environment. These studies have taken us to Labrador, Florida, the West Indies, and South America, and, in recent years, to the Rockies and other parts of the West. A number of friends, especially Mr. B. Preston Clark, have kindly given financial aid to these trips and now, through the generosity of other friends, the department has an automobile fitted up as a camping-collecting car for use in field work.

Naturally, we hope that our department may continue to enlarge its collections and, what is even more needed, its curatorial staff; but our most earnest hope is that we may be increasingly helpful to the amateur entomologist. It is from this class of naturalists that we derive much of our support, and honesty demands efforts to repay our debt.

The colony of beavers at Lava Creek, Yellowstone National Park, have erected a dome-shaped house of impressive size. The dam seen in the foreground is enlarged a little each year by the beavers, and as a result the government engineers are compelled each year to raise the road that runs along the shore of the creek

A Beaver Colony of Yellowstone Park[1]

By M. P. SKINNER

Park Naturalist, Yellowstone National Park

Inhabiting two centuries ago the greater part of the North American Continent, ranging southward as far as the Rio Grande and extending northward into the Arctic Circle, the beaver was subsequently threatened with extinction due to the merciless demand for its fur. Today, thanks to the respite from persecution that it has enjoyed, it again occupies half of its original territory. It is a pleasure to note that it has built in the security of some of our national parks. Visitors to the Rocky Mountain National Park, for instance, are familiar with the structures erected by beavers within that sanctuary. The wild life of Yellowstone National Park rivals in appeal the geysers of the region, and the establishment some years ago of a beaver colony near a roadway, where it might be viewed by the thousands of people who annually visit the park, was a development of interest. That colony has now grown to proportions that justify a review of its history.—Editor.

When I first knew the locality herein referred to—a willow meadow, hard and firm most of the time but swampy in spring—no beaver were to be seen in it. About 1910, I noticed beaver signs near the bridge below the meadow, and I assumed the beaver concerned had come up from the river three miles away. I doubt if there was more than one animal at first and he contented himself with a burrow in the bank of Lava Creek. A few years later he was joined by a second beaver, and in the spring of 1914 the trees cut down for food and the twigs stripped of bark became more conspicuous. Soon after that the beavers began moving up a small stream flowing in from the east through the swampy meadow. Late that summer small dams were built and a series of little ponds was de-

[1]Photographs by the author.

veloped, but still there was no house visible.

During the following September the beavers started work on the main dam and although they did not build it high at first, the barrier was sufficient to cause the water to back up. Whole branches were used, the branchlets and twigs sticking out and interlocking with those of adjoining branches and thus offering resistance to the stream. The larger branches and trunks of aspen were placed in the lower part of the dam with some willows on top. (In other places, where aspens are scarce, beavers have shown themselves adaptable and have built with willows only, or even with mud if the better materials could not be had. When obtainable, stones have been used to weigh down the branches.) Each autumn during the following four years the dam was built a little higher, and additions were made to the house, which had evidently been started at the same time as the dam although it was so small at first that it failed to attract attention.

By 1919 the colony had increased to twelve beavers, and, needing bigger accommodations, the animals all set to work tearing down the old house and erecting in its stead one of the largest houses I have ever seen. The site was the highest part of the pond bottom and the new house was a domed structure of mud with interlaced aspen branches of fair size, so placed that it would be exceedingly difficult for a coyote or a wolverine to dig through. While the building was going on, the entrance burrow was dug out and the interior chamber roughly shaped, the finishing touches being given later. This house is still the main home of the "original settlers," although several colonies have left it to go elsewhere.

After the house was finished an addition was built to the dam, and each year since, a little more has been added to keep the water at least three feet deep over the mud and silt that each spring freshet brings down. This complicates the work of the government engineers, who each year must raise the road along shore to keep above the rising water.

The locality had little beaver food except a few aspens, the willow bushes, and some water plants, and with the increasing population these were soon in danger of giving out. So the beavers started new works to the south, forming two more ponds and gaining access to a fine grove of aspens. In 1921 they built another house in the middle pond, and in 1922 they started yet another. During these operations much pine and fir land was flooded and the trees killed, with the result that the scenery is somewhat marred by the dead trees.

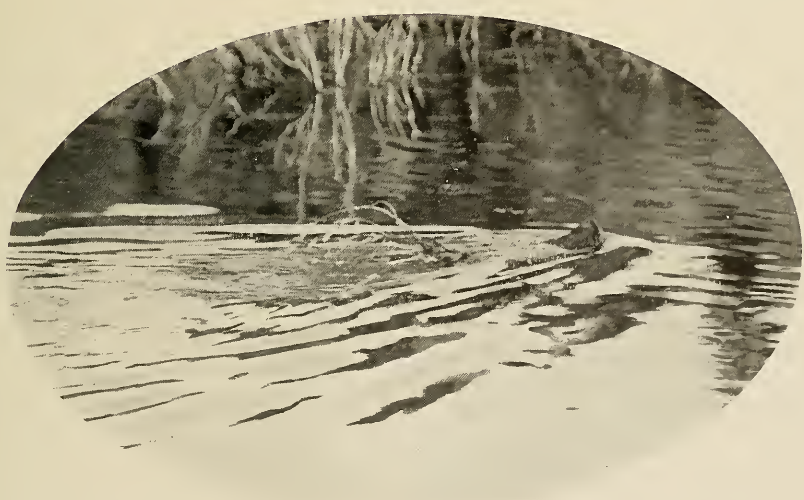
In Yellowstone Park beavers are protected, but it takes time for them to find it out. At first beavers were glimpsed only on moonlight nights, but now they are becoming so tame they are easily seen in daytime by the thousands of tourists that frequent the park. When the intelligent animals found that people did not molest them, they came out earlier and earlier, and now they often appear as early as three o'clock in the afternoon. But they still make their repairs and additions to house and dam at night, so that it is not often that they are seen at work. At present they number about twenty.

Usually the first indication of beavers is the sudden appearance of a small round head shooting up to the surface near the house, followed by a long, flat, brownish back. A V-ripple silvers the surface as the beaver circles about the house, and sometimes around the pond, to see if all is safe. Then the animal makes a straight course to the upper end of the pond where the willows grow. When a willow is found to his liking, he rises up on his legs, braces himself with his strong tail, grasps the willow with his paws, and cuts it off with one or two bites of sharp teeth driven by powerful muscles. The branch is taken by the butt and the beaver, with head higher and back lower than usual, swims off to a favorite eating place with the branch trailing behind. Arrived there, he crouches half in and half out of the water, grasps the willow crosswise with his fore paws (I almost said "hands," so soft and free from hair are they and so expertly used) and turns it rapidly about as the teeth strip off the bark. He works fast, and soon a peeled switch is left to mark the feast. Sometimes the branch is taken to the house, or dam, and the switch left there to strengthen the structure.

After a hearty meal, the beaver is apt to wash and smooth his fur. A peculiar split nail on the second toe of the hind foot is used, it is said, in combing the hair; I cannot vouch for this from personal observation, but I have seen our little friend dress his fur with his paws, afterwards washing them, his arms, and face cat-fashion. On the score of personal cleanliness, I am inclined to place the beaver very high indeed. Living as he does in close, crowded quarters all winter, he must be cleanly, or vermin would make his life miserable.

Willows did not always satisfy the beavers, and they craved aspens; but aspens grew farther away from the water and the animals had to go overland to secure them. They were rather awkward on land: in walking their toes were turned sharply out, and the high arched body swayed from side to side on the short legs, while the broad, heavy tail swung sidewise also but in the opposite direction. The task of the beavers was a hard one and when they started bringing the aspens back, they found it necessary to cut them into short sections, from one to four feet long, after trimming off the branches. Even so, many a time it took two or three workers to master a load. Then their engineers began building canals from the pond towards the "wood lot," for they found it easier to tow logs by water than to drag them over land. Also it was safer, for a beaver disturbed by wolf, bear, or bobcat could escape much faster by water.

Unlike the bear and some other animals, beavers do not hibernate and must eat all winter. Accordingly in the autumn, on the approach of cold weather, they busy themselves taking branches and tree sections to a pile near the house, where they are sunk to become available as food in winter when the pond is closed by ice. At Lava Creek, not so much food is stored, for there is a spring near the road and the comparatively warm water prevents the formation of ice over an area of a few feet. The patch of clear water permits the beaver to leave his winter prison if food becomes scant.



A beaver taking a willow branch to the storage pile near the house, to be used as food when the pond freezes over

American Men of the Dragon Bones

PERSONAL IMPRESSIONS OF A FIELD TRIP TO MONGOLIA WITH THE THIRD ASIATIC EXPEDITION

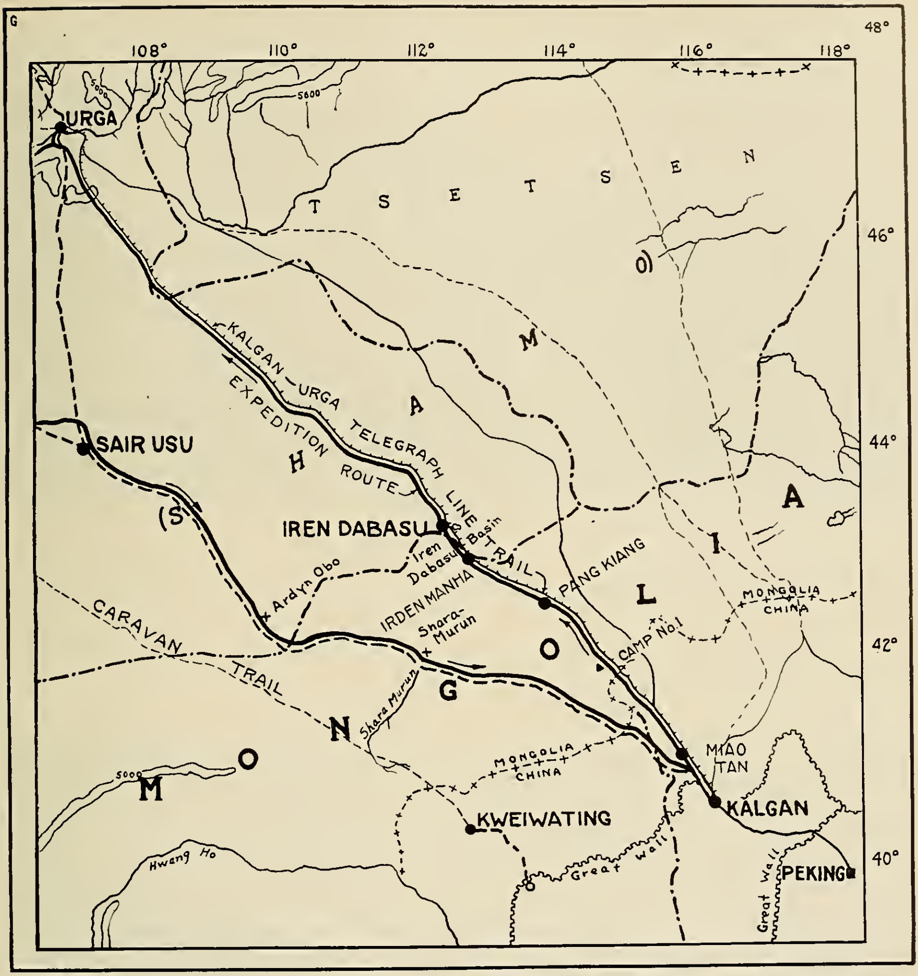
By HENRY FAIRFIELD OSBORN

Foreword.—Barely escaping the catastrophe in Yokohama, Professor Osborn arrived in Shanghai Tuesday, September 4, and received from Mr. Roy Chapman Andrews the following telegram: "Greatly worried about you. Am holding entire expedition in Mongolia awaiting your arrival." This anxiety was due to the failure of the American wireless station in Peking to get detailed news of the casualties of the Yokohama disaster. On receiving a reassuring reply, Mr. Andrews wired, "Thank God, you are safe! Awaiting you in Peking." In Peking at last, after two years' delay, Professor Osborn was greeted on the platform by Mr. and Mrs. Andrews. Mr. Andrews was full of suppressed excitement over the discovery of dinosaur eggs, a relatively small but ultimately momentous incident in an expedition so full of great discoveries. Messrs. Osborn and Andrews outfitted at once and started September 12 by train to Kalgan, close to the Mongolian frontier, at which point these notes from a week's diary crowded with interesting entries begin.

LEAVING Peking September 12 at half past eight, we arrived in Kalgan at three-thirty that afternoon and were met by John McKenzie Young, chief of the motor fleet of the Third Asiatic Expedition of the American Museum and *Asia* Magazine. Highly trained as an expert mechanician, with a fine record in the United States Marine Corps service, Young succeeded Colgate of the 1922 expedition and, ably assisted by C. Vance Johnson, another United States Marine Corps veteran, brought the fleet of five motor cars over six thousand miles of rough Chinese roads and Mongolian bowlders and sands triumphantly to the end of two years of service, and in such splendid condition that the entire fleet was sold to Chinese merchants at half the original cost.

From Kalgan, dusty and prosperous, Young guided our four-passenger Dodge car along the center of a dry river bed, where not a drop of rain had fallen for months, through cañons bordered by ancient towers, fortresses, and walls, over the first mountain ridges, and into broad open plain. We were deeply impressed with the Chinese struggle for existence, with the evidence of over-population, with the triumphs of Chinese agriculture—triumphs which have doubtless been accumulating for the last 12,000 years, since the first colonists settled on the Yellow River. Every bit of land is intensely cultivated; every mountain-side is terraced to the very summit, although there is no water with which to irrigate. We passed by an old grandly walled town, a monument of Chinese brick masonry, every line and angle in perfect symmetry. We had never been told enough of the Chinese as architects, as designers, as masons, as builders, as engineers. The entire interior of this walled town, which probably resisted centuries of Mongol attack from the north, is virtually deserted, very likely because infested with disease and with vermin, but a new Chinese town is springing up about a quarter of a mile distant.

From this point, where we rested to cool off and enjoy some fruit, there begins a sharp and rocky ascent to the summit of the pass, the ancient border between China and Mongolia—an



American Museum of Natural History and Asia Magazine

This map shows the line of the Kalgan-Urga Telegraph that flanks the route over which Professor Osborn and his companions, Messrs. Andrews and Young, traveled from Kalgan to the Museum camp at Irdin Manha, and thence to the fossil site of Iren Dabasu, 21 miles beyond. The roads were bad from Kalgan to Miao Tan, 35 miles; extremely variable from Miao Tan to Pang Kiang, a telegraph station, 139 miles; perfect from Pang Kiang to Iren Dabasu, in the eastern part of the Desert of Gobi, 87 miles—a total of 261 miles from Kalgan to Iren Dabasu. Iren Dabasu, signifying "Valley of the Salt Lake," is the chief spot indicated in the *Encyclopædia Britanica* map of the Gobi Desert of Mongolia

ascent where the stoutest automobiles are put to the severest test, because of both the grade and the terrible character of the road. We climbed slowly upward through the dust, but in the wet season no automobile can make this ascent. It is highly distinctive of Chinese civilization, past and present, that this people is blind to the value of roads as civilizing media and as channels of distribution for agricultural products. Roads were built only to the tombs and palaces of the emperors. The automobile is now welcomed on the single Kalgan-Urga route over the pass because the heavy *tuchun* tax on this vehicle enables the local military magnate to make a pretense of keeping

American Museum of Natural History and Asia Magazine

A section of the dry river bed north of Kalgan under a cliff crowned by a Chinese temple. Beyond rises a hill surmounted by one of the outer Chinese walls. The stern rock hill in the center and right of the picture is of Jurassic porphyry, the result of a series of volcanic flows, now tilted steeply up. The lower hills to the left of the hard rock are wholly composed of loose gravel. In the upper beds of these were found sands containing real "dragon" bones—dinosaurs. Photograph by Roy Chapman Andrews

American Museum of Natural History and Asia Magazine

These stout walls of an ancient Chinese city doubtless repelled Mongol attacks from the north throughout centuries. They still stand,—a memento of the past but serving today no practical purpose, for the city they guarded is deserted, while the tide of invasion has reversed itself, and the Mongol military pressure of old is being replaced today by the peaceful penetration of Mongolia by the Chinese. Photograph by Roy Chapman Andrews

American Museum of Natural History and Asia Magazine

Eastern side of the crumbling frontier wall between northern China and Mongolia, with a ruined watchtower in the center. Just beyond, as one looks into Mongolia, one may see the rich agricultural lands of the Chinese colonists. Photograph by Roy Chapman Andrews

the road in order. The Chinese carts with shining steel-studded wheels are forced aside into their own rutted roadways, through which men and animals struggle along, for a single train of Chinese carts would completely destroy even the rudimentary motor road that extends from Kalgan seven hundred miles north to Urga.

Reaching the summit of the pass at one o'clock, we were faced by the ruins of one of the outer walls guarding the passage from the Mongolian plains north of the mountains to the great plain of China on the south. To the right of the narrow road are the ruins of a tall watch tower and to the left the "Temple of the Gateway," which contains three once formidable and revered gods of war, somewhat dilapidated now as a result of the wave of irreverence for ancient deities which is sweeping all over the Celestial Empire.

Infinitely more impressive is it to look southward from the temple over the rich and fertile plains of Cathay and imagine the hardy Mongol conquerors clambering over or breaking through the wall, descending with little resistance to pass the line of fortifications which culminated in the Great Wall fifty miles to the south. The hardy and warlike Mongols have always held in contempt the peace-loving agriculturists of China, and even now the Mongol saying runs, "One Mongol is good for ten Chinamen and a Mongol troop of 300 is amply able to rout a Chinese army of 3000." In fact, in 1921, not far north of this barrier, which has been crossed and recrossed so often in the past three thousand years, the entire Chinese army was virtually annihilated, the few straggling remnants being driven back by Mongol troops armed with Bolshevist weapons.

The present peaceful invasion of Mongolia by China is, however, far more formidable than the warlike invasions of the past. The Chinese farmer is pushing northward the Mongol herdsman and horseman, just as the American farmer and settler slowly pushed back the Indians of North America. This agricultural invasion is irresistible; it is at the rate of from five to ten miles a year, along a very broad frontier, which has now reached a point between eighty and ninety miles north of the actual geographic line between Mongolia and China. The advancing invader is the adventurous Chinese with his plow; he goes well beyond the nearest Chinese settlement, selects what seems to be a promising piece of land, throws it into furrows, and plants the first crop of seed that has ever been put into this virgin soil, which the nomadic Mongols have used for thousands of years as grazing grounds. The next year the Chinese officials take over the land and establish corner posts, and in another season the Mongol *yurts* slowly disappear and Chinese mud-walled towns suddenly spring up. The present Chinese invasion, it is said, extends at least 125 miles east and west and from 50 to 80 miles north and south, constituting an area of not less than 6000 square miles.

Nowhere is there a more startling transition than that presented by the landscape as one leaves the terribly arid hillsides of northern China and, passing through the barrier wall, finds himself among beautiful, richly fertile slopes and fields, superbly cultivated. The melting snow of the preceding winter starts the crops in spring; then there is a period of drought, followed by an early autumnal rainy season. As we rolled along, passing entrancing golden fields, we were pelted by a heavy shower of hail, exactly as in the uplands of Colorado and Wyoming in the midsummer season. The roads are almost perfect and we bowled along at thirty-five miles an hour, reaching the important Chinese motor car station of Miao Tan at half past three, which gave us an opportunity before dark of studying a typical Chinese frontier town, into which the Chinese peasants retreat from their widespread fields at nightfall for protection. The harvest was in full tide. Women stumped along on their diminutive bound feet, for this region has not been penetrated by the foot reform wave. Chinese mothers do not want to jeopardize the future matrimonial prospects of their daughters by allowing their feet to attain a natural size, the small foot being one of the emblems of feminine beauty even in this farming community. Some of the women and girls, though moving about as if on stilts, appear to have overcome the pain entirely; others, their faces drawn, show that they are life-long sufferers from the mandates of this strange fashion.

Returning from the fields under the brilliant rays of the setting sun—the first of the incomparable Mongolian sunsets which greeted us—we had splendid appetites for our first truly Chinese dinner, and the doorway to the guest room of honor seemed most inviting even though the square windows of the room were covered with paper instead of glass, thus affording poor ventilation.

It was represented to our Chinese host in the inn of Miao Tan that the party was headed by no less a personage than the president of "the American Museum of Heavenly Creations," a man who had come an immense distance and must be duly impressed not only with all the delights of Chinese cooking but with the exotic comforts to be found between the baked-mud walls of the principal guest room, where one's bed is placed on top of the Chinese oven before the fire is kindled within.

But the dinner was a simple one compared with the elaborate banquet prepared for us at this same inn on our homeward journey a week later, because on our departure for the north the host was duly warned that when we returned there should be such a dinner as had never been served before in this inn.

This great feast on our return to Miao Tan was celebrated on the evening of September 19, when the entire fleet of automobiles was rolling southward. I may be permitted to digress for a moment in order to stress some features of that return trip. Andrews and I arrived in advance of the fleet and found the courtyard pretty well crowded with three northbound Russian-American motor cars, including an imposing French double-tired truck, utterly unfit for Chinese furrows or Mongol road bogs. It was evident that the cars were terribly overloaded and that, with a very rudimentary knowledge of motor construction, the chauffeurs were more intent on making loud explosions and thereby creating a great impression on the Chinese than in the care of their machines. One of these cars, with twelve northbound Chinese passengers on top of its load of freight, started out of the yard to the accompaniment of loud engine explosions, carrying with it a considerable part of the gateway. At this moment my American heart throbbed with pride as I heard the familiar toot of our own motor fleet and there swept into the yard in perfect order and at a rapid rate our two Fulton trucks and three Dodges, grandly driven by their bronzed, blue-eyed giants, J. McKenzie Young and C. Vance Johnson. The cars lined up side by side in military order, and for the remainder of the afternoon prestige was entirely with us. By their majestic and well-timed entry our motors had taken all the "face" out of the other cars. The yard bustled with life—motor men, Chinese attendants, Mongols, little Chinese soldiers, and dogs full of curiosity; while from the paper windows of the Chinese kitchen there were wafted the most delectable odors of roast pig, mingled with the acrid fumes of the camel-dung fuel. And never was there such a dinner as that celebrated that evening, with libations now to the gods of Mongolia, now to the American men of the expedition force, now to the president of the "American Museum of Heavenly Creations."

At the Chinese inn in Miao Tan.—Professor Osborn in the doorway of the mud-walled room reserved for distinguished visitors. Photograph controlled by the American Museum of Natural History and *Asia* Magazine

To return to our northbound journey. We were off before sunrise in the morning and soon passed the northern boundary of the Chinese agricultural lands to enter the hilly grasslands, where the Mongol herders still are to be seen with their horses, sheep, and goats, and where one must be on the lookout for bandits. This hilly country is probably the remnant of a once grand mountain chain, from the southern slopes of which were eroded the rich agricultural rolling plains now in possession of the Chinese, while from the northern slopes were deposited the fossil beds. A traverse of 139 miles brought us to Pang Kiang, where the single mud-built inn was so uninviting that we pitched our tent amid the ruins of a Chinese fort, from which the Mongols had driven the retreating Chinese army nearly three years before. The fortifications had been erected with military skill. They included earthworks of modern type designed by German engineers and proudly surveyed as impregnable by Chinese soldiers marching with the German goose step, so that the safeguards against Mongol attack were faultless—if only the Mongols had followed the orthodox methods of war and attacked from the front! But, greatly to the bewilderment of the Chinese soldiers, they violated all established rules and swept around the forts, attacking from the rear. It was a series of infantile military blunders of this kind which led to the destruction of the Chinese army.

We could not greatly regret the outcome, because we were in a country which we felt belonged historically to the Mongols, and under a glorious sky, in which the stars seemed so near that we could almost touch them, we made

American Museum of Natural History and Asia Magazine

Roy Chapman Andrews, chief of the "American Men of the Dragon Bones," in the Desert of Gobi, pointing out Iren Dabasu, "The Valley of the Salt Lake," where the first dinosaurs were discovered in Mongolia in the season of 1922. Photograph by Walter Granger our way through the darkness toward the little telegraph station of Pang Kiang, which is at once a sanctuary for the caravans and a point of communication with the outer world.

As we walked, I suddenly noticed a small group of men in the darkness pointing toward Andrews and myself. I asked Andrews to listen to what they were saying, and it was here that I learned the Chinese designation of our party, for the words were "*There go the American Men of the Dragon Bones.*" This did not impress Andrews as it did me; I was delighted with this Chinese christening, because it seemed to me both a tribute to the valor of our men and a wonderfully apt designation of the main objective of the Third Asiatic Expedition as it impressed itself upon the Chinese. For what purpose were we in Mongolia? Obviously enough to the Chinese mind, to collect the bones of dragons—the dragons which for ages past had ruled the sky, the air, the earth, the waters of the earth, and which even today are believed in implicitly by the Chinese. Of course we should find small bones corresponding to small dragons, large bones corresponding to remains of large dragons—also of vast dragons, some of which according to Chinese myth leave their tails in the eastern part of the Desert of Gobi, while their heads rest on the slopes of the Altai Mountains, four hundred miles distant! Here is the sum of the palæontology and zoölogy of the native Chinese—the dragon and the phœnix. Unlike the dreaded dragon of western Europe the dragon of central Asia is a beneficent creature, a friend of man, which brings the rain to produce crops and in turn supplies food. This creature is, in fact, so highly revered that one of the most sacred titles bestowed upon the emperors was "the true dragon." Consequently, I felt that the giving of this title to the American Museum expedition was a mark of reverence and respect, both for the animal whose bones were sought and for the men who could pursue such a difficult and adventurous calling.

The rosy hues of dawn were tingeing the sky next morning as I left my blue tent, and soon we were again under way. Before us was the line of rolling hills which intervened before we reached the borders of the desert; our motor car quickened its pace as it sped along the uplands. There were valleys leading outwards, no cañons, only broad flat basins surrounded by low-rimmed hills. This was a revelation to an eye accustomed to the well-drained cañon basins in Wyoming, Colorado, and all the Rocky Mountain region. These flat basins are, however, the geographic key to the southern borders of Mongolia—in fact, to central Mongolia itself. The water supply is so scanty that it sinks into the soil and never accumulates in lakes and rivers to cut its way out; the water is never seen, but lies in quantity below the surface, so that it can be reached everywhere by wells. These have been dug by the nomadic herdsmen for thousands of years past; from fifteen to twenty feet below the surface an abundant supply of pure water may be found, and on this the domesticated herds of camels, goats, sheep, and horses have always depended. In the Rand-McNally map of Mongolia the numerous little circles indicate these wells as mapped by the Russians and are not symbols for towns or villages as one would suppose. It is only in the height of the very brief rainy season that pools occur on the surface; consequently, all the wild animals have become accustomed to a waterless desert and live on the moisture they find in the plants.

We soon entered the southern borders of the great Desert of Gobi, which I have always desired to see above all deserts, especially after traveling in the Libyan Desert flanking the Nile Valley of northern Africa and in the desert wastes of the Rocky Mountain region. We passed on to this vast Mongolian desert, incredibly level as far as the eye can reach, and before long sighted our first herd of antelope or gazelle, of the species *Gazella sub-gutturosa,* and immediately gave chase. Although the speed of the car rose from thirty-five to forty, then to forty-five miles an hour, the gazelles easily kept their distance on the absolutely level plain. They went through the manœuvre of crossing in front of our car, after the manner described by Andrews in his volume *Across Mongolian Plains* and elsewhere,—a trait also of the wild asses when pursued. Andrews, who at that time had replaced Young at the wheel, drove the car with incredible skill, as if by instinct. "This is just the ordinary speed of the gazelle," he said, "I'll throw them into top speed by a rifle shot." He then fired and a fleck of dust marked the plain just to the left of the herd. Then I witnessed a wonderful mechanical change; the whole herd flattened down into an entirely different speed, which Andrews estimated at sixty miles an hour by taking into account the ease with which the animals ran away from our car traveling at forty-five miles an hour.

Altogether we had this exciting experience three times; on the third occasion near our Irdin Manha camp, when we were going at a high rate of speed, the gazelles crossed in front of us, making for a break in the plain to our left. Andrews suddenly slowed down to avoid a dangerous gully and as he swung around to the head of the gully, we witnessed a very rare sight: a gazelle that had dashed away from the herd reached the edge of the break, whereupon a wolf sprang out from its place of concealment and, quite oblivious of our presence, made a tremendous sprint for the gazelle, which was already somewhat fatigued by our previous pursuit of several miles. It was an exciting moment; in another instant, however, the two animals swept around the break out of sight and we could not see which creature won out in the struggle for existence.

At three o'clock on September 15 we witnessed another unusual sight: a camel caravan of four great divisions, with more than a hundred camels in each division,—420 in all. It was majestic. Throughout his experience in Mongolia Andrews had never seen a camel train equal to this in size, stretching for two miles in perfect alignment. It was a fitting introduction to the climax of this first step of my journey, namely, the approach to the American Museum camp. Andrews, who well knew its location on the edge of the great Irdin Manha plateau, told me that we were nearing it, but it was concealed by a glassy mirage, and it was only when we came within a mile of the camp that the American flag and the blue tents were discernible in the distance. We were now going at a very high rate of speed and in a few moments *I was there*—after two years of enforced delay!

All the men were drawn up in line to welcome us—six Americans, nine Chinese, four Mongols; part of our Mongol section was still with the camel

American Museum of Natural History and Asia Magazine

Motor trouble on the Mongolian plains at Irden Manha.—The rear housing of Dodge car No. 2, strained from overloading and severe jolting, is being straightened by C. Vance Johnson, chief mechanician, over a fire of camel dung. From left to right: C. Vance Johnson, Peter Kaisen, George Olsen, Professor Osborn, J. McKenzie Young, Albert Johnson. Photograph by Roy Chapman Andrews

American Museum of Natural History and Asia Magazine

The Mongol interpreters of the Third Asiatic Expedition.—Two of them are proudly dressed in American clothes in anticipation of the return to their homes at the close of the field work of 1923. The individual on the left is Tcherim, strongly of the American Indian type, courageous and loyal, a keen huntsman and fine example of the best unspoiled native Mongol. Photograph by Roy Chapman Andrews

American Museum of Natural History and Asia Magazine

A CARAVAN IN THE GOBI DESERT

The Mongols always ride their camels; they never walk. Consequently, even at a great distance it is easy to distinguish a Mongol caravan from a Chinese, in which the driver is always on foot. The Mongols do not like to have their photographs taken but Professor Osborn halted one of the sections by offering the leader a cigarette, a most coveted delicacy in the desert. Photograph by Roy Chapman Andrews

American Museum of Natural History and Asia Magazine

PROFESSOR MORRIS WITH HIS GURLEY PLANE TABLE

The edge of the plateau at Shara Murun forms the horizon line. In the badlands was found one of the richest deposits of dragon bones in all the Gobi, including titanotheres that resembled rhinoceroses and lophiodonts that were like small tapirs. Photograph by Walter Granger

American Museum of Natural History and Asia Maga

The expedition headquarters from which Professor Osborn set forth to Mongolia and to which he returned after his adventures in the desert. The picture represents a corner of the front court, and a glimpse into the Chinese rock garden beyond. The building in the center is Leader Andrews' office. Photograph by Yvette Borup Andrews

caravan on its way from western Mongolia. Every man showed his joy at the arrival of "the president." I shook hands in order of seniority—with Walter Granger, veteran palæontologist for thirty-two years in the service of the American Museum; with Frederick K. Morris, geographer and geologist, formerly of Columbia University; with Peter Kaisen, sturdy fossil-bone expert, whom I found thirty years ago in central Wyoming; with George Olsen, another sturdy Dane and, like Kaisen, a native of Medicine Bow, Wyoming, scene of Owen Wister's novel, *The Virginian;* with Albert Johnson of Sweetwater, Montana, "Montana Johnson," also an expert bone man. These with C. Vance Johnson, former United States marine and now first mechanician under J. McKenzie Young, and Young himself, who drove us out, completed the party of "American Men of the Dragon Bones."

This was one of the really great moments of my life, to see these men in splendid health, each bursting with some triumph in the way of fossil discovery, each modestly giving all the credit to his fellows. After a glorious sunset that gradually gave way to a

American Museum of Natural History and Asia Magazine

Within the front court of the headquarters of the Third Asiatic Expedition.—The ivy-crowned entrance leads to the spirit door beyond, in the sun-lit distance. The spirit screen, which closes the view, stops the invasion of ghosts, for in China spirits can travel only in a straight line. Photograph by Yvette Borup Andrews

wonderfully clear starlit night and the superb brightness of the Mongolian moon, we drew into our large Mongol dining tent and feasted on a delicious dinner of roast gazelle, sirloin cut, with a tenderloin cut for "the chief." As I looked around the table, feebly illumined by a central line of candles, I observed even by the dim light what I have noted in the case of other groups of explorers—all the hunters of the dragon bones were blue-eyed; whether from Denmark or from Wyoming or Montana or Vermont or Wisconsin, all were of the same adventure-loving northern exploring stock. This observation, followed by a large slice of tempting pumpkin pie cooked over a tiny Mongol brazier with unrivaled Chinese skill, sent me to bed with the happiest thoughts, chief of which was the complete success of the Third Asiatic Expedition under its incomparable leader, Roy Chapman Andrews.

THE RETURN JOURNEY

The three following days were devoted to a rapid review of the three great fossil fields which lay to the north, to the east, and to the west of our Irdin Manha camp. In the meantime the last specimens were taken out of the various quarries, the packing boxes were closed up, a final overhauling was given the machinery of the five automobiles, and on the morning of September 18 we started on the long homeward journey to the American Museum via Kalgan and Peking. On the afternoon of the same day, the fleet rolled into camp in the hilly country on the border of Mongolia and China, which is more or less infested with bandits. It was splendid to see the cars run into position, each in its place, and the men spring out to create the camp. Although the men were simply following the usual instructions, I was struck by the rapidity of their work and took out my watch to time them. At quarter to five the fleet came to a stop; at two minutes past five seven blue Mongol tents were lined up in order, ready for occupation—exactly seventeen minutes.

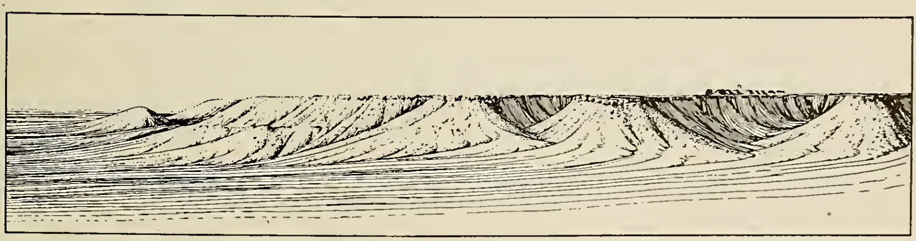
Suddenly we discovered that we were accidentally camping on a Mongol cemetery, consisting not of graves but of skeletons and skulls,—remains of the bodies thrown out to the dogs according to custom but which were none the less sacred to the natives. Our men began to bring in some of the skulls, precious in their record of pure Mongol traits; they were immediately stopped by Leader Andrews, who was aware that our party could do nothing more calculated to hurt the spirit of Mongol reverence for the dead, which is not less than that of the Chinese.

This spot among the hilly grasslands was also the site of the first American Museum camp in Mongolia, as it was there that the expedition made its initial halt in April, 1922. In high spirits we all assembled in the large blue Mongol mess tent, and after our pipes and stories we turned into our respective tents for the night. At this moment I observed four men approaching through the darkness with rifles, obviously not peasants. Were they soldiers or were they bandits? We did not know, and it was not a moment to take any chances, because the surrounding hills would have facilitated a bandit attack. As I stepped out in my pajamas, Andrews emerged from his tent, his revolver in his right hand and in his left an electric flashlight, which he gleamed in the faces of the approaching armed Mongolians. Out of every tent at the same moment emerged a peace-loving American, each similarly equipped with a revolver and flashlight. Andrews is known as an absolute dead shot with his revolver; he occasionally practises in camp on cans and other small objects, and the Mongols far and wide know that he never misses. A reputation for accuracy and steadiness of aim is very helpful. As in every other case of this kind, a show of preparedness was all that was necessary; Andrews waved his hand across the flashlight and the approaching band immediately put down their rifles and thus became harmless. One of our Mongols then went forward and friendly relations were soon established.

It was this combination of firmness and kindness during eight years in northern China—three of which were devoted also to eastern and central Mongolia—which resulted in an ever-increasing respect for the power of "the American Men of the Dragon Bones" and an ever-increasing welcome as their honest purposes and peaceful methods became more widely known. When our fleet of motor cars returned on September 20 through the narrow, dusty streets of Kalgan, with small American flags weatherworn from long exposure to the hot sun and sand of the Mongolian desert, the Chinese were confirmed in their impression that we were friends on a friendly mission, friends always ready for a critical emergency along the way or to do a deed of kindness, but not to be trifled with by bandits or outlaws.

Our methods have also won for us the respect and friendship of officials and men of prominence throughout China and Mongolia. When our privilege to explore was seriously challenged in the spring of 1923, Leader Andrews renewed his pledge to the Mongol government that in case of a discovery of economic importance—coal, oil, or other mineral wealth—it would first be communicated to the Mongol government and not to American or foreign corporations. As interpreter of the goodwill and of the determination of the expedition to thrust its way through unknown Mongolia, Mr. Franz A. Larsen, of Urga and of Kalgan, has for three years been giving his staunch support; he is now enrolled as one of the honorary life members of the American Museum. Also on the roll of life members of the American Museum is the name of Mr. C. Badmajapoff, Minister of Justice of the Urga government, who is friendly because he is thoroughly convinced that we are working entirely for the welfare of his country. Through the combined efforts of Mr. Larsen and Mr. Badmajapoff we were able to prevail over counter influence in Urga and to penetrate during the first and second years to Outer Mongolia, the northerly and westerly desert, where the most startling discoveries were made, namely, of the giant *Baluchitherium* and of the great horned or ceratopsian dinosaurs and their nests and eggs.

As the result of a long evening conference I had with Mr. Larsen, measures were planned to assure the success of our coming five years of exploration, 1924–28, to obtain a continuance of Mongol support, and to cement the friendship of the Mongol government. We examined Mr. Larsen's Kalgan compound and assured ourselves as to the safety of boxes 1 to 35—the early numbers of the great total array of 135 boxes of fossil riches which have slowly made their long journey from western Mongolia across the Pacific through the Panama Canal to New York. One cannot examine these converted Standard Oil boxes with their delicate fossil freight packed in camel hair without a thrill over this American and Mongolian romance, this new bond that connects the young, eager, expert explorers of America with the most venerable dominion of Mongolia.



Irdin Manha, with the flag-topped encampment of the Third Asiatic Expedition

American Museum of Natural History and Asia Magazine

WINTER QUARTERS IN SZECHUAN PROVINCE

The white-walled building which rises above the roofs of the clustered houses of the village of Yen Ching Kao is the ancestral hall of the Tan families, where Mr. and Mrs. Granger and their Chinese assistants spent the winter. The grandeur of the surrounding mountains makes the human habitations huddling together in the valley seem tiny by comparison

Wintering Over a Fire Basket in Szechuan[1]

By ANNA G. GRANGER

Third Asiatic Expedition, American Museum and Asia Magazine

Foreword.—The fire basket (*huo lant zu*) of China is a wicker-encased clay pot containing glowing coals. Held between the knees, its warmth helps one forget that the thermometer stands at 28 degrees above zero and the mountains are snow-covered. As the hearth is used symbolically for the home, so in the title of this article the fire basket epitomizes the quaintness yet attractiveness of that substitute for home which Mr. and Mrs. Granger found in a Chinese ancestral hall in Szechuan Province. Mrs. Granger's article in the March-April issue brought the reader almost to the threshold of this building; he is now invited to step in.

However much one may inveigh against the political and climatic conditions of Szechuan, no one can gainsay its scenic beauty. The tiny settlement of Yen Ching Kou (Salt Well Valley), where the American Museum camp was located, had for its setting high, rounded mountains, cultivated slopes, and glistening rice paddies. Under the magic of the sun's rays, no more charming spot could be imagined, but even when viewed through the almost constant mists, it was impossible to have other than a friendly feeling for the pleasantly undulating ranges, or to take seriously the smaller isolated cones that have come into existence at odd places in seeming defiance of natural laws. Whether these conical mounds really presented any geological problem to the "chief of staff," I know not. To my mind they were simply a caprice of nature, and enjoyed as such. A bona fide phenomenon did occur in the vicinity, though. It was a spring of cold water issuing from under the floor of a small cave and emptying into our valley brook. You could pass it one hour and the flow would be mediocre; a little later, and the volume would be increased tenfold, only to fall back again after a few minutes to the original amount. As yet this intermittent action is unexplainable. The Chinese long ago noted the spring's strange conduct and built a charming temple close by, which is dedicated to all flowing waters and commemorates their beneficence to mankind.

The mountains in this region would naturally have been clothed with a dense and somber growth of evergreens if the pine and a species of cedar or arbor vitæ which grow thickly had been left to flourish as nature intended. Where these surround a temple or a burying ground, they are usually respected, but elsewhere Chinese squeeze enters in and they are robbed of their branches as high up as it is safe to climb. The result of this pruning is a shape strongly suggestive of the imitation fiber trees that come with a child's set of building blocks, except that the triangle of green which is silhouetted against the sky, or mirrored in the paddies, is elevated on a proportionately taller trunk. The effect when the trees stand alone is by no means unpicturesque, and when they are massed a degree of airiness is attained, which would be less pronounced were the light not able to penetrate to their bases. Also, it seemed to me that the presence of so many surfaces of water at high levels assisted in creating a more luminous atmosphere than is usual under gray skies.

Two other trees helped to maintain a cheery, all-the-year-round greenness in this neighborhood. These were a

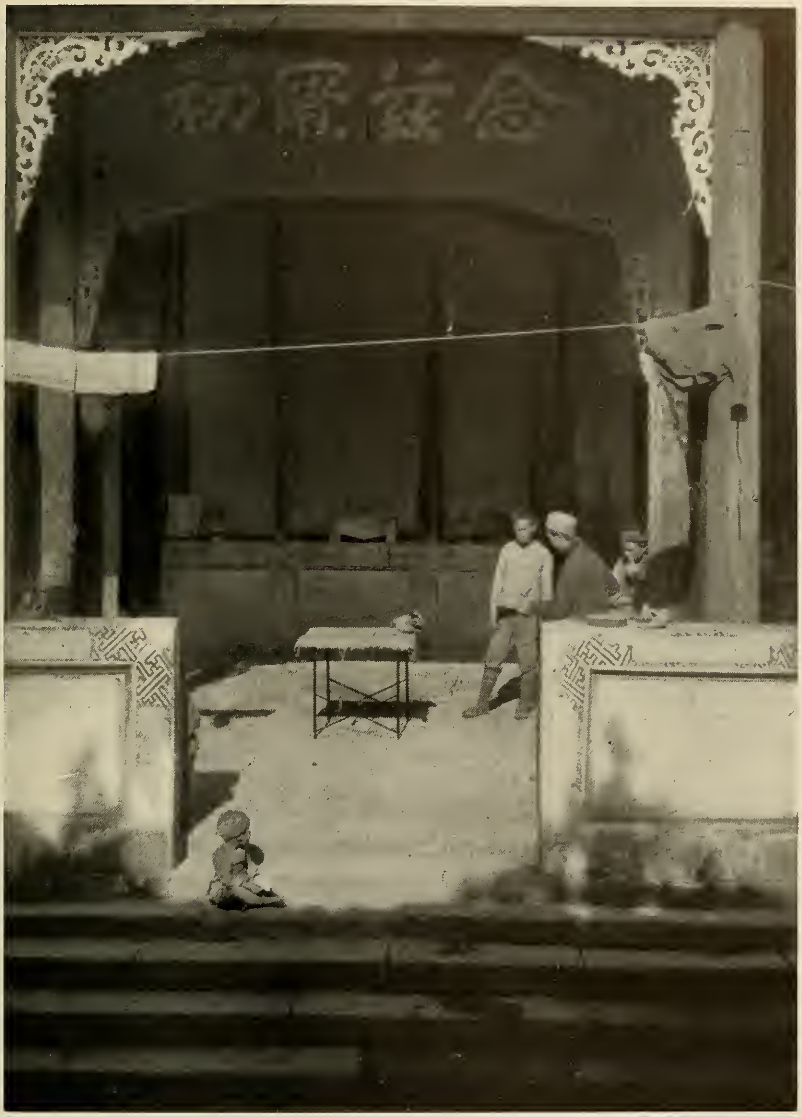
[1]Photographs accompanying this article were taken by Mr. Walter Granger.

American Museum of Natural History and Asia Magazine

The square stage that faced the altar platform on the opposing page.—The stage served as laboratory and office, as dining room and conning tower. To the left of the picture, beneath the gallery are ranged two or more empty coffins, which, according to Chinese custom, are selected by their future tenants while still in the flush of life and reserved for use on the inevitable day

species of palm and a bamboo. The latter is highly esteemed, and with good reason. Its grace is beyond compare, it can be cut and cut and still sprouts out anew, and its uses are endless. No farmhouse tucked away up on the mountain-side on its man-made platform of stones is without a cluster of these sunny-stemmed, feathery trees. Had it not been for these plants, the sight of the white-plastered, dark timbered buildings, often with thatched roofs and bearing the general form of a Swiss chalet, might almost have persuaded us on a snowy morning that we were spending the winter in Switzerland rather than in Asia on a parallel a little north of the city of Cairo.

All this scenery was lost to view once you stepped inside the Tan families' ancestral hall. The structure boasted only two round windows and these were placed high up in a deep-set wall and covered with a fretwork which, while delightfully ornamental, rendered them utterly useless as a means of observation. What light there was came from the uncovered court in the center. The plan of the roofed portion was very simple. A square stage, supported on high pillars, jutted out into the court over the entrance. Opposite this was a platform given over to the practice of ancestor worship. An altar and tablets inscribed with eulogies to the departed were placed against its rear wall. Here Mr. Tan, the innkeeper who lived next door, came every



American Museum of Natural History and Asia Magazine

The altar platform in the ancestral hall, with the tablets eulogizing the departed placed against the rear wall.—On the table is the camp pet, a bamboo civet (*Paradoxurus*) that interested visiting children of the neighborhood

morning and evening to light fragrant joss sticks, to beat a drum, and to draw bell-like tones from a bronze urn by taps with his wand. Ordinarily this little ceremony seemed a very pleasing way of saluting the rising or departing sun. To him it meant essential gain in the amount of "acquired merit" necessary for peaceful rest in one of the wooden coffins which already awaited the family in a row under the gallery. It was only when this devotion led him to set off a small-sized cannon at break of day during the New Year festival period that we weren't so sure of our enthusiasm for this ancient custom.

These airy graceful trees, with their feathery tops, are characteristic features of the landscape. The natives lop off all but the highest branches for fuel, leaving the trunk denuded of verdure. This picture is controlled by the American Museum of Natural History and *Asia* Magazine

To reach the stage one crossed the court, ascended seven stone steps to the altar platform, turned either to the right or left, mounted a ladder of four rungs, and traversed either one of the two galleries which connected these main sections. At each end of the altar platform was a small room. One of these was used as our No. 1 boy's apartment, and the other made a very dark kitchen. Back of the stage were two spaces rendered partially private by some openwork wooden grills of interesting pattern. These served as bedrooms for Mr. Granger and Mr. Wong during the second winter. One gallery was given up to taxidermy and sleeping quarters for the remaining Chinese. The other was utilized for storage of equipment and as a place to keep alcoholic specimens and to spread out the fossils, which always came in coated with wet mud. The stage was Mr. Granger's special domain, but aside from its usage as laboratory and office, it had also to be dining room and conning tower.

Considerable consternation was caused in the Tan family when it became known that I was expected to visit the camp. At first my coming was not going to be allowed at all. A conference of the elders was held and finally a compromise was arrived at. If I would only not sleep in the temple, even though I dressed and ate there, the wrath of the gods would be averted! So it happened that Mr. Granger and I put our cots in Mr. Tan's inn next door and had a chance to see, or rather hear, a phase of Chinese life not originally on the program. In many

A native Szechuanese carrying a baby on his back and a fire basket in his hands. The wicker on top of the basket is strong enough to support an individual seeking warmth and comfort by sitting upon it. This picture is controlled by the American Museum of Natural History and *Asia* Magazine

American Museum of Natural History and Asia Magazine

A view from the front of the ancestral hall.—On the top of these mountains are the pits that supply the "dragon bones" of Chinese medicine or the fossil treasures sought by the palæontologist

inns, as Mr. Archibald Little's books will testify, the guest room is situated over the pigsty. Had it been so located in this instance, my trip to Yen Ching Kou would have had to be abandoned. Barring the fact that Chinese never want to stop talking until about one o'clock, that they begin scraping their throats at the first streak of dawn, that a flock of ducks was put to sleep every night in a corridor just behind our heads, and began squawking to be let out at an early hour, and that rats and bats coursed freely through the two doorways of our room, we passed very comfortable nights in these make-shift quarters!

The camp day was usually begun at eight o'clock by Mr. Granger calling out, as soon as we reached the gallery floor, "Get up, Jim!" The response to this sally came generally from the kitchen, where Mr. Wong had been warming his shins for an hour, awaiting this hint of the approach of breakfast! This bit of pleasantry over, *hsi lien shui* (wash-face water) was demanded and in a few minutes we three were enjoying as nice a meal as if we had been in Peking, with the additional treat of a variety of persimmons much superior to those grown in the north. The Szechuan fruit is smaller and shaped somewhat like a very large plum, and is extremely sweet and juicy. (A foreigner eats it by cutting a thin slice off the top and scooping out the soft contents with a spoon.) Coffee, cereal, eggs, pancakes followed each other in courses. A hard life, we called it!

In the intervals between expeditions to the bone pits, which during this second season were a long distance from camp, or when the weather was too wet to make a trip practicable, Mr. Granger busied himself making up the smaller, more difficult bird skins. With the thermometer standing in the thirties, a damp wind blowing, and no sun to give warmth, this was a chilly business. When his fingers got too stiff, a walk was in order so as to restore circulation, but he would never desist from his labors until he had finished his day's work, often taking the last stitches in a skin and smoothing every feather down to a nicety after Chow had brought out the supper lamps. Sometimes the wind blew out their small flames before the label was written and the wee thing wrapped in its blanket of cotton. I never tired of watching this skilled performance. Buckshot, Chi, and Mr. Wong were the ones who kept the supply of bird specimens going strong, the interest being stimulated by the attractiveness of the birds and the ease with which a new species could be obtained. So keen were we all to see the new additions that the returning hunters were questioned as to their success before they were half way across the temple court. If the report was an "aye," even the cook joined the eager circle while the game bag was being examined.

We shall not soon forget the day that one of the Chinese brought in a bird which more nearly resembles our American hummer than anything else. Its flame-colored throat gleamed so brightly that not one of us could forbear to pass a finger over the spot as if to assure ourselves that the feathers were not really on fire. A marvelous purplish blue on the back of its neck next attracted the eye. Everywhere else an iridescent green shimmered, and its little body was appropriately terminated by two slender green tail feathers, carefully sharpened to tiny points.

It must be understood that in renting this temple for museum purposes, it was not expected that the native population of the village would be prevented from coming into the lower part of the enclosure as long as they didn't make any noise. The one exception we made was at meal times. At other hours the altar steps were rarely without a group of curious onlookers. Most of what they saw must have been a great puzzle for their untutored minds, but at least our being there brought a break in the frightful monotony of their lives.

After breakfast usually the first people to appear were the patients to whom "Doctor Chow" was giving first-aid treatment for sores of various kinds, many of them the result of dog bites. The weaver might be the next to fill the space on the altar floor with an apparatus for winding his spindles, or with some large skeins of white cotton to be dipped in a stiffening solution and hung up to drain. The dyer had found that a long bamboo pole placed under the eaves of the gallery roof made a fine place from which to suspend his freshly dipped pieces of blue coolie cloth. Idle curiosity brought many to see the *lao tài tài* (old mother), as I am always called by the Chinese. Most of the inhabitants had never seen a foreign woman before. In the town of Wan Hsien I was one of three English-speaking women. When the wives of the gentry came, Mr. Tan made no objections to their mounting the stage to have a closer look at me. My tan leather walking shoes and my many layers of wool clothing interested them, while their cleverly embroidered cotton suits and fancy hair ornaments were no less entertaining to me.

The biggest commotion was caused when a farmer on whose land a bone pit was being exploited arrived with some baskets of fossils which he hoped would be salable and Mr. Wong was hurriedly summoned to do the interpreting, to oversee the process of weighing (they are sold at from \$18 to \$23 a picul—equal to 133⅓ pounds—depending on the quality of the bones and the amount of mud and rocks adhering to them) and to advise as to how much *cumsha* above the sale price it would be proper to give so as to encourage the bringing of more material.

During my first visit of twenty-eight days at the camp the sun shone brightly for three whole days and as many half days, a better average than the winter months of some years show. Mr. Granger grew so tired of writing in his diary "cloudy, cold, and damp" that he said he fully intended having a rubber stamp made of this legend, should the Fates ever send him to Szechuan again! When a warm bright day did come, the villagers turned out *en masse* to make a thoroughgoing investigation of the live stock that had accumulated on their persons since the last sunshiny day! At our camp also unwonted activity appeared in the line of laundry work and bed airing, and the opportunity was not lost for taking and printing pictures and for giving our own selves the chance of a sunning.

On the first favorable day I was taken to see some of the nearest bone pits, a half-day's journey from the temple. They lay in some high uplands on the farther side of the range of mountains in sight from our front door, and were reached by a trail of stone steps which for steepness left nothing to be desired.

It was still early in January. Patches of snow lingered from the fall a few nights previous and a genuine holiday atmosphere pervaded the scene because of quantities of a shrub bearing bright red berries similar to those of our holly. Buckshot had brought branches of these to the temple a week before, when he and I had fashioned Christmas wreaths out of evergreens and had transformed the stage into a semblance of an American home at the Yuletide season.

As we climbed upward we met many carrying coolies coming down with their loads of wood, wood oil, and rice. There was hardly anyone who withheld a friendly greeting, or who would not, with the slightest encouragement, commence conversation, though what it was all about we seldom knew. Mr. Granger would invariably reply with a lingo as completely unintelligible to them. It often took the form of "Hello, Mike! Sure! Same to you!" so that if the speakers had not been polite enough to say something agreeable, their evil thoughts would descend upon them in turn! This answer, delivered in his gay manner, always brought a smile to their earnest, patient faces but I could never help regretting a little that the real humor of the jest from our point of view was lost to their minds. If the natives of Szechuan have, as I believe, the same childlike curiosity that the Chinese population has in Peking, these wayfarers were in all likelihood simply asking us whither we were going, whence we had come, and what our errand was.

By the time twelve o'clock had come round, we had conveniently arrived at a small temple at the entrance to a large cave. Here we warmed ourselves and ate our lunch around the caretaker's open fire while the rice-eating members of the party prepared their

BONE PITS OF SZECHUAN

This picture gives a good idea of one of the larger pits and some of the equipment needed in recovering fossils. The apparatus mounted over the pit in the background was used by the Chinese in making their descent into the deep dark shaft, and by its aid they were hoisted out again into the daylight. In the foreground is a basket filled with fossils

American Museum of Natural History and Asia Magazine

COOLIES ON THE WAY BACK FROM THE BONE PITS

The men are laden with camp equipment and with baskets containing fossil finds. "Buckshot," one of the Chinese assistants of the Third Asiatic Expedition of the American Museum of Natural History and *Asia* Magazine, is in charge of the detail food over a cement stove in the opposite corner of the kitchen. A wide doorway looked out upon the cave, the opening of which was lined with niches carved in the limestone and set with brightly painted gods, among them one representing the moon and another the sun. A scientific interest attached to the cave on account of the bats which it had yielded in the winter of 1921–22.

Soon after leaving the temple we came upon the first fossil pits. As had been anticipated, none of them were being worked at the time, but these excavations showed as well as any how deep and dark the holes were and how easy it would be for the sides to fall in, since nothing was used to shore up the wall of earth. In diameter a hole of moderate size may vary from four to sixteen feet; the depth, from twenty to sixty feet. Old pits—that is, those that have been worked a long time—are apt to be much wider and deeper. As the pits deepen, water gathers in the bottom, often forcing a discontinuance of work. The darkness of the wells is overcome by the use of tiny wood-oil lamps.

Where, as in some instances, the pits were in more rocky surroundings and the probability of a cave-in less imminent, there was still a strong element of danger in trusting oneself to the frail pulley which was erected over the top, and which served the Chinese as a means of descent and ascent. It looked hardly stout enough to raise the baskets of wet bones. A little later in the winter a report reached us of a workman who had been killed by a collapsing pit, and I was very glad that my usually intrepid bone-digger was willing to use discretion and keep out. The whole region seemed permeated with deep pits, many of which were so disguised by plants and vines that their true nature was not apparent.

To anyone interested in keeping fossil bones whole, and related ones in juxtaposition, the utter disregard of these matters by the Chinese during the process of removal from the pits or afterwards was most trying. Their sole object in digging them was to sell them to wholesale druggists for medicinal purposes, and since the final state of the bones would be powder, why take any particular pains? The number of pits was too great, the areas containing them were too widely separated and the quarries were worked by too many different people to make it practicable to do much in the way of instructing the operators as to the reasons for exercising special care in taking out fossils for the American Museum collection. The situation could have been remedied only by obtaining entire control of the pits, and that was out of the question.

The crowning treat of the day was the view we had as we began the descent to the camp. Never before had it been given me to look down on so vast a sea of peaks as were spread out below us. Had the air been clearer an even larger number would have been included in a picture which, as it was, will always be treasured in my memory as one of the very finest.

My next visit to the camp was in the middle of February and gave me an unusually good opportunity for observing the Chinese during their New Year festivities. The holiday period begins solemnly, with front doors closed and sealed with paper, and decorated with paper emblems. An unwonted stillness is about everywhere. On the second day groups of men and boys are seen playing gambling games at tables set out in the street. The quiet is broken on the third day by the setting off of firecrackers, and a time of real sociability ensues. Calls are paid and gifts of foodstuffs exchanged,—principally eggs, puffed rice, and a large round rice cake, highly varnished and brightly colored. During this season the more well-to-do people make their annual visit to relatives living at a distance. At our temple members of the Tan family came to offer special joss at the altar. Many of them brought along a present for Mr. Granger, and all were bidden to sit down for tea, sweets, and smokes, dispensed by Mr. Wong, who acted as master of ceremonies. In the village two large feasts were given by families who wanted to do honor to the gods in memory of departed ones. When, in fulfillment of this purpose, the house is hung with embroidered panels and painted scrolls, and men are hired to come to make paper facsimiles of things used by the deceased during life, and priests and musicians are engaged for a period of three days, the expense is large. Although it is easy to understand the glamor surrounding the part of the celebration which took place out of doors under a full moon, when candles and lanterns and sparks from firecrackers were all reflected in the waters of a near-by brook, we should have been better pleased to see the funds used for the purchase of that rare article in Szechuan, a piece of window glass, to lighten the dark homes of the present generation.

One of the chief events of the New Year festival is the arrival of a troop of itinerant acrobats. They appeared in the temple one afternoon at five-thirty followed by the occupants of both the upper and the lower village and everybody from the neighboring farmhouses, who entirely filled the steps, altar platform, and all of the court not actually needed by the performers. Three tables were piled on top of one another to obtain a stage high enough to permit the crowd to see everything well, and to add, as I suspect, a spice of risk for the participants. Part of the show consisted simply of feats of balancing. In the latter half, however, two of the men united in impersonating a lion. This was done by covering themselves with a variegated satin robe to which a huge lion's head with long mane was attached. A few bells sewed somewhere in the folds gave out a pleasant tinkle as the "animal" leaped about, trying to intimidate another man, disguised as a monkey. By six o'clock it became so dark that the manager of the show lighted three pretty, round, swinging lanterns and several four-sided ones set in the top of tall poles, in form not unlike our street gas lamps of some decades ago. These were supplemented by all the lights which the Museum outfit could muster: two carbide lamps and four or five kerosene oil burners. Even at that it couldn't be said that we outshone the Hippodrome! An orchestra of four shrill pieces beat out an accompaniment which seemed to please everyone else mightily, though it was wearisome to us. It was not until seven-thirty that the audience was satisfied and dispersed to their homes. So little out of the ordinary happens in these far-inland places, it is not surprising that the entertainment does not have to be of a very high order to win approbation.

On March 3, I reluctantly returned to Wan Hsien and remained at the Mission that is located there until our final departure from Szechuan. This month was an anxious one for both Mr. Granger and myself. Five days after my return the war clouds which had been gathering broke, the place where the clash came being about twelve miles from the camp. At this point the defeated Wan Hsien troops cut a dike which prevented the successful Northern army from following their retreat for several hours. This circumstance probably had much to do with the orderly procedure of both armies through Yen Ching Kou. For four days and nights Mr. Granger and Mr. Wong could not relax in their guard at the temple. One night about fifty soldiers were given shelter from the rain in the lower part under the gallery, but they departed at daybreak without committing any depredations. Among the last of the Northern troops to pass by the steps of the temple was a soldier whom Buckshot recognized as a Pekingese by the strong burr of his accent. A friendly exchange of courtesies took place on the strength of their common birthplace and the visit ended by his being intrusted with a letter to me to say that all was well at the camp. I was unable to send out any news of my safety from Wan Hsien because no messenger would contract for the trip on account of the fear of being drafted as a carrying coolie for the new army of occupation. It was not until five days after the evacuation of Wan Hsien that a coolie sent in from the Museum camp (in special uniform to make clear his identity) took back the news that the Mission, though threatened, had been unmolested, and that the military had placed a bridge of boats across the Yangtze a short distance above the city. This was done to facilitate the movement of Northern troops into Wan Hsien, but it very decidedly hindered our plans, for the junk which was to transport us down to Ichang still lay moored at Pei Shui Chi, and it meant a wait of several more days while negotiations were being completed for getting it through the blockade.

All was in readiness on March 22 for the journey down river. Owing to a band of robbers who, reports said, infested a place called P'an T'ou, twenty-five miles below Wan Hsien, it was planned to go only as far as that point the first day, and to remain there overnight under guard of the American gunboat "Palos," Captain Simpson commanding. The junk was a half day in covering the distance. We arrived in time for tiffining with the captain and his officers.

After lunch everybody who could left the ship to amuse himself as best pleased him. Some of the crew played baseball on a wide sandy beach with Captain Simpson and the ship's doctor; others made up a duck-hunting party to a place not far away. A visit to an old temple high up on a cliff on the opposite shore under the guidance of Lieutenant Connolly appealed to us. Dinner on board the "Palos" and afterward a game of hearts finished the day. The weather had been perfect and as we sat in comfortable easy chairs on the forward deck and watched the evening lights fade on a scene which for peaceful loveliness was unrivaled, it was hard to realize that only a week before bandits had popped out from their hiding places and had robbed one of the Yangtze River inspectors of nearly all that he had, even taking the clothing of the crew of his house boat. A luxury which Mr. Granger will always remember in connection with Captain Simpson's gracious entertainment was a chance to have a really-truly American shower bath, with hot and cold water. In fact, there wasn't anything about the ship that didn't look good to us, and we were loath to leave her side the following morning. The captain's last thought for us was to fill us up with coffee and egg sandwiches, for our own breakfast was to be delayed until we had walked around the Hsin Lung T'an, reached a half hour after getting under way.

En route between Wan Hsien and P'an T'ou a Chinese soldier had begged us to take him with us (he had a message to deliver to an army officer in Ichang) and at Captain Simpsons' suggestion we also took on board as passengers two sailors from the "Palos" who had finished their term of service and were homeward bound to America. This increased our number to twenty-five. When we were all stretched out for the night, there wasn't a great deal of superfluous floor space, and we congratulated ourselves that the weather during the five days of the trip down river was exceptionally good. Had it rained, there would have been little chance for shifting our positions to avoid the leaks in the mat covering.

A sort of boudoir was devised for me by partitioning off, by means of a large piece of canvas, a third of the space in the cabin which occupied the center of the boat. Mr. Granger and Mr. Wong had their cots on the other side of this improvised wall, but by folding up one of the beds in the day time, their erstwhile dormitory was restored to its proper use as a passageway from bow to stern, except indeed when we blocked it again while gathered there for our meals. The two sailors and our Chinese assistants slept on the floor just beyond the cabin.

All of the forward part of the junk was needed by the crew, consisting of twelve rowers, two steersmen, and the crew's cook. The *laodah*, or captain, had a bunk high up in the extreme stern, but the rest of the men lay down at night on almost the identical spots where they had stood to their labors during the day. They were protected from the elements by pieces of rush matting ingeniously erected on poles in about three minutes after the boat was tied up for the night. We marveled at the contentedness and even joyousness of these men who worked at the oars and sang to the strokes, fed only on meager rations of rice and green vegetables with occasionally a very little pork. Culinary operations by two separate cooks on two sorts of stoves were also conducted on that much overcrowded forward deck.

The Hsin Lung and the Hsin T'an are the only rapids bad enough in the spring season to warrant passengers disembarking. Our junk, being well manned for its size and guided by a special pilot, took the rough water of both of these rapids splendidly. Just below the Hsin T'an is another very short but troublesome rapid. This time two special pilots were hired, one to handle the tiller and one to manipulate the forward sweep, usually in the hands of our captain. At this last place, a steamer was tied up to the shore and her crew was steadily bailing out water. She had come to grief while trying to get up this rapid a short while before.

Assuredly the "god of flowing waters" was ranged on our side throughout this wonderful trip. The only accident we had to report was a broken oar, and this had happened where we could easily stop for repairs. The god of bandits, though, was not quite so mindful of our welfare. At the town of Kuei Cho, where we moored the second night, we were told that we were liable to meet trouble on the morrow. Shortly after lunch it came. We were then passing through the middle of the inspiring Wu Shan gorge. So great had been my joy at having a chance to see this long gorge—the most interesting of all the gorges—at a slower pace than was possible when we came up in the steamer, that I had completely forgotten the danger that threatened. Not so with the wiser heads of our party. Even as the first shot was fired, Mr. Granger was out on deck conning the cliffs with his field glasses for suspicious figures.

The shot was evidently intended for the man who was up on the running board holding the tiller. Two others followed in quick succession and these were aimed at the two sets of rowers. All three shots fell in the water. By this time everybody who could shoot had grabbed his gun and the return salute commenced. From my position on the floor of the cabin the reverberations sounded tremendous and as I was unable to tell which party was doing the firing, I assumed it must be largely the bandits and was naturally full of alarm. In reality all of the noise had proceeded from the junk, and it proved to be as effective in scaring the bandits as it had been in frightening me. Mr. Wong held the only long-range rifle and he was the first to open fire. Soon one of the sailors (who had taken a prize for good marksmanship) took the weapon from him and he was successful in scattering the straw thatch off a little hut which had evidently been sheltering our assailants. This put the finishing touch to their rout.

That there were no more than five men seen by our party was no guarantee that a larger force was not in hiding. We reckoned that they had the surprise of their lives when so great a racket came forth suddenly from so peaceful-looking a junk. The bandits were armed (Mr. Wong tells me) with high-power modern army rifles, whereas our complete outfit consisted of only two No. 12 shot guns, one 25-caliber Savage sporting rifle, four automatic pistols (including the two carried by the sailors) and a small, short range, combination 22- and 44-caliber gun.

Twenty-five li (about eight miles) below this point of attack was another place with a bad reputation for robbers and here Chi and Buckshot prepared to have some fun at Chow's expense by making him stand up with the little combination gun. He and the Chinese soldier passenger had flattened themselves on the floor beside me during the actual engagement at P'ai Shih and that had not accorded with their ideas of valor. Fortunately the rest of the afternoon had nothing further in store for us of a militant nature but the uncertainty as to what might happen kept us all watchful. Darkness had long since fallen when we reached a place where it was considered safe to tie up for the night.

If anyone should ask us whether we can recommend a similar jaunt down this age-old river when peach and plum blossoms deck the banks and spring adds a deeper hush to the silence of the gorges, we should have no hesitancy in saying, as the Chinese phrase goes, *k'o i* (can do), but should the question be as to whether we wish to renew experience with Chinese bandits, the reply would be emphatically, *pu yao* (not want).

Aiming a Camera at a Wild Mountain Goat[1]

By WILLIAM T. SHAW
Professor of Zoölogy, State College of Washington

ONE object dominates the landscape east of Bellingham Bay, Washington. This is Mount Baker, sun-bathed and radiant in the glory of its oneness. Beyond, standing scarcely a score of miles away, is Shuksan, all but hidden and little known, slightly less in altitude,—in ruggedness and inaccessibility quite the equal of the greater dome. Between, lies Austin Pass, of such remoteness as to challenge the visits of mountain-loving men from far up and down the Pacific Coast. Here, protected in its Arctic fastness, the slowly diminishing species of wild mountain goat in western America is making one of its last stands.

Biological research had taken me into this region during mid-August of 1922. At first my camp was solitary. Then, one evening a troupe of pack-laden boys came in "to do the peaks" and after they had enjoyed a brief space of rest and a cup of steaming coffee, we were "pards" in the fortunes of the forests and friends for life.

One morning soon after their arrival, one of their number, Mr. Henry Howard, Scout chief at Bellingham, and I dropped over the Pass down into one of the headwater forks of the Swift. We carried with us an outfit of traps and photographic material. After an hour or two of investigation in the grass meadows of the Swift, we left the trail and headed straight up for Crater Mountain, where we hoped to arrive in time for a certain afternoon lighting on the great ice dome of Baker.

Dropping down a thousand feet and climbing back over a trailless slope of moss, brush, and sliding granite flakes, is an endurance-testing feat; so when pockets were turned out and found to produce only one English walnut and two peanuts—last remnants of trap-line bait—as the day's meal for two toiling men, we had to look the problem squarely in the face but decided nevertheless to continue our journey upward. At last the old crater ridge was reached, and the tripod planted squarely in fine view of Baker, but just as the focusing was finished, my companion said, "Goat!"

Yes, it was a goat, a big wild mountain goat, wary and unhampered, with no park affinities to dull his instincts or lessen his aversion for man. There he stood, squarely in the field of the binoculars, quietly grazing from a patch of snow grass growing on the cañon-side, though quite a mountain mile from us.

Goats,—well did you ever try to photograph one?

To back up endurance a walnut and any number of peanuts are no fit substitutes for bacon; yet down came the tripod, and soon we were under the packs once more. By this time the goat had apparently finished his pasturing and had taken on some degree of stability,—just what we could not determine from our distance. At least he was not moving away.

We went along as quietly as possible on the lower side of the ridge, walking on the sun-softened snow whenever it

[1]In popular parlance this animal is referred to as a goat, but from a scientific standpoint this is not an accurate designation, for this ungulate is a member of a group more or less intermediate between the typical goats and the true antelopes. Like the American robin, which is not a robin but a thrush, the Rocky Mountain goat is the victim of a popular misconception.

Photograph by William T. Shaw

SHUKSAN FROM CRATER MOUNTAIN

The rugged beauty of Shuksan, a close rival in height of the more celebrated Mount Baker, is seen to advantage from this point of observation

Photograph by William T. Shaw

SHUKSAN FROM AUSTIN PASS

The aspiring height of Shuksan gains in impressiveness when seen mirrored in the still waters of a lake

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CONFRONTING THE INTRUDER

This picture gives an excellent idea of the habitat of the animal: the great height of the cliff, the depth of the cañon, and the mountain landscape in the background. The animal stands as if in a shadow box produced by the niche in the rock. Its sturdy mountain-climbing limbs are firmly placed, and the body form, massive shoulders, and head are well indicated by quartering light led in the direction in which we were tending, grateful always for the gentle breeze fanning full in our faces. When the distance was about half covered, we parted, and Henry dropped down through the timber to reconnoiter, while I kept to the up-running ridge, hoping to get above the goat,—a principle the value of which is well known to hunters of these animals. Passing a little grove of high-mountain hemlock, my attention was attracted to a well-marked trail leading out along the bluffside. Within this clump of trees was a veritable lair, where the goat had undoubtedly spent many a warm summer afternoon. Going back, I awaited my partner, who soon came up, reporting no sign of the goat, but expressing the belief that the animal was somewhere beyond a second or third prominence of rock reaching out from the main bluffside.

I showed him the trail, but no need—the incident of the walnut had long since been forgotten. We were after goats now! Slowly and cautiously we crept out along this path, and I still remember distinctly the pertinent things that passed keenly through my mind as we went carefully along. Here was vegetation such as had been found along a deserted goat trail on Rainier two years before. This was goat country to be sure. There were the patches of snow with lush grass of tempting greenness such as goats would drop low to procure. Far below we looked into the cañon of the Swift.

Out and out we went, as cautiously and silently as is possible on a granite-chipped goat trail. At one point we left a pack sack, at another a tripod or trapping bag,—whatever would lighten our burdens. Finally we passsed the second of the outstanding faces, with still a hundred yards to go. Have you ever noticed how hobnails grate against a slanting floor of granite? We were keenly aware of it, and presently discarded the shoes that bore the nails. With careful step we approached the last outstanding face, now creeping along the trail, again flattening against a difficult corner of jutting rock, listening to our own heartbeats, as a dislodged pebble went clattering down the cañon-side, expecting to hear at any moment a greater clattering of pebbles, loosened by a justly suspicious and alarmed goat. But the expected did not happen, and I shall never forget the expression on Henry's face as he turned around to me after looking over the ledge, saying in a whisper, "There's your goat." And there, in a beautiful coat of snowy hair, glistening in the sun of a late afternoon, lay the dozing animal, on the flat upturned stump of a tree that had been storm-wrenched from the mountain-side. He was probably not more than twenty-five or thirty feet away.

The sun was warm enough to produce marked respiratory movements over his flanks. His expression,—well it was that of boredom, as with half-closed eyes, and wearily twitching ears, he occasionally swung his head slowly in evasion of a large fly that buzzed about him.

Just one satisfying peep and we began work on the camera, a five by seven, fitted with a Zeiss Tessar lens, Series IIb. Moments were moments now, for what if the fickle wind of a mountain cañon should suddenly change? Fortunately there was a flat rock just man-high in front of us. Beyond was an open space past which we could not go. Here was our last stand. Cautiously we slid the camera up on the rock and with equal care leveled it with bits of flat stone flakes.

Photograph by William T. Shaw

MOUNTAIN HEMLOCK

This locality is within a short distance of the region where the picture of the mountain goat was obtained. The photograph was taken from Crater Mountain, looking northwest across the valley of the Nooksak to the Church Mountains. Two splendid examples of the mountain hemlock occupy the foreground. This tree is usually found in high altitudes, not infrequently growing in exposed places

The finding cloth was worked over with scarcely an inch to spare, the chief anxiety being to place the goat well in the middle of the field and to secure a careful focus.

Only two plates remained from the day's work. One of these was at once exposed. The other, a postcard size in a kit was the next and last. Again focus and other adjustments were gone through and every precaution taken to make the best of the situation on this greatly narrowed field and one remaining plate. We were ready, but why make a duplicate exposure? In whispered consultation we talked it over and decided to take a risk. Cautiously I began showing myself above the rock. At first the goat paid no attention, but in a few moments he began to look my way and then, half-suspicious, he gazed at me with a keen steady stare from his clear black eyes. I made no sudden movement and he was not alarmed; yet, still eyeing me, he got up and after a moment silently drew his body into one great muscle-straightening stretch. What a huge creature he was! Without moving from his tracks he looked calmly about, up and down and far out over the cañon. Slowly his head swung around and, as I saw the sharp tips of his beautiful black horns stand out vividly against his massive white shoulders, something told me the psychological moment had come and I pressed the bulb.

Just two hours before, we had been somewhat indifferently viewing this animal with the binoculars from Crater Mountain.

SEQUEL.—Not far back along the goat trail lay an object we had not discarded,—a gun, with ammunition of sufficient power to have served our needs. Over in camp was a State paper giving us the privilege of collecting for scientific purposes. Again we held a council of war,—yet was it not a parley of peace?

Three thousand feet below, from the little silver thread of the Swift, came the peaceful murmur of running waters. Far over the intervening weathered cañons lay silent Baker, flooding our wall with a warmth of reflected light and heat, shared by all alike, in that lovely, closing, summer day. Over to the east stood Shuksan, calm and patient in its vigil, a vigil maintained through countless ages. Our council *was* a council of peace.

Courtesy of Mr. Watts, Utah Fuel Company

A track imprint in the roof of a coal mine; the spread between the toes is twenty-four inches

Dinosaur Tracks in the Roofs of Coal Mines

A STRANGE PHENOMENON NOTED IN UTAH AND COLORADO

By WILLIAM PETERSON

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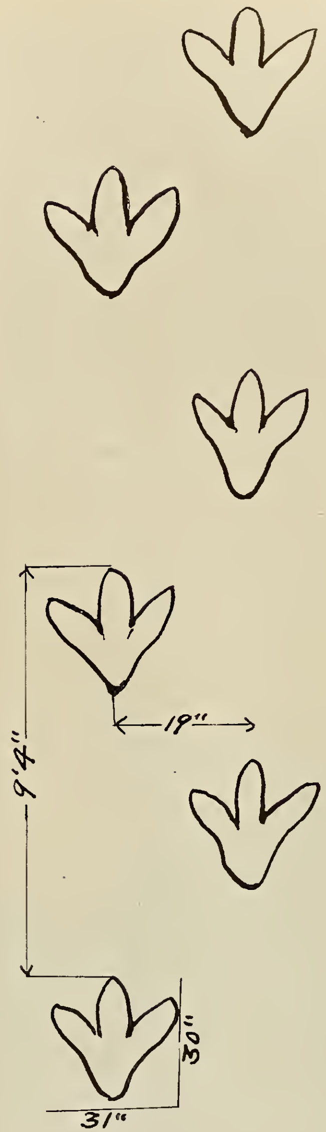
TO view the tracks of ancient Cretaceous monsters is not an entirely new experience, but to view these tracks from beneath instead of from above is somewhat of a novelty. This is a privilege open to those interested in the ancient life of the Cretaceous seas of Utah and Colorado. It was the writer's good fortune to spend three summers in a detailed survey and inspection of the coal deposits of Utah. While he was examining the underground workings of many of the mines, attention was called to certain protuberances from the coal seam roof. A definite shape had been recognized in the case of some of these, though most of them were spoken of as "carbuncles," "nigger heads," and under similar terms. In areas where the coal was low these protuberances had to be removed to give room for the mine hauling, for some of them projected as much as a foot below the roof of the coal seam. In some places the projections appear in groups while in others they are solitary.

After inspecting hundreds of these protuberances, the writer agrees with some of the mine foremen and superintendents that these peculiar formations undoubtedly had their origin as tracks of ancient monsters which tramped through or around the border of the Cretaceous sea. The tracks seem to have been made at a time when the peat accumulation was covered with a foot or more of mud. The layer of mud was not sufficiently thick to support the weight of the animal walking over it. The feet sank through the mud several inches, or even more than a foot at times, into the soft, yielding peat underneath. Some mud was pushed into the peat as the animal brought down its weight, and as it drew out its foot, the footprint would be filled with mud from above. As time went on, nature's distillation reduced the peat to coal, and the mud with its track projections was converted into solid rock. In most places the coal is easily separated from the roof, leaving the track-shaped protuberance extending partially or wholly as a definite appendage from the ceiling. When the coal is completely removed, the tracks appear in various forms. In some cases the footprints project only part way through the roof and in others they project so far that a clear space is shown between the portion of the track represented by the toes and the solid roof. It is interesting to note that, as far as observed, the largest tracks are the ones which protrude farthest from the rock roof. The material filling the track varies slightly but is for the most part an arenaceous shale or argillaceous sandstone.



Consecutive tracks in the roof of the old Ballard Mine on the property of the American Fuel Company

The animals seem to have walked for the most part along trails or definite paths. It was noted that some of these paths are twenty or thirty feet in width, and the exposures in many entries and rooms of the coal mines show them to be comparatively straight in alignment. The individual tracks in the paths are seldom clearly outlined and only when one of the animals has traveled independently does every imprint become distinct. In several places it has happened that an entry of the coal mine has followed approximately the path of a single animal, thus exposing several of the tracks for measurement and comparison. Seven consecutive tracks are shown in the old Ballard Mine on the property of the American Fuel Company, located on the Denver and Rio Grande Railroad about eight miles north of Thompson Springs. These tracks are among the largest observed and the measurements are shown in the diagram on p. 389.

In a different entry of the mine, tracks of similar size are found, and by courtesy of the company one of these was taken down and shipped to the Geology Museum of the Utah Agricultural College at Logan. On this page is shown a photograph of this track

The 12-inch rule, laid on this track after it had been removed from the roof of the old Ballard mine, indicates the huge size of the track

with a 12-inch rule placed on it for comparison. The track measures 31 inches between the spread of the outer toes and 32 inches from the heel to the front of the middle toe. Near the point of separation the toes are from 6 to 8 inches in diameter, and the toes are so pointed as to indicate the presence of rather sharp claws on the end of each toe.

In the mine at Castle Gate, Utah, a photograph was taken of one of the tracks as it appeared in the roof of the mine before removal. The photograph (see p. 388) is furnished by courtesy of Mr. Watts of the Utah Fuel Company. This track, which is similar in character to those mentioned above, is somewhat smaller than they, being only 24 inches between the spread of the toes and extending for about the same distance if measured from the heel to the front of the middle toe. Only one track smaller than this has been measured, that in the mine at Standardville in Spring Cañon, the length of which is only 16 inches; however, it is similar in other respects to the Castle Gate track. Two casts of tracks have recently been obtained by workmen of the United States Fuel Company at the Panther Mine.[1]

The tracks referred to in this article have been observed by the writer at intervals over an area more than one hundred miles in extent and in different seams of coal, which represent a stratigraphic thickness of more than two hundred feet of sandstone including three or four beds of coal. The coal seams total in thickness approximately thirty-five feet. The deposit is near the base of the Mesa Verde formation of the Upper Cretaceous. The tracks are all of the three-toed type

[1]There are unauthenticated reports that similar tracks have been observed on the roof of the coal mine at Somerset, Colorado.

and seem to have been made by an animal that walked only on its hind feet. In one place, where the roof of the mine was badly caved, careful examination was made for any trace of either front feet or tail track, but no evidence of either was found.

The most startling thing about the tracks is their enormous size. The writer has examined painstakingly the feet of the mounted skeletons of the *Apatosaurus*, *Ceratosaurus*, *Claosaurus*, *Hadrosaurus*, and others, but none apparently have feet large enough to fit these tracks.

Dr. W. D. Matthew of the American Museum interprets the tracks as having been made by a member of the deinodont family of dinosaurs, of which the *Tyrannosaurus* is the largest known type. He further describes the *Tyrannosaurus* as "the climax of evolution of the giant flesh-eating dinosaurs. It reached a length of 47 feet and in bulk must have equalled the mammoth, mastodon, or the largest living elephants. The massive hind limbs, supporting the whole weight of the body, exceeded the limbs of the great proboscideans in bulk, and in a standing position the animal was from 18 to 20 feet high as against 11 feet or so for the largest African elephant or the southern mammoth. The head was 4 feet, 3 inches long; 3 feet, 4 inches deep; and 2 feet, 9 inches wide. The long deep powerful jaws are armed with teeth from 3 to 6 inches long." The front limbs were small and were probably used only in capturing and gathering food. The great bulk of the body would imply slow movement, and that food was obtained from the shallow water of the Late Cretaceous sea.

The skeleton of *Tryannosaurus* in the American Museum

Dean's "Bibliography of Fishes"

A Review

By RAYMOND C. OSBURN
Professor of Zoölogy, Ohio State University

A BIBLIOGRAPHY is usually considered the driest and most uninteresting matter that can be reduced to print. The subject of the present review is much more than the usual catalogue of scientific writings in a particular field, for its completeness and manner of treatment lift it entirely out of the category of ordinary bibliographies and make it an outstanding contribution, not only to the subject of ichthyology in its various phases, but to every field of work connected with the lower vertebrates.

The prefatory remarks by Dean in this Bibliography indicate that he and his collaborators have taken this work very seriously and that the almost limitless task has often appalled them, as well it might. The quotation from Wood's preface to his *History of Oxford*, given in Dean's preface to Volume III, is certainly well chosen:

"A painful work it is I'll assure you, and more than difficult, wherein that toyle hath been taken, as no man thinketh so no man believeth, but he that hath made the triall."

The fishes occupy a unique position in zoölogical work, for they are the fundamental group among the vertebrates and must be investigated with regard to the evolution of every important anatomical, embryological, and physiological character shown by their higher relatives, and of all the vertebrates, with the exception of our domestic animals, they have the most important economic relation to man. Approximately 45,000 titles are included in Dean's Bibliography, the dates of publication extending from the time of Aristotle to the present, and this list does not include the vast amount of literature on marketing or utilization unless the papers are of special interest.

The Bibliography is a stupendous affair in three volumes, totaling 2127 pages,—a truly astonishing compilation of the sources of information, but so well arranged and digested that it affords easy access to the mine of knowledge regarding this group of animals.

The Authors' List of signed publications, since the period of Linnæus, occupies all of Volume I (published in 1916) and nearly all of Volume II (1917) and this, with the Addenda of 199 pages in Volume III (1923), makes an authors' catalogue of 1693 pages, covering the titles since the publication of Linnæus' tenth edition of *Systema Naturæ* in 1758. At the end of Volume II and the beginning of Volume III is a list of Anonymous Works, covering 29 pages. Volume III also contains a list of Titles of Pre-Linnæan Publications, totaling 134 pages; a list of the General Bibliographies Referring to Fishes, 4 pages; Voyages and Expeditions Which Relate to Fishes, 5 pages; Periodicals Relating to Fish and Fish Culture, 6 pages; Errata and Corrigenda, dealing chiefly with the correction of the names of foreign writers and with duplication in reprints, 7 pages. This is followed by a Subject Index of 305 pages and a Finding Index of 40 pages.

In the general Bibliography explanatory notes are inserted frequently under the titles. For example under Mast, S.O., "Vision in Flounders" is the following: "Simulation of background regulated by visual stimuli. Evidence of color vision. Motion vision as acute as in man." After Okada, S., "Catalog of vertebrated animals of Japan," is the note, "Classification in Latin; species in Latin and Japanese." The Authors' List is thus rendered much more useful than would be the case if there were merely citation of the titles and place of publication as in ordinary bibliographies.

In the section of Pre-Linnæan Publications these notes are more numerous. For example, under Leeuwenhoek, Antony van: "Continuatio arcanorum naturæ detectorum," Delft, 1697, the note, "Sexes of eels, circulation in eels, and scales of fishes." Under Marcgrave, George, (1610–1644), are given the various ways of spelling his name and references to biographical notes concerning his life and work, and under the first of his titles,—"Brasilianische Naturgegenstände

(Collectio rerum naturalium Brasiliæ) c. 1643," "these water-color drawings of the animals and plants of Brazil, made by Marcgrave, are preserved in the great library of Berlin, labeled 'Libri Picturati A. 36–37.' There is reason to believe that Count Maurice of Nassau-Siegen made some of these paintings. On at least some of the figures of fishes there are notes in his handwriting. They are (in part) the originals of the figures in Marcgrave's great work."

These copious notes on Pre-Linnæan works, including historical items, biographical notes, brief digests of the contents of papers, later editions and translations, etc., are sufficiently useful and important to justify the space occupied by and the care and labor expended on this study of the ancient literature devoted to fishes.

The Subject Index is naturally of the greatest interest and importance, not only to ichthyologists, but to students of vertebrate zoölogy, anatomy, embryology, parasitology, ecology, physiology, and teratology. The fish culturist, the angler, and the general reader will find a guide to special topics in this index. A careful analysis of the literature dealing with every subject pertaining to the life, structure, development, and habits of fishes is here made; the various theories of development, phylogeny, etc., that have been proposed are outlined, and the most important papers indicated by a star. The amount of material that has been digested for this purpose is not the least of the astonishing features of this unusual Bibliography.

The treatment of the Subject Index leaves little, if anything, to be desired. As examples of the arrangement, the discussion of behavior, habits, and angling will serve as well as any.

"Behavior," comprising the comparative psychology of fishes, covers about two pages, with cross references to other headings, such as: reactions to chemical stimuli, hearing, commensalism, and parental care. There is a paragraph containing general references to works on animal psychology, and following that appears the special literature, grouped under such sub-headings as the following: accounts or narratives depicting unusual actions or behavior; behavior of various types, chiefly instinctive; color perception; intelligence; memory; and the effects of stimulation by electricity, gravity, light, touch, and water currents. In fact, the materials are so assorted that one may readily find a reference covering almost any question that might be asked as to fish behavior.

Under the topic "Habits of Fishes" (covering nearly two pages), besides the usual cross references and general references, we find the papers dealing with habits classified under the natural order to which the fish belongs. For example, the papers devoted to the habits of the various sharks are brought together, and similarly those pertaining to the eels, the perches, etc. Other sub-headings are: various specific habits, such as burrowing, fighting, inflation, and water throwing.

Further references are also given at the proper place in the catalogue to such topics as sleeping habits, resting habits, nest-making, care of eggs and young, and all of the thousand and one things that the general reader, as well as the ichthyologist, may wish to know about the habits and mode of life of various fishes.

"Angling" embraces general treatises, in Dutch, English, French, and German, and bibliographies and catalogues of angling literature; historical matter, subdivided into Pre-Linnæan treatises, general treatises, books on husbandry, early laws pertaining to angling, dictionaries and encyclopedias, guides, handbooks, etc., piscatory eclogues; fly-fishing; sea-fishing; angling for salmon and trout; angling for various fishes; angling classified by regions—North America, Europe, and other localities. Here is sufficient material to point the way to the student of angling from the historical or any modern phase.

To the Systematic Section of the Subject Index is given the same scrupulous care as to the other sections, often with special reference to particular species that are of the greatest interest, though in general no attempt is made to index farther than genera,—and, in fact, another series of volumes would be required if such references were to be included. As examples of the treatment of the systematic portion we may call attention to the subheads under the Salmonidæ and Anguillidæ.

"Family Salmonidæ" (six pages); distribution, embryology, fossil forms, taxonomy; subfamily Salmoninæ, American trouts, European trouts, Atlantic salmon, references to American forms, references to European forms, general treatises, growth, metabolism during sojourn in fresh water, feeding, migrations, reproduction; Pacific salmons, general, death after spawning, growth and reproduction, migrations; *Salvelinus*, American forms, European forms; miscellaneous papers on salmon and trout, in various languages—Danish, Norwegian, Dutch, English, French, German, Hungarian, Japanese, Latin, Russian, and Swedish. And so on through the other subfamilies of the Salmonidæ.

The eels ("Family Anguillidæ") are given somewhat different treatment, as follows: principal literature; life history of the eel (more than a page devoted to outlining the history and indicating the literature of this phase of the subject); sexes of the eel; various leptocephali; general literature; taxonomy; other genera of the Anguillidæ.

The Finding Index is merely an index to the Morphological and Systematic Sections of the Subject Index and refers therefore only to part VIII, or pp. 361–665 of Volume III. Naturally it is a very useful portion of the work. Dependent upon the Authors' List alone, one would have to know the name of the author before locating a particular title: even with the addition of the Subject Index, one might have to look for a long time before finding all references to a particular topic—such, for example, as "Fins." In the Finding Index one is referred to the page in the Subject Index where the topic is mentioned, and the most important of such references are in bold-faced type. Under "Fins" seventy-four such references are found, and these are arranged for convenience in twenty-four groups, such as: paired fins, vertical fins, locomotion by, abnormal, primitive, etc.

If the student of fossil fishes wished to look up Dean's work on *Cladoselache*, he might turn to the Authors' List in Volume I, where he would have to scan nearly five pages of titles by Dean—and titles unfortunately do not always indicate all the contents of papers. If he knew the systematic position of *Cladoselache*, he might turn to the proper place in the Systematic Section of the Subject Index, where under the "Order Pleuropterygii" he would find Dean's three papers on this genus given in such form that he could locate them in the Authors' List without delay. If he turned at once to the Finding Index, he would come upon page references not only to the Systematic Section, but to three other references in the Morphological Section, where special points in the structure of *Cladoselache* are mentioned. Though this may at first seem a little complicated, anyone with experience in tracing out the literature of a subject will realize at once that only in this way could the vast and varied literature on the fishes be made available.

No one would expect such an extensive compilation to be absolutely perfect,—the authors least of all would make such a claim. Yet the reviewer has run down many subjects, in which he may claim to have some knowledge, without finding any serious errors. It is in cross-referencing, naturally, that such slips are likely to occur. For example, in the Finding Index one finds "*Batrachus*, see *Opsanus*," but under *Opsanus*, where the page references are given to both *Batrachus* and *Opsanus*, there is no indication that these terms are equivalent. Also there is a reference to *Opsanus*, p. 410, but on turning to this page no reference to either *Opsanus* or *Batrachus* can be found. Under "Fins" in the Subject Index one is further referred to "Limbs." This heading does not appear in the Subject Index, and upon turning to it in the Finding Index one is again referred to "Fins," where all references are given. Guided by the Subject Index the reviewer has followed up in the Authors' List the references to the papers of various writers with whose work he is familiar, but has failed to locate any errors.

In the prefaces to Volumes I and III are explained the origin, purpose, and methods pursued in the compilation of this great work, and credit is given to those who have rendered assistance. The most prominent among these are Doctors Louis Hussakof, Charles R. Eastman, Eugene W. Gudger, and Mr. Arthur W. Henn. The debt of science to Professor Dean and his collaborators is great indeed, and acknowledgments would not be complete without reference to the broad-minded policy of President Henry Fairfield Osborn and the Board of Trustees of the American Museum in providing funds to finance the publication and to pay the salaries of the editoral staff.

A résumé of this work would be incomplete without special reference to the work of Dr. E. W. Gudger, editor of Volume III, and the associate bibliographer, Mr. A. W. Henn. The tremendous task of bringing together the Subject Index of 274 pages might have been sufficient to deter even the most experienced from undertaking it. But no mere technical bibliographer could have succeeded with this phase of the work. It required the expert knowledge which only a well-trained zoölogist, thoroughly familiar with the fishes, could bring to the performance of the task, which required not only a careful indexing, but a full appreciation of the contents of the papers listed in the authors' catalogue. That the task has been admirably done no one will gainsay, and this portion of the work will stand as a lasting monument to the service which these scientists have rendered in the field of ichthyology.

In closing, the reviewer cannot do better than to quote the final paragraph of Dean's preface to Volume III, "The present volume terminates a task, infinitely painstaking, thankless, insistent, withal necessary, which has been upon our table for over thirty years. It seemed never to end, and we grew old with it; *Quousque tandem!* Our hope is only that the references we now provide will be of constant service to workers everywhere, for when all is said and done, an elaborate bibliography is the strongest scaffolding upon which any research can be built." The only exception one may take to this is in regard to the thanklessness of the task. In this we cannot agree with Professor Dean, for we feel sure that countless workers will have occasion to heap silent gratitude upon him and his staff of collaborators for generations to come. Such a landmark in vertebrate zoölogy will hardly cease to be useful until science in this field has progressed far beyond even our present conception of its possibilities.

A Historical Sketch

By E. W. GUDGER
Editor of Volume III

IN 1890, Dr. Bashford Dean, then instructor in zoölogy at Columbia University, began his career as the leading American student of the anatomy, embryology, and palæontology of fishes.

In exchange for papers from his prolific pen, articles on fishes came from students of ichthyology all the world over. From these and from the bibliographical lists of papers cited in his own publications, he began to build up for the use of himself and his students a card catalogue which formed the nucleus of the present *Bibliography of Fishes.*

In 1895, Doctor Dean published his well-known book *Fishes, Living and Fossil.* In this was a twenty-page bibliography of the embryology, morphology, and palæontology of fishes, composed of the most important citations found in his card catalogue. Notwithstanding the fact that these references were put in the most abbreviated form possible, this bibliography was often referred to in ichthyological articles during the next twenty years.

In 1903, Doctor Dean was made professor of vertebrate zoölogy in Columbia University, and in 1907 curator of fossil fishes in the American Museum. Two years later (1909) he became curator of ichthyology and herpetology in the Museum. In the meantime the roster of his publications on both fossil and recent fishes grew as did his card catalogue. By 1900 this catalogue contained about 20,000 entries, and was by far the most extensive catalogue of ichthyological literature in existence.

Doctor Dean's students made free use of it and added citations of their own where any were found lacking. Correspondents wrote in for lists and in turn sent in lists of their own, and students of ichthyology even came to New York to consult the entries. By 1910, this card bibliography, which in the meantime had been removed to the American Museum, had reached a critical stage in its development, for it had become too immense to be carried on by one man, upon whose time and energies multifarious duties made demands. It was also clear that it had become a great reservoir of references which ought to be made accessible to workers not merely in America but all over the world. To achieve this end it would have to be published.

It was clear, however, that in the form in which its entries were set, it could not be put into print. The material required revision and additions. It was imperative that the earlier bibliographies—those of Agassiz, Bosgoed, Carus and Engelmann—be checked up. The cards of the *Concilium Bibliographicum,* and the entries in the *Zoölogical Record,* the *Royal Society Catalogue,* and other recent bibliographies would have to be examined critically. Then in many cases citations would have to be compared with the original titles in order to clear up discrepancies, and bibliographies in special outstanding books and articles would have to be reviewed. Finally, it would be necessary to ask specialists in ichthyological subjects all over the globe to send in lists of their publications. All this in order that nothing might be omitted, that this work might be truly a BIBLIOGRAPHY. But how was all this to be done?

Then the man and the opportunity met. President Henry Fairfield Osborn, with a great vision of what might be done for science in general and for ichthyology in particular, brought the resources of the American Museum to the aid of this great enterprise, and funds were made available to provide a secretary for the work of checking up, verifying, and transcribing references. Later, when publication began, certain friends of the enterprise, particularly Mrs. Isaac M. Dyckman, Mrs. Bashford Dean, and Doctor Dean himself, generously contributed funds.

About 1910, Doctor Dean, being occupied with many other matters, entrusted the responsibility of supervising the work of the secretary, Miss Evelyn Tripp, to Dr. Louis Hussakof, associate curator in the department. During the next five years the scientific literature of the world was minutely searched for ichthyological titles. The largest single contribution was made by the Smithsonian Institution, which turned over to Doctor Dean the huge manuscript bibliography collected and compiled by the late Dr. G. Brown Goode, who for many years before his death had been engaged in working up a fish bibliography along similar lines. In the meantime letters had been sent to 468 leading specialists the world over, asking them to send in titles of all their papers dealing with fishes. Of this number 304 complied with the request, and thus a vast amount of data came at first hand to the Bibliography.

In 1914, Doctor Dean, who had previously been made curator of arms and armor in the Metropolitan Museum of Art, felt obliged to retire from the headship of the department of fishes in the American Museum, and became its honorary curator. Doctor Hussakof was promoted to curator, and because of his increased duties as head, was obliged to give up the supervision of the Bibliography. About this time Miss Tripp resigned and was succeeded by Miss Marguerite Engler, who served as secretary during 1915–16.

At this critical period in its history, the Bibliography was certainly favored by fortune. Dr. Charles Rochester Eastman, the distinguished student of palæontology, having just finished certain special researches on the fossil fishes in the Carnegie Museum, Pittsburgh, was persuaded to assume the editorship. Not only was Doctor Eastman a distinguished palæontologist, but he was almost equally well known as a palæobibliographer—having a knowledge of the Pre-Linnæan literature of fishes probably unequalled in America—all this due to his researches not only in ancient fishes but also in the older literature of this subject. His wide experience as a student of fishes, his extraordinary linguistic attainments, his natural critical faculty, and his ability to do an enormous amount of work made him an ideal editor for the *Bibliography of Fishes*.

Under Doctor Eastman's hand there went steadily forward the enormously detailed work of compiling and editing into definite and uniform style the 37,000 titles found in Volumes I and II. No one who has not had the experience can realize the prodigious task involved in such editorial work. A uniform style had to be decided upon for titles; capitalization, spelling, abbreviations, punctuation, and styles of type had to be standardized. And when these standards had been established, the task of editing the myriads of cards according to these standards was truly Brobdingnagian. But Doctor Eastman was not to be discouraged, and when Volume I appeared in the spring of 1916, it is not putting it too strongly to say that it created a sensation among American men of science, and particularly among students of fishes. This volume embraces the letters A–K and covers 720 pages.

In 1916, Miss Engler retired from the position of secretary and her place was taken by Miss Florence Schwarzwaelder, who devotedly served the Bibliography until the summer of 1919. Also late in October, 1916, Mr. Arthur W. Henn, at that time a graduate student in zoölogy at Columbia University, began half-time work on the task of noting on the proof sheets alongside each citation the entries for the Subject Index.

Doctor Eastman having brought Volume II, comprising the letters M–Z, plus the Anonymous Titles—a total of 702 pages—through the press in 1917, sailed about June 1 for Brazil to collect fossil fishes, having at the same time, however, a connection with the intelligence branch of the United States government. Doctor Dean had entered government service as major in the ordnance division, where his special knowledge of armor was of the greatest service. However, Mr. Henn and Miss Schwarzwaelder went on with the work of indexing. The present writer having expressed his warm appreciation of the great value of Volume I of the Bibliography, and having sent in a good many missing titles, was invited to come up and hunt for others, and at this task he spent the months of June and July, 1917.

The summer of 1918 brought Doctor Eastman back from Brazil, but he at once "joined up" with the War Trade Board in Washington. Doctor Dean was up to his eyes in the work of making invaluable improvements in helmets and gas masks for the ordnance division of the War Department. During the winter and spring Mr. Henn continued to work on the Subject Index, but in April went to France with the American Expeditionary Forces. I had devoted much time during the winter to the collecting of missing titles, and toward the close of May I again came to the Museum, bringing 1400 titles with me and spent the months of June and July in this work. Then in September Doctor Eastman, who during the war had been subjected to at times dangerous and always nerve-exhausting duties, was drowned at Long Beach. In consequence of all these things, work on the Bibliography was almost at a standstill during the winter of 1918–19.

It was at this stage in the history of the enterprise that Doctor Dean sent in the following quotations for ultimate setting on the page immediately preceding the preface of Volume III.

"Deep calleth unto deep at the noise of thy waterspouts; all thy waves and thy billows are gone over me."—Psalm XLII.

"Tetzel, the Bohemian, gazing at the sea at Cape Finisterre, remarked—as if he had our Bibliography in his mind's eye—'The end of it no one knoweth, save God alone!'" *The Bohemian Ulysses* (1477); Mrs. Henry Cust, *Gentleman Errant*, 1907, p. 87.

On June 1, 1919, I came up from the North Carolina College at Greensboro, under promise to Doctor Dean to stay with the Bibliography as editor until it was finished. A few weeks later Mr. Henn returned from France, was discharged from service, and began on a full-time basis the work of finishing the index notations. In August Miss Francesca La Monte assumed the duties of secretary, and the work of completing Volume III went forward under a full head of steam.

At this point it was decided on the urgent advice of Doctor Dean to limit titles in our Addenda to the close of the year 1914, which marks a great break in scientific work and literature due to the World War. In Volumes I and II Doctor Eastman had included titles of works that appeared later than 1914, with the idea that the Addenda should bring the literature up to the time of going to press with Volume III. That Doctor Dean's judgment was sound, and that it saved us a world of trouble, has since been realized a thousand times by everyone concerned. In two sets of cases only have we violated this rule. There have been included *all* the papers of Eastman, Steindachner, and others who have died since 1914, so that their lists might be complete; and in the second place such outstanding epoch-making works as Boulenger's *Freshwater Fishes of Africa* and Jordan's *Genera of Fishes* have been listed. For the same reason we have set in the Subject Index such authoritative works as Radcliffe's *Fishing from the Earliest Times* (1922), Phisalix's *Animaux Venimeux et Venins* (1922), and others of like standing, because these review the literature extensively and are literally the last word on the subjects considered. This was done even though these titles came to us too late to be included in the Addenda.

When I came to the Museum from Greensboro in 1919 with a year's leave of absence, we all thought that the Bibliography could be finished in fifteen or eighteen months, but in the spring of 1920, it became clear that at least two years more would be needed for the task. In the meantime (spring of 1920) the college authorities in North Carolina were pressing me for a declaration of my plans. Matters were complicated by the fact that Doctor Dean was in Constantinople and President Osborn in Honolulu. However, the task had to be finished, so I sent in my resignation to the college and continued work on the Bibliography.

During the winter of 1919–20 I checked up about 50,000 pages of new and hitherto untouched bibliographic sources, especially in the Pre-Linnæan literature of fishes. With the completion of this checking, the search for missing titles ended, and the work of editing these cards into standard form began. On August 20, 1920, the first batch of Addenda cards—4029 in number—was sent to the printer. Other titles came to us later and incidentally in the course of the work, and were added from time to time until the Addenda now embraces in round numbers 4500 titles and covers 203 pages of Volume III. In the same way the section of Pre-Linnæan titles (i.e., from the beginning of printing until 1758), which (left incomplete at Doctor Eastman's death) numbered about 1000 citations, was expanded to 2300 entries covering 130 pages. This Pre-Linnæan material is of value mainly, of course, because of its historical interest, but as it was realized that in all probability never again would an effort be made to "bibliograph" this ancient literature, I endeavored to make it as complete as possible.

During the fall and winter of 1919 "copy" steadily went forward to the printers (The University Press, Cambridge, Massachusetts), and proof came back, and the interminable work of proof-reading began. At this time and in fact for the next year, one great difficulty was to keep *all* parts of the Bibliography moving simultaneously. This was particularly true with reference to getting the Addenda and Pre-Linnæan sections along so that they might not delay the notations for the Subject Index and the making of the cards.

Final page proof had been read on the Addenda and Pre-Linnæan sections and these were ready to go to press early in March, 1921, when a printers' strike occurred in the Boston region and prevented our printers from doing anything but piecemeal work for more than nine months. Fortunately, however, this did not cause us any ultimate delay, for the editorial work went steadily forward. We were particularly lucky in having page proof sheets of the Addenda and Pre-Linnæan sections wherefrom to complete the notations for the index cards.

By June, 1921, I had finished the four small sections of "General Bibliographies which Include References to Fishes," "Voyages and Expeditions which Relate to Fishes," "List of Periodicals Relating to Fish and Fish Culture," and "Errata and Corrigenda." These subjects in all cover but twenty-two pages— a space out of all proportion to the time and trouble required to gather the data and present them in proper form. As soon as these sections were off my hands, I gave attention to those topics of the Morphological Section of the Subject Index which had more or less fallen within my lines of investigation, and in the intervals of proof-reading, I worked steadily on these with Mr. Henn for the next fifteen months.

Meanwhile Mr. Henn had finished the task of annotating the proof sheets of Volumes I and II, and of the Addenda and the Pre-Linnæan sections of Volume III for the index cards. These were typed and distributed under the great headings to which they severally belonged. Now began the tremendous task of digesting these 150,000 or 200,000 index references into an intelligible and usable form. This was done by Mr. Henn first for the great section Palæontology. The classification of this large mass of material was fairly easily worked out, but the choice of the types perplexed us considerably. Had we had an unlimited amount of money, enabling us to use all the styles and sizes of types in the print shop, and could these have been set by hand, this problem would have been comparatively easy of solution. However, as it was, we were limited for our great headings, our sub-heads, and sub-sub-heads down to the most subordinate paragraphs to the two sizes and three styles of type which could be set from two plates on the monotype machine.

These limitations of types called for the utmost ingenuity on the part of Mr. Henn, to whom is mainly due the credit for the format of the Subject Index as well as for the majority of the subjects therein contained. The accompanying reproduction of a page of the Subject Index gives some idea of the sizes and styles of type used.

"Palæontology" went to the printer on January 13, 1921, and early in February we received the proof. Mr. Henn was now at work on another great section "Fauna of the World," but before it could be set the printers' strike in Boston occurred. Galley and page proofs covering the Addenda and Pre-Linnæan sections had, however, been read and we were therefore prepared to go to press with these 338 pages. In the meantime the work of arranging the vast material under the headings in the Morphological Section of the Subject Index went steadily on.

In September, 1921, Miss La Monte resigned to go abroad. Her place was taken by Miss Elsie M. Heinrich, who gave us loyal service until she was forced to resign by reason of ill health in June, 1922. However, Miss La Monte returned to the Museum in October, 1922, and devoted her attention to

VIII

SUBJECT INDEX

SYSTEMATIC SECTION[1]

CEPHALOCHORDATA (*LEPTOCARDII OR LANCELETS*)

Marine acraniate fish-like chordates.

General treatise. Delage, M. Y. & Hérouard, E. 1898.1; Willey, A. 1894.1.

Classification and geographical distribution. Tattersall, W. M. 1903.1. — *For a map showing the geographical distribution of the Cephalochordata, see* Herdman, W. A. 1904.1 (*p.* 138).

Taxonomy of forms from — Maldive and Laccadive Islands. Cooper, C. F. 1903.1; Parker, G. H. 1904.3. — *Japan.* Jordan, D. S. & Snyder, J. O. 1901.12. — *Ceylon.* Tattersall, W. M. 1903.2.

Family Amphioxididæ

Amphioxides (*A pelagic form*). *Taxonomy and relationships.* ★Goldschmidt, R. 1905.1, 1906.1, 1909.1, Add. **1905.1.** — *Review of the above.* Willey, A. 1906.1.

Family Branchiostomidæ

Marine littoral forms

Taxonomic revisions of genera and species. Gill, T. N. 1895.2; Jordan, D. S. & Snyder, J. O. (*Japan*) 1901.12; ★Kirkaldy, J. W. 1895.1, Add. 1894.1.

Amphioxus (Branchiostoma). *Natural history, descriptions of young, etc.* Bert, P. 1867.1,.5; Clark, H. J. 1865.1; Harting, P. 1876.1; Kemna, A. 1906.1; Krause, W. 1898.1; Lindsay, A. 1857.1; Müller, J. 1839.1, 1841.2; Quatrefages, J. L. 1845.1; Reichert, C. B. 1870.1; Rice, H. J. 1878.1; Schultze, M. J. 1851.1; Schneider, A. F. 1878.1; Sundevall, C. J. 1840.1; Sundewall, F. 1843.1; Willey, A. 1891.1, 1901.1; Yung, E. J. 1906.1; Putnam, F. W. Add. 1865.1.

Phylogenetic relationships. — Relation to Balanoglossus. MacBride, E. W. 1897.1. — *Amphioxus a slightly metamorphosed tunicate (with consideration of homologies).* Wijhe, J. W. 1906.1, 1914.1,.2. — "*Amphioxus and the ancestry of the vertebrates.*" Willey, A. 1894.1.

Asymmetron. *Natural history notes.* ★Andrews, E. A. 1893.1; Benham, W. B. 1901.1, 1901.2; Mark, E. L. 1904.1; Römer, F. 1896.1; Willey, A. 1896.1.

Epigonichthys. *Natural history.* Harting, P. 1877.1; Passzlavsky, J. 1877.1; Peters, W. C. H. 1876.1.

CRANIATA

Animals (Vertebrate) distinguished by the possession of a definite "head."

CLASS CYCLOSTOMATA, *OR MARSIPOBRANCHII.*

Aquatic craniates without true jaws.

For parasitic habits of Cyclostomes, see under Parasitic Fishes, *also pp.* 416 *and* 500.

Natural history. Duméril, A. M. 1812.1, .2; Partiot, L. Add. 1848.1; Thomson, J. A. Add. 1912.1.

Taxonomy and systematic relationships. Dean, B. 1900.1; Gill, T. N. 1883.7; ★Howes, G. B. 1892.1; Woodland, W. N. 1911.4. — *Supposed gnathostome ancestry of Marsipobranchii.* Woodland, W. N. 1913.2.

Taxonomy of species found in — Russia. Berg, L. S. 1906.10. — *Japan.* Jordan, D. S. & Snyder, J. O. 1901.12. — *Australia.* Ogilby, J. D. 1896.2.

ORDER MYXINOIDES
(Hyperotreti)
Hag-fishes or Borers

For a map showing the geographical distribution of the Myxinoides, see Meek, A. 1916.1 (*p.* 31).

[1] Arranged in general according to the system used in the Cambridge Natural History — this for convenience.
Confined chiefly to natural history, occurrence and the larger and more recent papers on fossil forms and taxonomy. Rarely going below genera, save in the case of the fishes of great economic as well as scientific importance (i. e. Anguilla, Pleuronectidæ, Salmonidæ, etc.).
For further data on natural history, *see* Habits, Reproduction, etc., *in* Morphological Section. For further references to fossil fishes, *see the elaborate section* Palæontology, *also* Hay, O. P. 1902.1, *and* Woodward, A. S. 1889.2, *and also the* Bibliography of North American Palæontology *cited in* Part IV, General Bibliographies. For further data on taxonomy and occurrence, *see section* Fauna of the World, and for particular regions, see such great faunistic and taxonomic works as Day, F. 1875.1, Boulenger, G. A. Add. 1909.1, Eigenmann, C. H. 1912.2, Goode & Bean, 1896.1, Jordan & Evermann, 1896.1. For new species, *see* Zoological Record.
For all other subjects, *see* the Morphological Section.

A PAGE FROM DEAN'S "BIBLIOGRAPHY OF FISHES"

This page, only one of 305 that constitute the Subject Index of the monumental Bibliography, may serve as a suggestion of the painstaking editorial labor required in dividing the vast literature of fishes into sub-headings and sub-sub-headings and in selecting for each entry a style and size of type that enables the reader at a glance to associate it with entries of corresponding value and to differentiate it from larger or from subordinate classifications the Bibliography until the last card was ready to be sent to the printer in 1923.

Mr. Henn's work on the Subject Index was twice considerably interfered with. In 1920, he was appointed curator of fishes in the Carnegie Museum, Pittsburgh, Pennsylvania. Dr. W. J. Holland, then director, seeing how badly Mr. Henn was needed for the Subject Index (the work of which he had initiated and had carried on alone until I joined him in June, 1921) and fully appreciating the value of the Bibliography to science, kindly agreed to let him stay with us until this index was completed. It was necessary, however, for Mr. Henn to go to Pittsburgh at intervals to examine the fish collections and see that everything was in proper order. He was away for about two months in the fall of 1920 and for about four months in the winter of 1921–22. During his second absence I worked over all the index material not completed and in the hands of the printer, and got it into shape for more rapid handling on Mr. Henn's return.

In the meantime the strike had ended and early in 1922 we began to receive proof with fair regularity while on January 24 the bill of lading was received for the printed sheets of the Bibliography up to page 320. In the fall of 1922, Doctor Holland, feeling that Mr. Henn had been permitted to remain with us as long as he could possibly spare him, and that the work of the department of ithchyology of the Carnegie Museum was suffering by reason of his absence, called for him to come to Pittsburgh, and on November 9, Mr. Henn severed his connection with the Bibliography for good.

At the time of his departure the situation was not exactly reassuring, for notwithstanding the help that I had been able to give in the fifteen months that I had worked on the Subject Index, there was much left unfinished. Naturally, as the work progressed, omitted items were picked up, errors were detected, faulty and erroneous titles were cleared up, resulting in considerable changes in various sections of the Subject Index, through cutting out here and adding there. This material was held until the last; insertions and deletions were then made in the galley proofs of the Morphological Section, and at that time, too, the sizes and styles of type were made uniform throughout. These proofs had to be read not merely word by word and date by date, but letter by letter and figure by figure. And now was realized how wisely the poet wrote when he said, "To err is human." Mr. Henn asked that the final proofs be sent to him at Pittsburgh, and these received the benefit of his careful reading.

With this off our hands there yet remained undone one large section which Mr. Henn (far better fitted to handle it than I) had left incomplete. This was the Systematic Section, of which only the sub-sections Anguillidæ, Salmonidæ, and part of Pleuronectidæ were done. However, there was no one else to do this Systematic Section, so with the constant advice and help of my colleague in the department, Mr. John Treadwell Nichols, this was finally arranged, following the general classification set out in the *Cambridge Natural History*.

This work was lightened and its bulk reduced in two ways. First, there had been left in the Systematic Section great masses of material which were now brought out and inserted under various sub-headings of the Morphological Section, or made into such great group headings as "Aquarium Fishes" and "Anatomy and Morphology." This relieved the situation greatly, and further reduction was obtained by following Doctor Dean's advice that we confine our taxonomic references almost entirely to revisions of families, genera, and species. For most genera and species the "natural history" references were retained, and where the fishes mentioned were rare or unusual or of great interest and value, there were listed in addition all the citations. For the complete literature covering all fishes the searcher is referred to such great faunal works as Boulenger's *Freshwater Fishes of Africa*, Jordan & Evermann's *Fishes of North and Middle America*, etc. This plan seems to have won almost unanimous commendation as has our adoption of the classification used in the *Cambridge Natural History*. Finally the large Systematic Section was completed and the last cards sent to the printer on April 27, 1923.

During all these years of prolonged brain-deadening work, Doctor Dean visited us every week or ten days and was the court of last resort in settling doubtful and disputed points. His advice and his optimism sustained us on many an occasion when we were almost ready to give in under the strain. Furthermore, he read all the proof and gave us much valuable advice and help in that connection. Indisputably he was the *Deus ex machina*.

The Subject Index, which is the *summa maxima* of our work, is composed of two sections: a Morphological and General Section of 254 pages with its 118 great headings and the Systematic Section of 51 pages—a total of 305 pages wherein the literature of fishes is minutely analyzed into hundreds of small headings and smaller sub-headings. To this there is a Finding Index of 41 triple-column pages in alphabetical arrangement. The total pagination of our combined index is therefore 346 pages.

While this work was progressing, Miss La Monte had for months, in the interval of other duties, been at work on this alphabetical Finding Index to the Subject Index. With the sending of the last of the cards of the Systematic Section to the printer, she devoted herself almost exclusively to the Finding Index until it was finished, and she finally left the service of the Bibliography about the first of July, 1923. Too much cannot be said of the intelligent, skillful, and faithful service she gave the Bibliography.

I was out of my office on account of illness from May 16 to June 15, 1923. On my return I at once set to work on the editing of the Finding Index cards and as soon as possible in July sent them to the printers. Galley proofs came promptly and were as promptly read and sent back. Final page proofs were returned August 14 and orders given to print everything up to the word *finis*. After some delay this was done, but to the very last the Bibliography proved itself the child of misfortune, for by an inadvertence when the final printed sheets were forwarded to us, the "front matter"—title page, preface, table of contents, etc.—was not included. The missing part was sent, however, at once by express. On its way here the containing crate was smashed and a large number of the sheets badly damaged. Sick at heart, I wired the printers, fearing that the monotypes had been melted and that this matter would all have to be set up afresh, causing another delay. However, the forms had been held, new sheets were printed, shipped at once, and received promptly.

Due to these delays, a new complication had arisen. The Bibliography was to be bound in the Museum bindery but had now lost its turn to the current issue of NATURAL HISTORY, which was just coming from the press, and to pile Pelion upon Ossa this issue of NATURAL HISTORY was a special edition, and therefore taxed the bindery to its capacity. However, on November 13, 1923, the first bound copy of the Bibliography was put into my hands, and our book was formally published.

And now that our task is done, too much cannot be said of the far-sightedness and the faith in the ultimate success of our work and of its value to science shown by President Osborn and the Board of Trustees, who through all these years of work—long drawn out, thanks to the war—have furnished the money to pay the salaries of those of us who have been privileged to do the task, and to provide for the far larger costs of publication. The debt of science to them is certainly very heavy.

At this writing the Bibliography has been distributed to a large number of ichthyologists and reference librarians, and from every quarter of the civilized world letters and reviews are arriving that speak in the heartiest terms of the inestimable and enduring value of our work—which covers every subject wherein fishes touch the life of man—and that declare it a landmark in the bibliography of scientific literature. And so the editors feel that, as Honorary Director Lucas wrote us on hearing that the final volume had come from the bindery,

Finis coronat opus.

NOTES

SCIENCE OF MAN

Professor von Luschan and His Superb Collection of Anatomical Specimens.—Prof. Felix von Luschan, a distinguished German anthropologist, died last February. For many years he had been professor of anthropology in the University of Berlin and had held a corresponding position in the national anthropological museum of Germany. Though he was interested in all phases of anthropological research, his best-known contributions are in racial anthropology and the archæology of the Near East. He was a true field man and inspired all those around him with the spirit of inquiry. Naturally these qualities made him an ideal teacher and drew to his laboratories many foreign students, especially from the United States and England. The most interesting scientific contribution made by Professor von Luschan was his demonstration, before the modern theory of heredity came into general notice, that in mixed populations the two constituent original human types will continue to appear century after century instead of all individuals being leveled down to a uniform blend. For example, when a long-headed people mix with the round-headed, we may expect a number of medium heads to appear in their progeny, but also, according to the now accepted laws of heredity, there should be represented both long heads and round heads. Thus it was that Professor von Luschan first saw in human data what through the researches of De Vries and others led to an epoch-making discovery in biology.

On the other hand, Professor von Luschan was a great explorer and collector. He possessed one of the largest and most complete collections of anatomical specimens in existence,—the work of a lifetime. His series of human crania is representative of all living races of men from the extinct Tasmanian to the modern European and thus contains in itself the story of man's racial differentiation. Accompanying the material is a large series of photographs, extensive notes gathered during von Luschan's wide travels, and an unusually complete library. Just a few months before his death, Professor von Luschan completed arrangements to transfer this magnificent series of specimens and books to the United States and to deposit them in the American Museum. He believed that the scientific usefulness of the materials gathered during his long life would be greatly enhanced by placing them in America and in this Museum. So at the time of his death Professor von Luschan was superintending the packing of this collection for shipment to New York. Needless to say, this addition to the Museum's anatomical collections will make the institution one of the very best places in which to study human biology.

Mr. Clarence L. Hay, who for many years has been engaged in archæological research in Mexico, was elected a member of the Board of Trustees of the American Museum at the annual meeting in February. Formerly a graduate student in Harvard University, where he specialized in Mexican archæology, Mr. Hay has for several years been carrying on his researches in the department of anthropology, American Museum. In that connection he has made frequent collecting trips to Mexico. He is now developing plans for an extension of the Museum building on Columbus Avenue, in which are to be housed, in artistic setting, the Museum collections from ancient America. President Henry Fairfield Osborn has appointed a committee to assist Mr. Hay in working out the architecture and other details. In general, the plan is to use full-scale reproductions of the best-known examples of Mayan and Aztecan sculpture as integral parts of the inner wall faces, thus in the end housing the exhibits within walls that are representative of their own time and place. In Mexico and Yucatan were realized the highest types of aboriginal American civilization and it is fitting that the proposed new hall, which will house examples of the archæology of these areas, should form the west entrance to the Museum.

Dr. J. Alden Mason, of the Field Museum, has been appointed assistant curator of Mexican archæology in the American Museum. Doctor Mason has carried on extensive researches in Mexico and northern South America and is well prepared to take up the development of new work in this field.

Almost from the first, the American Museum undertook the accumulation of collections illustrating the wonderful cultures of aboriginal Mexico. Its first collection of Central American antiquities, that of the Hon. E. G. Squier, one of the early students of the ancient American civilizations, was acquired in 1875. Later, under the generous patronage of the Duc du Loubat great impetus was given to research in the field of Mexican and Central American archæology, and the collections were greatly enriched both by exploration and by purchase. Among the early acquisitions made possible through the Duc du Loubat were casts of prehistoric sculptures from the Valley of Mexico, Chiapas, Yucatan, Guatemala, and Honduras, pottery and stone objects from Mexico and Guatemala, and reproductions of ancient codices, now on view in the Mexican hall of the American Museum.

In 1896 a concession for archæological exploration was obtained from the Mexican government, and work was begun under the direction of Prof. M. H. Saville, who explored the famous ruins of Mitla, and those of Xoxo and Monte Alban in Oaxaca, and of Xochicalco in Morelos. Professor Saville returned to Mexico in 1898 and again in 1900–03, and during these periods explored the curious cruciform structure among the ruins at Mitla, a model of which is in the Museum.

After Professor Saville withdrew from the Museum, Doctor Herbert J. Spinden, now of Harvard University, was appointed curator in this field, and carried on explorations from 1909 to 1920, not only in Mexico, but in other parts of Central America and the adjacent sections of South America.

In recent years, the Central American section has been greatly enriched by the unrivaled collection of Mr. Minor C. Keith, consisting of stone carvings, pottery, and gold objects.

It is not possible to enumerate here all the expeditions sent out by the Museum to gather materials for the Mexican hall, but acknowledgment can be made to the generous donors who financed these undertakings and to the many distinguished archæologists who made the field studies. Among the patrons are: Willard Brown, Austin Corbin, R. P. Doremus, Anson W. Hard, Archer M. Huntington, Morris K. Jesup, James H. Jones, Minor C. Keith, the Duc du Loubat, William Mack, Henry Marquand, Dr. William Pepper, A. D. Straus, I. McI. Strong, Cornelius Vanderbilt, Henry Villard, William C. Whitney. The archæologists include: George Byron Gordon, Aleš Hrdlička, Carl Lumholtz, Francis C. Nicholas, Marshall H. Saville, Eduard Seler, Herbert J. Spinden, and John L. Stephens.

So the appointment of Doctor Mason as assistant curator in charge of Mexican archæology inaugurates a new period in the development of the department of anthropology.

NEW ACHIEVEMENTS OF THE FAUNTHORPE-VERNAY EXPEDITION

Additions to the Mammal Collection.—Mr. Arthur Vernay, who is extending the work of the Faunthorpe-Vernay Expedition into new areas of Burma, Assam, and Siam, has sent to the American Museum several reports, conveyed by bearers from the depths of the jungle, regarding the progress of the undertaking. In addition to Mr. Vernay and the officers and scientists associated with him, the expedition has a complement of 72 men—Indians, Shans, Korens, and others—and no less than 30 elephants for transporting the equipment and for driving out the concealed jungle beasts through an approach in line formation.

Writing from a camp established at Lampa in the Tenasserim Division of Lower Burma, Mr. Vernay states that he has secured in that locality specimens of the giant bamboo rat as well as of the smallest of these rodents, several interesting squirrels, a wild pig, and three bats (*Pteropus intermedius*),—the last-mentioned being caught in mouse traps appropriately baited!

In a later letter sent from a camp established on the La-oh Plateau he mentions that he obtained a fine young bull bison, standing 5 feet 3½ inches at the shoulder. This animal rounds out admirably the proposed bison group, for which there are available, in addition, an adult bull, a cow, and a calf. When Mr. Vernay wrote this letter (January 5), the specimens secured already totaled 280. Among the animals alluded to are gibbons, several monkeys, and specimens of the large squirrel (*Ratufa giganteus*). A cable dated March 14 contained the news that a prized specimen of a rare Malayan tapir had been bagged and that Mr. Vernay was about to leave for Assam to hunt buffalo.

Not only is Mr. Vernay zealously collecting himself but, desirous that no important area in or near India should be without faunal representation in the American Museum, he arranged to have an expedition sent to Kashmir, with the result that the Museum has come into the possession of many desiderata from that area.

Birds Collected by the Expedition.—Although the present expedition of Mr. Vernay has been fortunate in obtaining a representative collection of the smaller mammals, it has devoted its energies with conspicuous success also to the collecting of birds. It was with the purpose of securing, if possible, as complete a representation of the avifauna as of the mammalian fauna, that Mr. Vernay induced Mr. Willoughby Lowe of the British Museum, to accompany him. Seventy-five different species of birds were represented in the collection made during the first week in the field and a daily average of from twenty to thirty specimens in subsequent days has resulted in the addition of many other species, some of them being of great rarity. Among the more spectacular birds obtained are the Burmese peacock and peahen and specimens of the hornbill *Dichoceros bicornis*.

BIRDS

Bird Collecting in Chile and the Argentine.—Dr. Frank M. Chapman, curator of the department of birds, returned to the American Museum in April after an absence of more than four months in Chile and the Argentine. Sailing from New York on Thanksgiving Day, accompanied by Mrs. Chapman, Mr. F. C. Walcott, and Miss Helen Walcott, he joined Lord William Percy on Christmas at Puerto Montt,—the end of rail service in Chile. Here the party chartered a small steamer and for ten days explored the islands south and east of the island of Chiloe, where an expedition from the Field Museum of Chicago was engaged in collecting some time ago. Motion pictures taken by Mr. Walcott, studies of the flightless steamer duck made by Lord Percy, the discovery of penguins nesting in luxuriant forests associated with humming birds, and specimens as well as still pictures of nearly all the species observed are the principal results of this cruise.

A return was made to Puerto Montt and there the party divided, to reassemble later. Lord Percy continued his study of ducks along the coast of the mainland, Mr. Walcott went to Bolivia to investigate flamingo "rookeries," and Doctor Chapman accepted an invitation from the Hon. William M. Collier, the United States Ambassador to Chile, to accompany him to Punta Arenas. Crossing the Gulf of Peñas and sailing along the coastal islands and the mainland on to the Straits of Magellan, Doctor Chapman had an excellent opportunity to view the country where Darwin made observations during the memorable voyage of the "Beagle." From Punta Arenas a crossing to Tierra del Fuego was effected by gunboat. There American motor cars met the party and when later the travelers returned to the mainland, other motor cars took them northward 150 miles along the eastern base of the Andes.

On the way from Puerto Montt to Santiago a stop was made in the Cordillera east of Temuco for the special purpose of viewing the *Araucaria* forests. Doctor Chapman obtained an excellent series of photographs of the fruit and habit of growth of this tree, but he could not discover that any birds are associated with it. In Santiago he rejoined Mr. Walcott, who had completed most successfully his side trip in search of the flamingoes, and the party proceeded to Puente del Inca, a station at an elevation of 9000 feet on the Argentine side of the Trans-Andean railroad.

Here studies and collections were made for what should prove to be a most impressive habitat bird group. The background will offer a superb view of Aconcagua in a setting which naturally lends itself to group construction. The dominant bird will be the condor, with other characteristic upper life-zone species, including seed snipe and a humming bird.

At Chascomús, only three hours south of Buenos Aires, material was obtained for the construction of a group representing the bird life of the pampas and lagoons. Here a combination of grassland and lake brings together such forms as the rhea, various tinamous, the crested screamer, the black-necked swan, the flamingo, and other almost equally interesting types. This locality has the additional advantage of being in the region of which Hudson wrote. All the species in the proposed group appear in his books and as a result the popular value of the group is greatly enhanced.

As a further evidence of the success of the trip it remains only to state in conclusion that Doctor Chapman succeeded, in addition to his field work, in arranging certain important exchanges, which will add several species and at least one genus to the collection of birds in the American Museum.

Dr. Robert Cushman Murphy, assistant director of the American Museum and associate curator of its department of birds, has been elected a member of the Association of

American Geographers, which is devoted to the cultivation of the scientific study of geography in all its branches and is limited as regards its membership to individuals who have done original work in some branch of this science. There are at present 138 individuals who have been honored by membership in this society.

The Cattle Heron.—Mr. James P. Chapin in an article of this issue has called attention to the service which one African bird (the honey guide) performs while seeking its own ends. To the cattle heron (*Bubulcus ibis*) man is indebted in even larger measure, though its good actions, confined to the control of insect pests, have not the spectacular interest that attaches to the behavior of the honey guide. It is estimated that in 1920 these insectivorous birds saved in Egypt alone crops to the value of £2,000,000 or £3,000,000. Yet only eight years prior thereto herons had been dangerously reduced in numbers through the persistent persecution of plume hunters and, had not protective measures been set on foot at that time under the patronage of the late Field Marshal Earl Kitchener, agriculturists in Lower Egypt would probably ere this have been deprived of the services of a useful ally. The birds derive their name from the fact that they are usually found in association with cattle, but they may be seen also with other domestic and wild animals, snapping up the insects, especially grasshoppers, that are driven out of the high grass by the quadrupeds as they move about grazing. Sometimes the birds will alight on the backs of elephants, finding these pachyderms a convenient perch in country where dense, high growth of vegetation makes progress over the ground rather difficult.

PUBLIC EDUCATION

An Expedition to Sweden and Lapland.—Thanks to the generous coöperation of the Swedish State Railways, the American Museum has been enabled to send an expedition to Sweden for the gathering of important data. Dr. G. Clyde Fisher, curator of visual instruction, has been entrusted with the leadership of the undertaking, and is fortunate in having associated with him Mr. Carveth

Courtesy of Dr. L. Bayer

Cattle herons at Entebbe, Uganda

Wells, F. R. G. S., whose sparkling lectures have on more than one occasion delighted members of the Museum and their children.

Doctor Fisher and Mr. Wells sailed May 10 on the S. S. "Drottningholm," Swedish American Line, for Gothenburg, whence by the River and Lake Route of the Göta Canal they will proceed to Stockholm.

As one of the purposes of the trip is to make a study of the Swedish educational system, they will visit elementary and secondary schools, universities, museums, and other centers of learning. Attention will be paid to sloyd work in its native home, for it is proposed to inspect one or more of the schools in which this system of manual training is emphasized. Upsala, the seat of one of Sweden's complete universities, founded before Columbus discovered America, will be included in the itinerary. An added interest here is the fact that Upsala was the home of Linnæus, "The Father of Modern Botany," who is perhaps as well known to zoölogists as to botanists due to his system of scientific names for animals and plants, which he devised in the middle of the eighteenth century and which is still the basis of our scientific nomenclature. The university center of Lund will also be visited.

Leaving southern Sweden behind, Doctor Fisher and Mr. Wells will travel northward by rail to Porjus, from which point they will go by motor boat up the Stora Lule-älv River as far as it is navigable; thence into the wilderness quite off the beaten track of the casual tourist.

Here it is hoped that both a still- and motion-picture record of the country and life of the Lapps may be secured. Doctor Fisher and Mr. Wells will also make a study of the extremely interesting and, in some ways, unique flora and fauna of the region. Since they will be working within the Arctic Circle during June and July, not the least of the points of interest will be those correlated with "The Land of the Midnight Sun."

It is only recently that Doctor Fisher and Mr. Wells visited Bermuda and there made motion-picture records of the wonderful underwater life—the coral gardens and angel fish—in addition to obtaining many excellent still pictures. On April 3, the occasion of John Burrough's birthday, Doctor Fisher lectured to Bermudians and sojourners in the islands upon the great naturalist, of whom he has so many intimate memories and such a fine series of pictures. It was on this anniversary that Doctor Fisher saw for the first time the interesting long-tailed tropic birds that had attracted the notice of Burroughs during his sojourn in Bermuda, and by a curious coincidence he viewed them from the very spot where Burroughs had gazed upon them, and in the company of the Bermudian novelist, Miss Minna Caroline Smith, who was with Burroughs when he made the observation.

ERRATA

The attention of the editor has been called to an error in connection with the full-page picture on p. 221 of the issue of Natural History for May-June, 1922. The picture shows a party collecting fossils in a cliff near Peking, and as it is credited to Mr. Walter Granger, palæontologist of the Third Asiatic Expedition, a reader would naturally draw the conclusion that it represents the activities of that expedition. The photograph was, however, not taken by Mr. Granger but by Dr. J. G. Andersson, of the Geological Survey of China, and depicts the work of that organization at Chou-K'ou-Tien, in the Province of Chihli. The picture had been presented to Mr. Granger and for the sake of convenience placed with photographs of his own work. During Mr. Granger's absence in Szechuan, Mr. Roy Chapman Andrews, desirous of giving emphasis in the article he was then preparing for Natural History to Mr. Granger's achievements, selected from among the photographs this print, not unnaturally believing it to be Mr. Granger's. The unfortunate error has at least this offset, that it gives opportunity again to direct attention to the important work that is being done by the Geologic Survey of China. In the issue of Natural History for January-February, 1921, a detailed account was given of this organization, while in the issue for January-February, 1924, mention was made of some of the valuable results which it has achieved and of the program of work still to be undertaken.

Confession is reputed to be good for the soul, incidentally it is good for a proper understanding of the facts. An additional error is, therefore, noted: the formation shown in the picture is described in the caption as loëss; it should have been referred to as limestone.

The picture of the excavations at Chou-K'ou-Tien has been used by Dr. Otto Zdansky in his account of this fossil locality published in the *Bulletin* of the Geological Survey of China, No. 5, October, 1923.

CONSERVATION

The John Burroughs Memorial Association held its third annual meeting in the American Museum on April 3 under the presidency of Dr. Frank M. Chapman. The association is dedicated to the purpose of preserving, in the spirit of John Burroughs, the places with which his life and work are as irrefragably linked as is Selbourne with Gilbert White or Walden Pond with Thoreau. Thanks to the vigilance of the special committees of the association—the one charged with the preservation of Woodchuck Lodge, the other with the maintenance of Slabsides—these two dwellings are being safeguarded as much as possible from the assaults of time and weather and, when renovation becomes imperative, the replacements are either duplications of the original parts or harmonious additions thereto.

The abiding interest in Burroughs is well illustrated by the fact, reported by Dr. Clara Barrus, of the Woodchuck Lodge Committee, that from the middle of September to the last of October—at a season, in other words, when the summer pilgrimages to different places are at an end—nearly 1200 people visited the spot where Burroughs spent his boyhood and where he lies buried.

After a report by Mr. John Shea, chairman of the Slabsides Committee, regarding the steps taken to keep Slabsides as nearly as possible as Burroughs left it, Doctor Chapman read an entertaining letter from Theodore Roosevelt, assistant secretary of the Navy, telling of a visit which young Roosevelt paid at the age of eleven, when his distinguished father was governor of New York State, to the home of the naturalist. This visit had a curious sequel, which Doctor Chapman illustrated through lantern slides. A phœbe, rather needlessly resentful of the fact that a little boy had taken a peep in her nest, flew to a house near Slabsides and there started a new home on one of the numerous beams under the roof of the porch. Presently she lost her bearings, bewildered by the series of parallel beams of like structure that offered support for a nest. In her perplexity she laid the foundations of a second home and then a third. With three nests under way the deluded bird flew from job to job, not knowing how to divide her time between her several building projects,—a dilemma similar to that of the donkey which, dialecticians claim, starved to death while trying to decide which of two piles of hay of equal attractiveness and of equal proximity it would munch. It was at this crisis in the bird's affairs that Mr. Burroughs helped her to concentrate her activities by demolishing two of the uncompleted nests.

The slides shown by Doctor Chapman were supplemented by others illustrative of the environment in which Burroughs spent his days, and finally, as a culmination of the session, the artist, Mr. Wickenham, explained the circumstances connected with the several admirable oil paintings from his brush of subjects near Burroughs' birthplace that ornamented the walls of the room in which the gathering was held.

The Farne Islands, lying off the northeast coast of Northumberland, have been used as a breeding station by more than twenty species of sea birds, that congregate there in numbers. The nearest island of this group of fifteen is only three miles from the mainland and, as often happens under such circumstances, the bird life has become imperiled through the visits of individuals who are wantonly destructive. It is the proposal to purchase these islands and to have them more adequately guarded than is now possible. Funds in support of this worthy object may be sent to Mr. Collingwood F. Thorp, of Belvedere, Alnwick, England.

The National Conference on State Parks was held in Gettysburg, Pennsylvania, from May 26 to 28 and was attended by an interested group of delegates. At the request of Prof. Henry Fairfield Osborn, Mr. Barrington Moore represented the American Museum at the gathering. The success of these conferences may be gauged by the growing response on the part of official bodies and private associations to the measures urged. Since the last conference, for instance, Kentucky has passed a state park law; West Virginia, Louisiana, and Texas have created state park associations; in Tennessee there is a movement under way to establish a state park around Reelfoot Lake; and California is working on a plan for its state parks. It is to be hoped that the developments of the months ahead may reflect in like manner the interest shown by the present conference in the extension of the park movement.

NEW YORK ZOOLOGICAL SOCIETY

In Memory of Mrs. Russell Sage.—An impressive ceremony took place on April

15, near the well-known rocking stone[1] in the New York Zoological Park. An oak tree was planted by the Conservation Committee of the New York City Federation of Women's Clubs "in grateful memory of Mrs. Russell Sage, foremost woman philanthropist of the world in the bestowal of wisely chosen benefits upon science, art, literature, education, and the welfare of humanity." Although Mrs. Sage's benefactions had the broad foundation indicated, conservationists will feel that her memory is more fittingly preserved through the planting of a tree than through any other symbol of her public-spirited interests. Just as the memory of Burroughs and Muir is literally kept green through the pin oaks planted in front of the American Museum, so the important part Mrs. Sage has had in assuring the preservation of the wild life of the country will be commemorated each recurring spring in the beauty of foliage of this memorial tree, a symbol of her perennial interest in the world of living and growing things. Through the permanent wild-life protection fund she established; through the Sage Game Sanctuary on Marsh Island, Louisiana; and other wise provisions in the interests of conservation, she has made a lasting contribution for which all nature lovers are deeply grateful.

The tree-planting ceremony was preceded by a procession and the delivery of a eulogy by Dr. William T. Hornaday, director of the New York Zoological Park, and was followed by the recital, by Mrs. Charles Cyrus Marshall, of the poem "Park Trees," written by Margaret E. Sangster.

In the afternoon the New York City Federation of Women's Clubs held a session, under the chairmanship of Mrs. Marshall, on conservation of wild life. Mrs. Thomas Slack, president of the organization, delivered the greeting; Mrs. Otto Hahn, the secretary, presented the report of the conservation committee; Senator Elwood M. Rabenold, chairman of the State Senate Committee on Conservation, spoke on "The Conservation Outlook Today," the St. Cecelia Choral Society sang Joyce Kilmer's "Trees," and Doctor Hornaday delivered an address on "Our Campaign for Retrenchment and Reform."

The Tropical Research Station of the New York Zoological Society has contributed an interesting exhibit of its work at Kartabo, British Guiana, to the Empire Exhibition recently held in London, both as testimony of the nature of its undertakings and as a tribute to the continuous support which the government of British Guiana has given to the station. Included in the material sent were a number of pictures, for it was felt that through such photographic records could be conveyed more effectively than in any other way the natural interest of the site and the facilities for scientific work that the station offers. The studies in water color made by Miss Isabel Cooper of insects, reptiles, birds, and mammals, were represented, and a large oil painting of the station was a prominent feature.

[1]A photograph of this stone appeared in the issue of Natural History for September-October, 1922, p. 433.

EXTINCT ANIMALS

A Survey of Pliocene Fauna and Stratigraphy.—The department of vertebrate palæontology, American Museum, has been engaged since 1910 in making a very accurate survey of the Age of Mammals, beginning with the Eocene of northern New Mexico, Utah, and Wyoming, which has been explored in the greatest detail, especially through field expeditions under the direction of Mr. Walter Granger. Precise study of these collections in the Museum by Professor Osborn, Doctor Matthew, and Mr. Granger has yielded the entire life history of Eocene time, showing especially the connections with western Europe and with Mongolia. The next period, the Oligocene, is now being studied with great precision by Professor Sinclair of Princeton. The Miocene east of the Rocky Mountains is being especially surveyed by Curator Matthew, with the coöperation of Mr. Harold Cook. West of the Rocky Mountains, the Miocene is now being examined, likewise with great thoroughness, by expeditions under the direction of Dr. John C. Merriam, president of the Carnegie Institution, who has also conducted epoch-making explorations of the Pliocene in the Great Desert of the Pacific Slope, that have resulted in the discovery especially of unsuspected migrations of Asiatic antelopes into North America. The Pleistocene, or Ice Age, has been studied in detail during the past twenty years by Dr. O. P. Hay of the Carnegie Foundation.

There remains the problem of the Pliocene east of the Rocky Mountains, from the Mexican border northward into Nebraska; also the Pliocene of Florida. This is the least-known and the least-understood part of the Age of Mammals in this great region, because the fossil deposits are so sparse and so scattered. Yet we feel confident that it contains a fossil store of surpassing interest, because of great migrations both from Asia and from South America.

For the purpose of making possible research in this period of the Age of Mammals, one of the Trustees of the American Museum, Mr. Childs Frick, has contributed the Pliocene Fund, in addition to conducting field work of the utmost importance and interest, especially in southern California. Mr. Frick has been working for several years, with the assistance of the staff of preparators and artists, upon certain papers that will be published in *Bulletin* and *Memoir* form. These include: (1) "Description of New Material from the Pliocene of Eden, California, and the Pleistocene of El Casco, California," (2) "Description of New Material from the Barstow Region of California," (3) "Bears and Aberrant Dogs of the late Tertiary and Quaternary," (4) "Horses of the North American Pleistocene."

The plan of the present year includes the survey of the Pliocene of Florida by Curator Matthew, whose recent visit to Florida is the subject of the following note, and the exploration of the Pliocene of northern Arizona and central Texas by Dr. James W. Gidley and Curator Matthew.

Fossil Localities in Florida.—Dr. W. D. Matthew spent the month of March in Florida, examining various localities for fossil vertebrates and studying specimens in museum and private collections. Many fossil mammals have been found in different parts of the state, but most of them in a fragmentary condition and scattered, and their exact geologic age has often been doubtful. Most of the fossils come from the phosphate workings in the central part of the state. Florida, as many readers of Natural History know, is the great phosphate state of the Union. It supplies about nine-tenths of the phosphates mined and used in the United States, and a great part of the European supply. The later Tertiary formations that cover a great part of the state contain almost everywhere a considerable percentage of phosphate of lime, but not enough to be profitably extracted. The workable phosphate deposits are concretionary layers and masses in which the phosphate of lime is sufficiently concentrated to make its removal profitable. In the "hard rock phosphate" district these deposits are in pockets and lenses upon the very irregular surface of marine limestone, and covered by a layer a few feet or yards deep of surface soils. Farther south in the "land pebble phosphate" district these phosphatic beds have been overrun by the sea. the phosphates broken up into pebbles and redeposited as conglomerate lenses and layers over a limestone floor planed down by the waves to a more uniform surface. As in the district farther north, a surface covering or overburden, ten, twenty, or sometimes fifty feet in thickness, overlies the phosphate bed. The river pebble phosphates, dredged from the channels of various streams, are due to a similar concentration of the phosphate concretions—pebbles, fossil teeth, and bones—through the action of rivers and streams.

The mining is done on a huge scale, with sand pump, dredges, hydraulic jets, elaborate machinery for crushing, washing, sorting, and concentrating the phosphate, which is then shipped off to be treated with sulphuric acid or otherwise made available for fertilizer. Fossil teeth or bones show up every now and then, occasionally a lower jaw, and even fairly good skulls have been found, but probably far more has been destroyed in the course of operations than has been preserved. There is no practical safeguard against such loss except to maintain and increase the interest that is quite generally shown by the managing staff of the principal mining companies, and by the more intelligent workmen, in any fossils that are seen, especially the unusual ones. The American Museum and other institutions are under obligations to these gentlemen for various important or interesting fossils saved and presented to them. The American Museum in particular is indebted to Mr. Anton Schneider and Mr. H. L. Mead, present manager of the pits of the American Cyanamid Company at Brewster, Florida, and to Prof. C. R. Halter of Southern College, Lakeland, for a number of very interesting fossil mammal specimens from the pebble phosphate district.

The concretionary phosphates probably have been forming wherever the conditions were favorable ever since the land emerged above sea level, and the bones and teeth of the animals associated with them have been buried, preserved, and petrified at various times from the middle part of the Tertiary period down to the present. Under such circumstances, there is sometimes an admixture of species of very different age, especially in beds that have been reworked by marine or river action. As a general rule, however, most or all of the fossils found in one pocket or excavation are of the same age; or, if not, the earlier remains and the later intrusions can usually be distinguished by differences in their preservation. With exact records of the finds and a practical knowledge of the faunas found associated in the Western Tertiary formations, it is possible to distinguish several different faunas among the fossil mammals of Florida. Doctor E. H. Sellards, the former state geologist, has done a great deal of very excellent work along this line, and it is to be hoped that the present staff of the Geologic Survey will be enabled to continue the work in coöperation with various institutions and individuals interested in learning more of the geological history of the state. To the three faunas distinguished by Doctor Sellards—Miocene, Pliocene, and Pleistocene—Doctor Matthew was able to add a fourth and older one, at the base of the Miocene, and to add various items to the later faunas. Nevertheless, our acquaintance with the extinct Floridian mammals is still extremely scanty and fragmentary, and a great deal will probably be added to it in the near future.

In a later number some account will be given of the interesting fossil finds recently made in Florida by one of our life members, Mr. Walter W. Holmes.

The Excavation of the Peale Mastodon.—Readers of Prof. Henry Fairfield Osborn's article on "Mastodons of the Hudson Highlands," contributed to the issue of Natural History for January-February, 1923, will recall the historic painting by Charles Willson Peale that appeared in connection with that article. The picture has recently been lent to the American Museum by Mrs. Harry White and has been placed in the hall of horses on the fourth floor. In addition to its artistic value—the work of a painter to whom Washington gave fourteen sittings—this picture has documentary significance, for it records an event of interest in the history of palæontology and among those represented in the group of individuals witnessing the exca-

The excavation of the Peale Mastodon.—This historic painting has been lent to the American Museum by Mrs. Harry White vation are the artist himself and members of his family. Charles Willson Peale is the conspicuous figure with the right hand extended and the left holding the diagram of the leg bones. The other figures immediately on the right of him are Mrs. Peale, Mrs. Rembrandt Peale, Titian Ramsay Peale, who was the naturalist of Long's Expedition and later of Wilkes's Expedition to the Antarctic and Pacific, the daughters of Rembrandt Peale, and Rembrandt Peale himself, who wrote a memoir on the mastodon.

FISHES

EDWARD PHELPS ALLIS, JR.—Thirty years ago Edward Phelps Allis, Jr., began his career as the leading student of the head structure of fishes—skull, bones, muscles, nerves, blood vessels, sensory organs, foramina, cavities, mouth parts; practically all the organs of the head except the brain and the eyes. He founded the Lake Laboratory in the early nineties of the last century and was one of the founders of the *Journal of Morphology*. About twenty-five years ago, however, Doctor Allis moved his laboratory to Mentone, France, in the Riviera region, and from it has poured forth an unceasing stream of articles of the highest class along the various lines noted above.

Two papers are of particular interest. In 1922 there appeared his great memoir on the cranial anatomy of *Polypterus*, published in the *Journal of Anatomy*, Cambridge, England. Of so great value was this paper, that the Journal Club of the American Museum sent a letter of congratulation and good wishes to Doctor Allis on the completion of this important piece of research.

However, the particular paper calling forth this note is his "Cranial Anatomy of *Chlamydoselachus anguineus*, published in *Acta Zoologica*, Stockholm, 1923. In this contribution, 99 pages in length and illustrated by 23 magnificent plates (19 of them colored), Doctor Allis deals in a masterly fashion with the skull, visceral arches, muscles, laterosensory organs, circulatory organs, and nerves. The Japanese frilled shark—the subject of the paper—is designated by Samuel Garman, its original describer and first student, as a "living fossil." It is an archaic shark, not greatly changed in its general form and structure from its Devonian ancestors. Hence such a work as that of Doctor Allis is necessarily of a fundamental character, both by reason of its accuracy and because of the primitive form on which the researches are based.

In both these papers Doctor Allis pays high tribute to Mr. Jugiro Nomura, his Japanese assistant, who made the dissections and drawings, and who has since died.

These papers are of great interest to the scientific staff of the American Museum, particularly to those connected with the departments of ichthyology and comparative anatomy, not only on account of their morphological bearings, but also because the material on which Doctor Allis worked was supplied to him in large part by Dr. Bashford Dean, honorary curator of ichthyology, from specimens in the American Museum or secured by that institution.

FISHES TAKEN BY THE CONGO EXPEDITION.—Some years ago there appeared several reports dealing with the fishes brought back by the Congo Expedition of the American Museum (1909–15). The first,[1] by Messrs. John T. Nichols and Ludlow Griscom, was based on the collection of about 6000 freshwater fishes. Among the 234 forms represented, 4 genera and 29 species proved to be new to science. The second,[2] by the late Dr. Charles R. Eastman, noted many interesting and peculiar structures in the skull of *Hydrocyon*, generally called the "water leopard," the whole mouth of which is edged with an armature of long, dagger-like teeth. Comparison was made with the Cretaceous genus *Onchosaurus* and the recent South American *Hoplias*. The third,[3] by Dr. L. Hussakof, referred to the discovery of a new fossil fish. *Lepidotus congolensis*, from the Lualaba beds of the Upper Triassic near Stanleyville. This report also recorded from the Paleocene strata of Landana the first indication of teleosts in that formation.

In the large collection of fish were included about 250 salt-water specimens, collected near the mouth of the Congo River by Mr. Herbert Lang while he was waiting there for a ship to take to New York the rest of the material gathered during more than six years of field work. Recently the study of this part of the fish collection was undertaken by Mr. Henry W. Fowler, the well-known ichthyolo-

[1]*Bulletin*, Amer. Mus. Nat. Hist., XXXVII, Art. 25, 1917, pp. 653–756, 31 figs., 3 maps, Pls. LXIV–LXXXIII.

[2]*Bulletin*, Amer. Mus. Nat. Hist., XXXVII, Art. 26, 1917, pp. 757–60, 3 figs., Pls. LXXXIV–LXXXVII.

[3]*Bulletin*, Amer. Mus. Nat. Hist., XXXVII, Art 27, 1917, pp. 761–67, 7 figs., Pl. LXXXVIII.

gist of the Academy of Natural Sciences of Philadelphia.

In his preliminary report just issued,[1] Mr. Fowler describes one genus and four species as new to science. Especially noteworthy among these discoveries is a shark *Mustelus osborni*, named in honor of President Henry Fairfield Osborn, who encouraged the publication of the series of reports on the scientific results of the Congo Expedition. This series has now reached the seventh volume and reports for the next three volumes are practically ready for the press. Later, when the full series of volumes as originally planned by the president is published, the work will appear under the title *The Zoology of the Belgian Congo*.

Centrarchops, a new genus, belongs to the family Serranidæ, carnivorous fishes of warm seas. Its description is based upon *Centrarchops chapini*, so called after Mr. James P. Chapin, the second member of the expedition. Paradoxically enough, this, although new, is one of the common fishes of the Congo estuary and like its near relative *Lates nilotica* of the Upper Congo, one of the large and most highly prized food fishes. In addition to these there are two new forms belonging to families represented by a multitude of small species in the shore waters of the tropics: *Gobius bequærti*—named in honor of Dr. Joseph Bequært, an enthusiastic collaborator in this extensive series of reports—and *Blennius langi*, named after the leader of the Congo Expedition.

MARINE LIFE

Bahaman Coral-Reef Group Expedition.—An expedition under the leadership of Dr. Roy W. Miner, curator of lower invertebrates, sailed for the Bahamas on June 6 to prosecute work on the coral reefs at Andros as a preliminary step in the work of constructing a large coral reef group to be placed in the splendid new hall of ocean life, now nearing completion. In order to collect trustworthy data for this group, Doctor Miner is undertaking a six or eight weeks' trip, accompanied by Messrs. Chris. E. Olsen, Herman Mueller, and George H. Childs, modeler, glass blower, and artist respectively on Doctor Miner's staff. The expedition will be financed by the Angelo Heilprin Fund, the Morris K. Jesup Fund, and the Trustees' Emergency Preparation and Exhibition Fund.

[1] *Novitates*, Amer. Mus. Nat. Hist., No. 103, 1923, pp. 1–6.

An important feature of the expedition is the undersea tube which has been made available for the work at Andros through the courteous coöperation of the Submarine Film Company, whose general manager, Mr. J. E. Williamson, will sail with Doctor Miner's party on June 6. Mr. Williamson is the pioneer in undersea photography and will operate the tube, which was invented by his father. His coöperation will add greatly to the success of the undertaking.

Valuable assistance has also been rendered, through Mrs. William Belknap, by the firm of A. Schrader's Son, which has donated a complete diving outfit with pump. This will greatly facilitate the problem of securing undersea specimens.

A week will be spent in outfitting at Nassau, after which boats will be hired for the passage across "The Tongue of the Ocean" to Andros, where a coral reef sixty miles in length follows the coast of the archipelago at a distance of about a mile. Here is an unlimited source of supply of the living material needed for the photographs, sketches, and other data to be collected. And here Mr. Williamson will bring his marvelous undersea tube, which forms an open-air passage through which one may descend to the observation chamber attached to its base, and sit comfortably with two or three companions gazing out over the ocean floor fathoms below the surface. Here one may study, sketch, and photograph the tropical marine life in its natural environment and direct the work of divers in collecting corals under such favorable circumstances as scientist never enjoyed before.

The group to be constructed as a result of this trip will be a replica of a West Indian coral reef, planned on a huge scale that will embrace both the floor and gallery of the hall of ocean life, rising to a height of thirty-five feet and extending to a width of thirty feet. On the gallery level will appear the coral island as it might look to an incoming boat, with its palm trees, expanse of beach and lagoon, waves breaking over the outer reef, and in the distance trade-wind clouds blowing over a tropical sky. Then, in descending to the lower floor, one puts on, as it were, a diver's suit and descends to the submerged part of the reef, where countless plants and animals of varied colors crowd over the ocean bottom and gay-hued fishes dart in and out among the rocks.

INTERMUSEUM PROMENADE

A BROAD AND SAFE PATHWAY FROM THE METROPOLITAN MUSEUM AT 80TH STREET EAST TO THE AMERICAN MUSEUM AT 79TH STREET WEST

PRESIDENT OSBORN'S APPEAL.—On Monday, March 31, a public hearing was held by the Board of Estimate and Apportionment on the matter of the proposed War Memorial, the reclamation of the lower reservoir, and the construction of the Intermuseum Promenade. President Osborn appeared on behalf of the Museum, in connection with the Intermuseum Promenade and the development of the lower reservoir space into a children's playground. An excerpt from his address is appended:

Since 1911 I have been promoting by every means in my power the present movement to turn the southern reservoir back into Central Park space, to create a new and large playground for the children of the city, and to design an Intermuseum Promenade between East 80 and West 79 Streets to enable the great population of the east and west sides of the city, respectively, to visit our two great museums. I have closely observed this great area of the park for thirty-two years. It separates two of the finest museums of the world by a barrier dangerous by day and impassable by night. School parties now pass through the park subway to attend the morning and afternoon lectures of the American Museum. Within the last two years parties of schoolboys have been attacked and robbed in passing through this area. When the State Roosevelt Memorial Commission met two years ago, I told them that this part of the park was very dangerous; two nights later a man was robbed and murdered within a stone's throw of the American Museum. With all these facts in mind, the mayor, the comptroller, the president of the Borough of Manhattan, and the Board of Estimate and Apportionment have had before them since 1911 the question of the redemption of this space. The plan now presented by Commissioner Whalen and Commissioner Gallatin represents ten years of continuous and conscientious study for the welfare of the people of New York.

One of the leading newspapers of the city has been opposing the promenade plan since February 9, 1916. Since then the colonnade known as the War Memorial has been substituted for the Mitchell fountain originally planned by Mr. Hastings. If you look at the site, you will see at once that the use of the open colonnade and lagoon is the only possible landscape-architectural solution of this problem. Between the upper reservoir and the lagoon there must be some dominant feature. It cannot be a forest, because a forest will not grow there; it can only be some form of building, and of all forms of building none solves the problem as does the colonnade. No other solution has been or can be suggested. To my eye the colonnade should be on a larger scale than Mr. Hastings has planned it. He intends to develop his plan with the aid of our Fine Arts Commission. In this matter of the War Memorial I speak from my own individual experience and judgment and represent no one but myself.

In the matter of the Intermuseum Promenade and the redemption of the southern reservoir and its conversion into thirty-two acres of new playground, however, I speak officially. This matter has been repeatedly before the Trustees of the American Museum and I have had their authority in strongly recommending it to the city. In fact, the American Museum has spent years of time and effort and a large amount of money to develop this plan. On May 10, 1916, the Museum first secured from the Department of Water Supply, Gas, and Electricity a promise to release the southern reservoir and return it to the park. The Museum is now taking the best professional advice obtainable. It is considered by the Museum an essential feature of the great Roosevelt Memorial plan that the Roosevelt Memorial should have a safe, adequate, and beautiful approach from the east side of the City. In its promise to the state the city is pledged to the Intermuseum Promenade plan, which will, I am confident, have the unanimous support of all our citizens.

President Osborn brings to the consideration of this subject an experience gained through association with many park projects. Since 1898 he has been an honorary member of the Boone and Crockett Club, founded by Theodore Roosevelt,—a club that played its part in furthering the great national park system in the United States. Since 1896, as chairman and president of the Zoological Society of New York, he has supervised the planning for the city of New York of an incomparable park and aquarium with an annual attendance of 5,000,000 people. Since 1869 he has been visiting and studying the park systems of the great cities of Europe and America. In laying out the Zoological Park he had twenty years of experience with many landscape architects of America, including the landscape architects of the park, Heins and Lafarge, the endeavor being to create a park at once beautiful, inspiring, educational, and practical. Since 1907 he has been a warm supporter of the Bronx Parkway movement under Madison Grant, which has given to New York the most beautiful exit parkway in the world, fifteen miles in length, and has solved a most difficult engineering problem. In 1915 he was chairman of the national movement to save the Hetch Hetchy Valley of California, adjoining Yosemite Park, from invasion by a municipal water plant. In 1917 he started, with Madison Grant and John C. Merriam, the national movement known as "Save the Redwoods," which at present under California leadership is redeeming the glorious redwood forests along the Pacific Coast.

MAMMALS

The American Society of Mammalogists held its sixth annual stated meeting in Boston and Cambridge from April 15 to 17. The sessions of April 15 were devoted to a symposium on the scientific and economic importance of predatory mammals. The subject was opened by Mr. H. E. Anthony of the American Museum and among the speakers that followed him was Mr. Herbert Lang of the same institution. Attention was called to the energetic measures which the Bureau of the Biological Survey is taking, over a large part of the United States, to exterminate the predatory animals as well as to complete the destruction of certain so-called mammal pests. The majority of the speakers deplored the far-reaching character of the measures taken and rather questioned their necessity, expressing the belief that the situation called for judicious control rather than complete extermination. So strong was the sentiment in favor of a less drastic mode of procedure that a committee was appointed, with Dr. Charles C. Adams as chairman, for the purpose of drawing up suitable resolutions.

The resolutions as drafted called attention to the fact that there is a dangerous propaganda abroad in the land because of this federal activity and that private interests are seizing the occasion to exploit the destruction of mammals, being actuated by hopes of financial gain. In view of these circumstances the president of the society was authorized to appoint a committee to go into the question and ascertain whether there are not some areas in which predatory animals might be spared from measures of extermination.

The symposium was attended by reporters from the Boston papers, who gave wide publicity to the views presented.

April 16 and 17 were devoted to subjects of a more miscellaneous character, including an account of "Small Mammals from the Asiatic Expeditions of the American Museum," presented by Dr. Glover M. Allen; a résumé of the work now being carried on by the Museum in Ecuador, given by Mr. Anthony; and two papers, one entitled "Variation in the Cranial Characters Due to Age in the African Viverrine Genus *Civettictis*," and the other "Comparison of Ecological Conditions in the West African Rain Forest with those of the British Guiana Forest, with Remarks on the Mammal Life," presented by Mr. Lang.

Mr. H. E. Anthony, associate curator in charge of the department of mammals, has been unanimously elected an honorary life member of the Sociedad Colombiana de Ciencias Naturales of Bogotá, Colombia. This honor has been voted Mr. Anthony in recognition of his researches in South America.

The Colombian Society of Natural Sciences was founded some years ago largely through the efforts of Brother Apolinar Maria, who was recently made a corresponding member of the American Museum because of his active interest in South American zoölogy. The society is made up of a group of earnest and enthusiastic students of natural history who have done much to bring to the attention of the world the interesting character of their native fauna.

THE INTERNATIONAL COMMISSION OF EUGENICS

The International Commission of Eugenics is composed of four officers—Major Leonard Darwin (president), Prof. Henry Fairfield Osborn (vice president), Dr. Albert Govaerts (secretary-treasurer), and Mrs. C. B. S. Hodson (assistant secretary)—and twenty-three other members, representing fifteen countries. The function of this commission is to determine the place and time of the next ensuing congress and to function as an interim committee, authorized to act on other international eugenical matters that require action in the interval between congresses. The first International Congress of Eugenics was held in London twelve years ago. The Second International Congress, which took place in the American Museum in September, 1921, is still fresh in the minds of those who attended it and who listened to addresses of distinguished scientists from all parts of the world.

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Since the last issue of Natural History the following persons have been elected members of the American Museum, making the total membership 7610:

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The EXPEDITIONS of the American Museum have yielded during the past year results of far-reaching importance. The fossil discoveries in Mongolia made by the Third Asiatic Expedition, the representative big-game animals of India obtained by the Faunthorpe-Vernay Expedition, the collections of fossil vertebrates made in the Siwalik Hills by Mr. Barnum Brown, the achievements of the Whitney South Sea Expedition, and of other expeditions working in selected areas of South America, in the United States, in the West Indies, and in Panama, are representative of the field activities of the Museum during 1923. Many habitat groups, exhibiting specimens secured by these expeditions, are planned for the new buildings of the Museum.

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NEW YORK CITY

Vol. XXIV JULY-AUGUST, 1924 No. 4

NATURAL HISTORY

SOUTH AMERICA

THE ANDES: A NEW WORLD BY FRANK M. CHAPMAN—COLLECTING MAMMALS IN THE HIGH ANDES OF ECUADOR BY H. E. ANTHONY—FREDERIC E. CHURCH, PAINTER OF THE ANDES BY H. F. SCHWARZ—ALEXANDER VON HUMBOLDT, SOUTH AMERICAN EXPLORER—HUNTING NEW FRUITS IN ECUADOR BY WILSON POPENOE—INTO THE INTERIOR OF BRITISH GUIANA BY HERBERT LANG—PERUVIAN PETS BY HILDA H. HELLER

PANAMA

HUNTING STINGLESS BEES WHERE EAST IS WEST BY FRANK E. LUTZ—BIRD-HUNTING AMONG THE WILD INDIANS OF WESTERN PANAMA BY LUDLOW GRISCOM

A HUNTRESS OF SPIDERS BY WILLIAM SAVIN

The American Museum is under especial obligations for the generous aid accorded its expeditions by representatives of the South American governments and of Panama and for the hospitality and friendly spirit manifested by individuals in the regions where the explorations were conducted.

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

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The Oceanic Issue

In the previous numbers of Natural History published this year great continental areas—Australia, Asia, Africa, South America—have successively received emphasis. In the September-October issue the reader will be invited to step off *terra firma* and to cruise with the Whitney South Sea Expedition in the island-dotted Pacific. Dr. Robert Cushman Murphy, associate curator of marine birds in the American Museum, will tell of the significance of the work of this expedition, which has been engaged for four years in studying the bird life of Polynesia.

Marine mammals like the whales and seals that, departing from the ways of their landlubber relatives, have made the ocean and its shores their home, find a proper place in an **Oceanic Issue,** and special articles will be devoted to them, while it is hoped that some attention can be given also to those empire builders of the sea—the corals—which Dr. Roy W. Miner has recently been collecting at Andros Island in the Bahamas for the projected hall of ocean life in the American Museum. Features of this hall will be features also of this issue.

Finally, the great oceans themselves, occupying as they do more of the earth's surface than the combined land masses, will be treated from certain novel standpoints by Prof. W. M. Davis, the eminent geographer.

Photograph by F. M. Chapman

NORTHWEST SLOPE OF PICHINCHA, ECUADOR

The photograph, taken from an altitude of 11,000 feet, shows in the foreground a forest of the Humid Temperate Zone, the bird life of which is of tropical origin. The treeless slopes immediately above timber line are in the Páramo Zone, and their bird life is chiefly of Patagonian origin

NATURAL HISTORY

VOLUME XXIV JULY–AUGUST NUMBER 4

The Andes: A New World

BY FRANK M. CHAPMAN

Curator-in-Chief, Division of Zoölogy and Zoögeography, American Museum

IF the press despatches should report a heavy snowfall on the Amazon, we should question their accuracy. Nevertheless, snow does fall so frequently in Amazonian latitudes that great areas there are covered with it throughout the year. This apparent anomaly is to be explained, however, not in degrees of latitude but in feet of altitude. The whole problem can be encompassed in a glance when from the sweltering heat of Guayaquil we look upward to the eternal snows of Chimborazo; or, to take another example, when from the tropical coastal forests of Vera Cruz we see the white crown of Citlaltepetl, the "star mountain" of the Aztecs. These, indeed, are notable views. In both instances, faunally and climatically we are, as it were, standing on the equator and gazing at the poles!

Let us make this journey from endless summer to perpetual winter. If we measure our progress by the changes in climate which we shall encounter, we shall be traveling at a space-defying speed. It was von Humboldt who first determined the relations between latitudinal and altitudinal climates and, in his *De Distributione Geographica Plantarum* (Paris, 1817), he gives a diagrammatic representation of the plant zones on Chimborazo which might have been made by an ornithologist, so closely does the distribution of birds conform to that of plants,—evidence that both are subject to and obey the same laws.

In a general way it may be said that, as we proceed from the equator toward the poles, the mean temperature decreases one degree Fahrenheit with each degree of latitude. But as we ascend a mountain, the mean temperature decreases one degree with each three hundred feet of altitude. That is, approximately 300,000 feet of latitude equal 300 feet of altitude. If, therefore, our trip from Guayaquil is made up Chimborazo, we shall be traveling, climatically, somewhat more than one thousand times faster than we should have journeyed had we started for Panama!

Now, if we bear in mind the fact that the flora and fauna of a region are to a large extent an expression of its temperature, we shall have some conception of the rapidity with which the nature of the plant and animal life changes as we proceed from sea level to snow line.

It is not my present purpose to discuss here the factors which determine the limits of the faunal zones, or bands, which we shall find in ascending a snow-capped, equatorial mountain. The very fact that the mountain *is* snow-capped is graphic, convincing evidence of the relation between altitude and temperature. But just as rainfall, slope-exposure, topography, proximity to and temperature of the sea will determine the amount of snow, and the distances to which it descends on different sides of a mountain, so these and

A panoramic view of the Inca Mine at Santo Domingo in southeastern Peru

other factors govern the altitudes which mark the boundaries between faunal zones. The point I wish to make here is that these zones exist as well-defined bands of life the limits of which are subject to the control of natural laws. To discover those laws is the aim of the faunal naturalist or zoögeographer. In no other place will he find them more vividly expressed than on mountain slopes, where, as we have seen, the phenomena ordinarily spread over many miles of latitude are compressed within a few thousand feet of altitude.

My own investigations in this field have been made almost exclusively with reference to the distribution of birds; and it is a tribute to the potency of the governing influences that they evidently control the distribution of these active creatures just as rigidly as they do that of quadrupeds or even plants and trees. Indeed, the potential mobility of birds combined with their unusually sensitive, responsive natures makes these animals particularly valuable indices of the effects of those forces and circumstances which are or have been active in producing faunal areas.

With this preamble, and avoiding details not essential to a general understanding of the more important facts concerning mountain life zones, let us as ornithologists make the proposed ascent of an equatorial mountain. We shall first pass through the Tropical Zone. The lowlands at the base of our

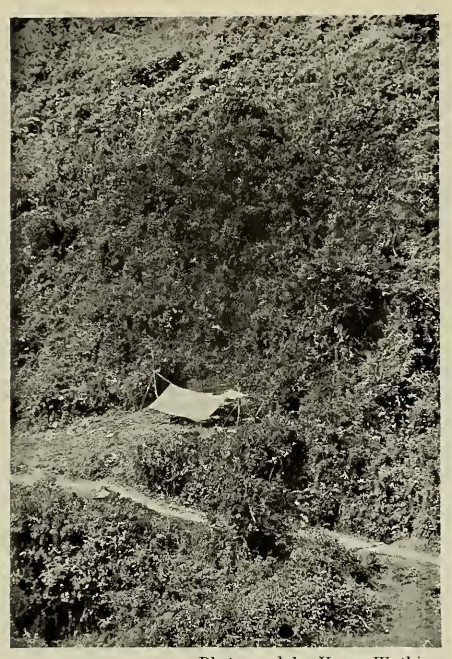
Photograph by Harry Watkins

This is a famous collecting locality in the Subtropical Zone

mountain may vary greatly in character. There may be arid plains, marshes, and luxuriant forests, all at the same level and within a short distance of one another. These, however, mark different types of habitats in the same life zone and we are not here concerned with the causes responsible for them. As we reach the foothills, we shall find further variations in habitat, which we may also disregard, other than to observe that due consideration must be given to habitat requirements in our broader study of distribution. Birds that are associated with sandy plains are not to be sought in marshes; nor shall we come upon forest-haunting species where there are no trees. The significant fact to remember is that when the habitat is favorable, we shall find that most of the birds of this Tropical Zone have so wide a latitudinal range that we might travel for weeks and still see them daily, whereas their altitudinal range is so limited that within a few hours we may leave them wholly behind, that is, below us.

When we have reached an altitude, usually of 4000 or 5000 feet (though under exceptional conditions it may be much less), we shall begin to observe birds we have not seen before and at the same time note the absence of others which were previously abundant.

We shall miss, for example, the great macaws, the harsh voices of which resounded through the forests lower



Photograph by Harry Watkins

Camp of the American Museum Expedition at Maraynioc, in the Humid Temperate Zone forests of eastern Peru.—More than a score of new species of birds have been discovered at this locality, and of these a number have not as yet been found elsewhere

down. Some of these birds are found in wooded regions from Bolivia to Mexico: that is, they have what may be termed a horizontal range of nearly 2500 miles. But their vertical range, as we have just discovered, is less than a mile.

We are now reaching an altitude where decrease in temperature produces condensation with resultant rainfall and an incredibly luxuriant vegetation. Every available foot of ground is claimed by trees and undergrowth, and every available inch of the trees is claimed by parasitic or epiphytic vegetation. This is the Subtropical Zone. It is a marvelous stratum of life occupying the mountain slopes, usually between the altitudes of 4000–5000 to 8000–9000 feet, and extending from Bolivia to Mexico.

The Subtropical Zone is remarkable not only for the richness of its life, but also for the high percentage of species found only within its boundaries. Thus, the American Museum's expeditions collected about 360 species of birds in the Subtropical Zone of the Colombian Andes, of which approximately three-fifths are practically confined to this narrow stratum of mountain life. This is about one-third as many as were encountered in the forests of the Tropical Zone. Comparison of the areas occupied respectively by the far-reaching tropical lowlands and the narrow subtropical belt further emphasizes the wealth and distinctness of the bird life of the Subtropical Zone.

At an elevation of from 8000 to 9000 feet we shall pass from the Subtropical into the Temperate Zone. The former is uniformly humid and forested; the latter has humid and arid divisions, the first of which is

Photograph by F. M. Chapman

Scene in the Subtropical forest on the summit of the western range of the Andes of Colombia.—Note the moss-covered tree trunks indicating the extreme humidity of the locality

Photograph by F. M. Chapman

Guaillamba Cañon is a few miles north of the equator. This picture was taken from the Arid Temperate Zone looking down into the Subtropical Zone, where sugar cane is growing

wooded, the second treeless. Both divisions may occur at the same altitude, the difference between them being chiefly due to rainfall. Some of the most distinct species of Andean birds are found in the dense, scrubby forests of the Humid Temperate Zone. On the other hand, the species inhabiting the plains of the Arid Temperate Zone have changed but little from the types represented by their ancestors,—a phenomenon which forms an illuminating contribution to the study of evolution by environment. The upper limit of the Temperate Zone corresponds closely to the elevation at which agriculture ceases, that is, about 12,000 feet. Between this altitude and the lower level of permanent snow, which averages about 15,000 feet, lies the Páramo, or Puna Zone. In a measure it is the equivalent of the tundra, that vast area which extends from the northern limit of forests to the shores of the Arctic Ocean. While few in numbers, nearly every bird of the Páramo is confined to this zone.

Without going further it is clear that in our vertical journey of less than three miles we have run the gamut of climatic and faunal zones: Tropical, Subtropical, Temperate, and Arctic or Antarctic—for the Páramo contains both boreal as well as austral elements.

The first and most significant fact for us to consider in connection with Andean life, and the one which makes its study of such surprising interest, is the comparatively recent origin of that life. It cannot, of course, be older than the region it occupies, and geologists tell us that the Andes did not

Photograph by F. M. Chapman

Mt. Aconcagua, Argentina, with an altitude of 23,000 feet, is the highest peak in the Western Hemisphere. The photograph was taken from an elevation of 11,000 feet in the Páramo Zone, at its base

Photograph by F. M. Chapman

This locality in the Páramo Zone at an altitude of 14,000 feet is immediately north of La Raya Pass, which separates Titicacan and Amazonian drainage in southern Peru. The Urubamba River, second longest tributary of the Amazon, rises in the small openings shown in the middle distance.

Photographed from the platform of a car on the railroad to Cuzco attain their full elevation until the latter part of the Tertiary, at which time the continent of South America had essentially its present outline.

There is, consequently, good reason for calling the Andes a New World, or possibly we might better term them a recent annex to the world. Not only have we comparatively definite knowledge of the age of the Andes and of the character of the area from which they arose, but it is probable that at the time they had attained a sufficient elevation to support zonal life, the bird life of South America, in its major aspects at least, did not differ materially from that which exists there today. Hence it follows that not only can we give the Andes a geological birthday but we can form a fairly exact conception of the character of the avifauna from which the hundreds of species of birds that have evolved in them were derived.

Furthermore, we must remember that the value of the Andes to the biologist is increased by the regional compression or concentration of the forces which control distribution and promote evolution, and by the consequent definiteness with which these forces manifest themselves.

We must also take into consideration the topography of mountains as, through altitude, enclosed valleys, or disconnected summits, they supply the isolation which permits environmental or mutational factors, acting continuously on a comparatively limited number of individuals, to produce new forms. For instance, a distinct mutational form of tanager-finch (*Buarremon inornatus*), confined to the Chimbo Valley of Ecuador, and a humming bird (*Oreotrochilus*) on Mt. Chimborazo are cases in point. Many others might be cited.

It is obvious, then, that in a study of the origin and distribution of life we can associate cause and effect far more often in the Andes than in those great continental areas, the early pages of the geological and zoölogical history of which are lost in an incalculably remote past. We ask, therefore, what are the factors which determine with such surprising definiteness the boundaries of these Andean life zones? Whence came the hundreds of species which are confined to them?

For some years the American Museum has been conducting explorations in the field and researches in the study designed to answer these questions. It was found that previously existing data were too inaccurate to be of value in determining exactly the ranges of the species to which they referred. It was necessary, therefore, to begin nearly at the beginning and work intensively at station after station from base to summit of the three ranges of the Andes in Colombia, where our survey was inaugurated. The outline of the life zones presented above is based chiefly upon our labors in that country. I shall not here go further into this phase of the subject but refer the interested reader to Volume XXXVI of the Museum *Bulletin*, where the results of the work in Colombia are presented in detail.

Satisfactory treatment of the origin of the birds of the Andes is too wide a problem to be handled locally. We have discovered, for example, the apparent ancestor of a subtropical Colombian motmot in the Tropical Zone of eastern Mexico. Again, a finch of the Páramo Zone has evidently come from Patagonia. It is obvious, therefore, that we have to deal not only with the *height* of the Andes but with their *length*. While at present this is coextensive with that of South America itself, our researches indicate the former existence of a range connecting the Andes of Colombia with the mountains of western Panama and Costa Rica, and these in turn seem to have had a faunal relation with those of Mexico. Our field, therefore, reaches from one extremity of the Western Hemisphere to the other.

Since birds could not develop in space, it follows that the Andes have been populated from below upward. But in hunting for ancestral types we must consider not only place of origin but also the matter of habitat requirements mentioned in the earlier part of this article. That is, the ancestors of forest-frequenting birds must be looked for in other forests; those of the plains, in other plains. To illustrate: the tanagers, flycatchers, parrots, trogons, toucans, and other forest dwellers of the Temperate Zone, while very distinct, are all obviously descendants of forest-inhabiting ancestors. Similarly the ancestors of the finches and ovenbirds of Temperate Zone plains we should expect to find in other plains. The only available forests are those of the Subtropical and Tropical zones and the only available plains are those of the South Temperate Zone. As a matter of fact it appears that the Temperate Zone forest birds did originate in tropical forests while the Temperate Zone plains birds came from Argentina and Patagonia.

Here, then, we have a clue to the widely varying degree of distinctness shown by the birds of the forested and treeless divisions of the Temperate Zone to which I have previously called attention. Obviously in extending their range from the Tropical to the Temperate Zone the tanagers, trogons, flycatchers, and other birds making this journey have experienced as pronounced a change in environment as though, let us say, they had gone from Ecuador to Ontario, and their differentiation from the ancestral type is correspondingly pronounced. But the birds that came from Patagonia, by increasing their altitude as they approached the equator have merely advanced from the South Temperate Zone to the Andean Temperate Zone, and thus, not having been subjected to marked environmental change, show comparatively slight differentiation from the ancestral type. It seems apparent, therefore, that the evolution of these forms is not a question of time or of distance from the point of origin, but of the extent of the change in surroundings to which they have been subjected.

This is the type of problem which we hope to solve by our explorations in the Andes. We are still on the threshold of our subject, but already we believe we have discovered in these mountains a biological laboratory where nature is conducting intensive experiments in distribution and evolution on a continental scale and producing results with such directness and rapidity that we may hope to gain an insight into the methods by which she operates.

The High Andes of Ecuador[1]

EPISODES IN THE TRAVELS OF A MAMMALOGIST

By H. E. ANTHONY

Associate Curator of Mammals of the Western Hemisphere

HOMER tells us that when the giant sons of Poseidon, Otus and Ephialtes, warred against heaven, they planned to pile Ossa on Olympus and Pelion upon Ossa, attempting in this way to reach the abode of the gods. These mountains massed upon one another would have attained a height of a little more than 21,000 feet above the sea. If Homer had known of Ecuador, he could have pointed to Chimborazo as the fulfillment of this aspiration, for the snowy summit of this Andean peak towers almost 21,000 feet above the Pacific, and in very truth seems to raise its head to heaven. Nor in Chimborazo alone does one find evidence of a vast exercise of energy, for there are in Ecuador many lofty-crested mountains and elevated regions where the rough, wild topography, characterized by gaping craters and abysmal gorges, looks like a scarred battle field over which the gods themselves have struggled. And in a sense this impression is justified, for here the forces of vulcanism, the fires of the inner earth, have cast off the restraining hand of gravity and raised mighty mountain masses, or blown away into ash the rock which once filled the now dead or dying craters.

One of the features that will appeal to a climber of Ecuadorean peaks is the ease with which one may arrive at the base of a high mountain. It is possible to ride in a railroad coach across the very flank of Chimborazo. It is no less true, however, that one would still find himself a long distance below the summit even then, for the elevation at Urbina, the highest point attained by the railroad, is 11,400 feet. Chimborazo has been scaled by but few persons,—a distinction it has maintained because of its great elevation rather than because of any prohibitive feature of topography.

The visitor to Ecuador takes the train at Guayaquil and in a comfortable coach soon finds himself leaving the tropical lowlands to enter the gorge of the Rio Chanchan. Higher and higher the engine toils, now in the heart of the western Andes, and for the greater part of the two days' ride to Quito, the end of the line, the traveler does not descend below 8000 feet. By marvelous feats of engineering the track climbs up over ridges and divides, follows up watercourses until the rivers dwindle to brooks and the brooks to mountain springs, and crosses elevated plateaus more than two miles above the sea. During most of this time, if the day be clear, one or more snow-clad peaks will dominate the horizon. In one ravine the engineers have been forced to ascend in a zigzag course, switching and running the train backward a short distance in order to reach the pass above.

During the field season of 1923 the American Museum Expedition to Ecuador visited several of the highest of these Andean monarchs and collected specimens right up to the line of perpetual snow. I was accompanied during this time by Mr. G. H. H. Tate,

Up the ravine of the Rio Chanchan the trains of the Guayaquil and Quito Railroad puff their way, the heavy exhaust from the laboring engine roaring and echoing in the rocky defiles. Looking backward from the last coach, one sees an ever-changing panorama reminiscent of our own Royal Gorge

the field assistant of the department of mammals, and we secured such native help as was needed to tend camp, care for the pack animals, and perform similar services. Our headquarters were at Quito, where we had as host Mr. Ludovic Söderström, who has studied the natural history of Ecuador for more than fifty years.

Quito lies upon the margin of a vast interandean basin, rimmed by rugged peaks thrust upward from 16,000 to 19,000 feet. Fairly overhanging Quito is Mt. Pichincha, 15,918 feet[1] above sea level, which is easily climbed from this city. It is said that some men go up and back the same day, but most climbers prefer to devote two days to the trip. Quito itself has an elevation of about 9400 feet and one can ride a good horse or mule most of the way from Quito to Pichincha.

The Museum party spent some days camped on Pichincha, the lower camp being at about 11,500 feet, the upper at 13,300 feet. The latter station was called Verdecocha, and here we were practically in the ancient crater of Rucu-Pichincha. The mountain has two peaks: one called Rucu-Pichincha, or the Old Pichincha; the other, Guagua-Pichincha, or Baby Pichincha —*guagua* being Quichua for baby. Strangely enough the Baby Pichincha is slightly the higher and takes its name from the fact that its crater still

[1]All of the important elevations mentioned in this article are taken from the volume *Travels Among the Great Andes of the Equator*, by Edward Whymper.

steams and consequently appears to be younger than the burnt-out crater of Old Pichincha.

At Verdecocha we seemed to be atop the world. Soon after sunrise and before the clouds had swirled up from the valleys far below, it was possible to obtain glorious views of distant peaks. To the southward we could just catch sight of Chimborazo's rounded summit, but the finest spectacle lay to the eastward. Looking out from the grassy hillsides of Verdecocha one saw the swelling flanks of Pichincha running down to meet the parti-colored fields below, where green pastures alternated with thickets of scrubby brush or met the rectangles of ripened stands of grain in patterns like to the quilts our grandmothers made. To the right a long ridge dropped away to swing up again to the sky line at the summit of Mt. Atacazo, while Mt. Corazon peeked at one over the truncate summit of Atacazo. Across the Quito plain and the Chillo valley the stark outlines of Rumiñahui rose above a basal blanket of fluffy cloud, the long-dead crater at the summit cold and forbidding in the early light. Lowell's line about "burnt-out craters healed with snow" came to mind and we could not help wishing that such a ghastly scar on the earth's surface were concealed under a soft white bandage. As a background to the torn and gashed ramparts of Rumiñahui, the symmetrical outline of lovely Cotopaxi reached up and towered against the sun-flecked eastern horizon, a superb elevation of 19,613 feet. Antisana, to the north of Cotopaxi, 19,335 feet of snow-draped grandeur, and Cayambe, north of Antisana, 19,186 feet, completed a triumvirate of mountain peaks of unsurpassed splendor. All over the lower slopes of the mountain ridges and billowing up out of hidden ravines and valleys the morning mists and white, night-heavy clouds stirred at the beckoning of the sun god and began the long upward struggle which brought them about our camp later in the day, when their clammy touch was poor fulfillment of the soft downy promise they gave in the far distance.

Our camp at Verdecocha was set on the grassy sod of a small valley which headed up against the high andesite cliffs of Rucu-Pichincha. Great condors wheeled majestically along these crags and sometimes perched on some out-jutting promontory to pass professional judgment on the two-legged creatures below. We were poor prospects, however, and the condors had little encouragement. Only by extreme good fortune, nevertheless, had the condors been robbed of a meal when some days previously we had moved camp up to Verdecocha.

With our camping equipment packed on four mules and ourselves riding two more, we had begun the climb from San Ignacio. We had completed about one-third of the distance when we had to swing north from the so-called trail—a mere bridle-path at best—and take to the crest of a steep narrow ridge, knifelike in its proportions. At the steepest point along this upthrust edge, one of the pack mules pulled back on the lead rope, jerked it from the hand of the *arriero* in a series of stiff-legged jumps, and disappeared over the edge of the ridge, amidst a wail of "Aye, Aye, Aye," from the Indians. We expected to see the animal rolling head over heels to certain death, for there was a continuous steep pitch for at least five hundred feet. Sounds of crashing impacts came to our ears but no mule appeared from behind the little shoulder immediately before us.

Then hundreds of feet below one of our pack containers flashed into sight. Whirling end for end, it touched the earth only to rebound in great leaps and I had a sickening vision of fractured cameras and ruined equipment. Even as we were looking, the pack caromed over a slight rise and vanished. Tate was certain that the pack had been completely destroyed and that the very bottom of the ravine had received the fragments, but I thought that it might have been checked by some low brush out of which I had seen nothing issue. I made up my mind that the mule was dead. And now follows a sequel hard to believe.

The mule had rolled about fifty feet, over and over, when it had managed to check its fall somewhat, but the strain had burst the pack harness, which slipped from the animal. The mule, freed of its burden, then came to a full stop and saved itself. The pack was made up of two square containers, one of which fell flat and stopped. The other was thrown on edge and given right of way to the bottom. Nearly a quarter of a mile down the slope I followed it, at first by means of the gashes it had made in the turf and earth, and then, as fastenings had given way, by means of sundry articles of equipment. My relief was great to discover that the pack was the one containing the kitchen equipment. Flour dusted the grass, rice was sprinkled lavishly under vegetation that never grew it before, while unrecognizable odds and ends festooned the margin of the course. Finally, the container had struck squarely against a small clump of brush and burst wide open. How I regretted our conservative use of eggs in the camp below when I saw the reckless way in which they were now distributed over the terrain! Amidst all the wreckage one egg had preserved its integrity.

The errant mule was repacked with what could be salvaged of the cook supplies and the rest of the trip was one series of mishaps after another until long after sundown, when we pitched our tent at Verdecocha. How that mule escaped apparently certain disaster twice that day can be answered only by the special providence that watches over the destiny of these hardy Ecuadorean song birds.

We climbed to the crater of Guagua-Pichincha, on foot from Verdecocha, and after a long arduous ascent over a barren waste of ash, at an altitude that made climbing unusually tiresome, reached the lip of the vast cauldron, which steamed with sulphurous fumes. We could not see to the bottom on account of the dense vapor, but as far as the eye could penetrate, were huge blocks of andesite. It is possible to descend deep into the crater, and scrubby vegetation grows within where there is soil.

A later camp brought us near to the great bulk of Cotopaxi. The symmetry of Cotopaxi, while beautiful, does not have the grandeur that a more rugged character gives to such peaks as Antisana.

From our camp on a broad, ancient lava flow at Llavepungo, we could look across a wide stretch of beautifully green pâramo to where the regular outlines of Cotopaxi were momentarily revealed by the kaleidoscopic shifting of heavy cloud masses. Although not very activê volcanically now, Cotopaxi has erupted with considerable violence within comparatively recent times, and Whymper, the noted English mountain climber, who ascended the peak in 1880, comparing his measurements with those of earlier explorers,

COTOPAXI AT SUNRISE

It is characteristic of Ecuadorean skies that they are often clearest at sunrise. Sometimes the only glimpse one can get of Andean peaks is early in the morning. As soon as the sun's rays have warmed the night-chilled air, heavy banks of cloud envelop the mountain ranges and shut off the view. It was well worth the effort to arise early and leave one's tent to behold Cotopaxi at dawn. In the hush of the day's arrival—for here no call of tropical jungle denizen greets the sun—the vastness of the great distances is borne in upon the beholder with well-nigh overpowering force

Guagua-Pichincha rises sharply to an ash-rimmed crater. Within the crater the descent is equally abrupt. Upon the lip of this vast inverted cone the mountain climber is assailed from one side by faintly sulphurous steam, while from the other side the strong wind brings the billowing white clouds charged with refreshing ozone

concluded that Cotopaxi in the previous century and a half had built up its height about seven hundred feet.

Our most intimate association with high Andean peaks began when we hunted and trapped on the slopes of Antisana Here all of our work was done at elevations above 13,500 feet and up to 16,000 feet. Small rodents were trapped almost at snow line, about 15,500 feet, where there were scattered patches of low shrubs, grassy nooks, and low, dwarfed flowering plants. The flowers of these high

Short-stemmed white flowers, a species of the Compositæ, dot the greensward of Chimborazo near Urbina. Beautiful humming birds of many different species visit the blooms of these high mountain meadows

Although high elevation sets a limit upon plant growth, the foliage of Ecuador fights for the last inch. At Antisanilla, an elevation of 11,500 feet, the trees were stunted, but vines and ferns luxuriant

One of the most characteristic growths of the high mountain páramos is the hummock formed by close-set clusters of one of the wernerias. The foliage of this plant is rather hard and spinelike

The dwellers on the high Andean slopes encounter a problem in providing fuel. The only source of wood for fires is the low, dwarfed shrubbery scattered in favorable basins or pockets

elevations are especially interesting and occur in great variety. Many of them are species of the Compositæ and all are so dwarfed that they are practically stemless and grow close against the ground.

A large deer, quite similar in appearance to our Virginia deer, makes these high páramos its home, while a large tawny "wolf" ranges throughout the same region. Caracaras, which are large, strikingly marked hawks, walk

ON THE GLACIER OF ANTISANA

The broad southern shoulder of Antisana bears a great glacier which is fed by perennial snows. This glacier is shaped by the sun into a rugged field of diminutive spires and chasms. On the surface the rotten ice, snow, and dirt form an opaque covering, and conceal the dangers of hidden crevasses. Whymper fell through this covering into a crevass of this kind which he estimated to be seventy feet deep. Fortunately for him, he was tied by a rope to his two companions at the time. Under the surface the water from the melting ice drains away in tinkling rills

THE FRONT OF THE GLACIER OF ANTISANA

The glacier spreads out on the ash-covered slope of Antisana in a bold well-defined front. Streams milk-white in color, gush out from under the icy mass and wax and wane with the heat of the sun. At some places the glacier looms like a great white cliff, at least sixty or seventy feet tall, and the sheer sides of such a cliff, cleansed of the covering of rotted ice and snow, are translucent green. It is no easy task to scale this glacier wall, and one must seek a spot where the crumbling ramparts are least precipitous

The upper slopes of Antisana command a glorious view of mile upon mile of Andean scenery. Over most of the plateau lies a beautiful green covering of páramo grass inexpressibly restful to the eye. Distant peaks stand out in crystal clearness and mountains twenty miles away seem close at hand. Sincholagua in the foreground rises to a height of 16,365 feet, while Illiniza boasts an elevation of 17,405 cloud-piercing feet

About Punin, where the Museum party camped while excavating fossils, there was a large population of Quichua Indians, descendants of the Incas. Water being scarce and local, the Quichuas drove their flocks to a spring in a ravine, where countless rains had deeply eroded the volcanic beds, and where the bones of mastodon and saber-toothed tiger were mute witnesses to a former use of the spring about on the green slopes; and along the numerous watercourses and boggy areas one meets with ducks, a large species of ibis known to the natives as *banduria*, and the clarion-voiced, spur-winged plover. When the sun shines brightly on this Andean upper-world, it is a region of fascinating beauty and attraction but, when the clouds drop low and the *guarua*, or mist, rides the land, the traveler draws his poncho closer and yearns for shelter and a fire.

There are many things to be written of Antisana, of the bold-fronted glacier that ever creeps down its southern slope, of the fierce wild cattle that roam from Antisana over into the jumbled mass of deep ravines and rugged peaks known as the Cimarrones, of the mountain lake that gives birth to the Rio Napo, and finally of Antisanilla near by, where for several miles one can trace an eruption of the past and note how a mighty volume of lava has poured forth, been checked in its flow by cooling, and frozen into the stream lines of its original course.

So many are the beautiful peaks of the Ecuadorean Andes the writer scarcely knows which to single out, and pages might be penned on the mountains seen from Antisana alone, from which the eye picks up a host of white pinnacles against the horizon—Illiniza, Quilindaña, and Sincholagua, not to mention the better-known peaks, such as Cotopaxi, or the nameless ones of the wild hinterland to the southeast. But no account of the high Andes of Ecuador is complete without something about Chimborazo.

We spent several days at Urbina, where we were almost under the summit of Chimborazo. We were too close to appreciate the immense height of this mountain and, furthermore, the shepherds who have livestock on these high pasture lands were setting fires everywhere to burn away the old grass, with the result that the air was murky with smoke. To the north we could see Carihuairazo, a lesser brother of Chimborazo, but a high mountain in any company.

Cænolestes fuliginosus is the scientific name of one of the most primitive of living South American mammals. It is a marsupial, distantly related to the opossums

The bleak cold which grips the páramos of Antisana whenever the sun does not shine calls for warm clothing. The sheep-herder of Antisana when he came out of the *hacienda* on a frosty morning looked as rough and shaggy as one of his own sheep. These people must be of hardy stock to withstand the constant hardships they encounter

Chimborazo standing out against a cloudless sky is far less impressive than Chimborazo bulking huge above the clouds, its shoulders parting the white masses

Our best view of Chimborazo we obtained from Punin, near Riobamba. Here, on a barren hillside, we could look out over a great stretch of desolate-appearing terrain, a rain-carved bed of volcanic ash, to where the mightiest of Ecuador's high mountains overtopped and dominated the land, seeming to hang in the very sky,—above the massive line of ridges which formed the backbone of the Cordillera, above the heavy banks of cloud which rolled along this mountain chain, above the highest of the lighter clouds that drifted in the upper air currents.

A number of high mountains lie to the east and southeast of Chimborazo, but lack of space forbids mention of them by more than name. These include Sangay, sometimes spoken of as one of the world's most active volcanoes, El Altar and Tungurahua, all more than 16,500 feet and the highest more than 17,700 feet.

The great extent of high country in Ecuador forms a life zone of interesting characteristics, and the higher peaks such as Chimborazo, Antisana, and Cotopaxi, might be likened to high-altitude islands in a low-altitude sea. That is to say, the mammal life of the peaks is confined to its proper zone because, in attempting to migrate, the mammals must pass down into regions of lower altitude where the conditions are not so much to their liking. To

Although the clouds all too frequently shut out the mountains completely and thus destroy a view, no scene in the Andes is at its best without a proper cloud setting

many species a barrier of this sort, namely, an altitude difference, is not very effective, but other mammals are held as closely to these mountain areas as they would be to true islands by the surrounding seas. Isolation of this sort has brought about development of separate and distinct species of mammals on some of these peaks, and it was to determine the extent of this development of species that our season's work was planned. For example, large-eared mice of the genus *Phyllotis* were found only on the *arenales*, or ash-strewn crater slopes, and were not living on the great stretches of páramo which link the craters of the Andean system. In southern Ecuador, where one is beyond the zone of high craters, this mouse has perforce had to adapt itself to lower elevations if it was to live in that region at all; there, accordingly, we find species of the same genus but quite distinct from the mountain-loving forms of the north. A very tiny deer, the Ecuadorean *Pudu,* is known only from high country near Antisana.

The working out of the problems of mammalian distribution furnishes the zoölogist with sufficient incentive to undertake expeditions into the field. When his field work brings him into a region of such fascinating possibilities as Ecuador, he finds his days are all too short, his visit terminates too quickly.

Frederic E. Church, Painter of the Andes

IT is fitting that a South American issue of NATURAL HISTORY should present some of the pictures of Frederic E. Church, for, although this artist in his search for the awe-inspiring and the beautiful, eternalized with his brush the fleeting glory of the northern lights, transferred to canvas the columnar stateliness and grace of the ancient ruins of Greece, and depicted the majesty of the irresistible sweep of waters at Niagara, it was the region of the high Andes that furnished the inspiration for several of his most notable paintings.

Telling effects produced by color—the dazzling beauty, for instance, of the rainbow hues that sparkle in the vapory dissolution of a waterfall, the misty softness of mountain valleys, and the dimmed brilliancy of the sullen red sun staring through the dark billowy swirl from a smoking volcano—are necessarily lost when a picture is reproduced in black and white, and yet it is the hope that the photographs—inadequate as they are—that appear in connection with this article may convey something of the beauty of the originals, or at least prompt those who are not familiar with the works of Church exhibited in the Metropolitan Museum and in the Public Library of New York, to seek their inspiration direct by a visit to these institutions. Nor should the opportunity be overlooked in this connection of studying the artist's work in the making by an examination of the preliminary sketches in pencil and *gouache* on view in the Museum for the Arts of Decoration at Cooper Union. To insure the attainment of the proper color values in the paintings subsequently prepared from these sketches, Church took the precaution of indicating on a great many of the sketches the precise color desired. Thus one finds such jottings as "dazzlingly white," "dark blue shadow," "warm shadow, russet with reflected lights," "smoky orange," "buds and ends green gray," "remember the black rocks and brown grass," and the like. It is interesting to note that now and then in his South American sketches these jogs to the memory are in Spanish instead of English.

Church was born at Hartford, Connecticut, on May 4, 1826, and at an early stage of his development as an artist came under the influence of Thomas Cole, the founder of the Hudson River school of painting, that culminated in the art of George Inness, Alexander Wyant, and Homer D. Martin. Church went to live with Cole in the latter's house in the Catskills and worked under his precepts and influence until the time of Cole's death. Subsequently, in his search for ennobling scenes of nature, he visited many of the far places of the world, as a mere enumeration of some of his more important paintings will indicate: Falls of Tecendama (1854), Cotopaxi (1854), Mountains of Ecuador (1855), Niagara (1857), Heart of the Andes (1859), Twilight in the Wilderness (1860), Chimborazo (1864), Aurora Borealis (1865), Rainy Season in the Tropics (1866), Lava of St. Thomas, Jamaica (1867), The Parthenon (1871), El Khasna Petra (1872), Valley of Santa Ysabel (1875), El Ayu (1876), Morning in the Tropics (1877), The Monastery (1878), Valley of Santa Marta (1879), Ægean Sea, Damascus, Jerusalem, The Great Mountain Chain of New Granada, Morning on the Magdalena.

Courtesy of the Museum for the Arts of Decoration, Cooper Union

On July 9, 1857, Church started out from Riobamba for the volcano Sangay and was fortunate enough to obtain an unobscured view of it for twenty minutes just before sundown on July 11. He has left a record of his impressions in the sketch reproduced herewith. Supplementing this sketch, there is at Cooper Union a work sheet of the artist on which appear three rough drafts of the columns of smoke emitted by the volcano, with such notations for the artist's future guidance as, "2, smoky orange," "3, beautiful creamy white," "4, cloud pearly grey," and the like, the key figures referring to designated areas of the sketches

The preponderance, in this list, of South American subjects indicates the influence which that continent exerted upon the art of Church. Twice in the fifties he visited its west coast and has left in his journal an animated record of his experiences. That Church could paint with words as well as pigments, let the following extract witness. Reading it, one has the feeling that Church is setting down his impressions with quick verbal brush-strokes that nevertheless convey a vivid picture.

"My sketch finished, I turned my face, and Lo! Sangay, with its imposing plume of smoke stood clear before me. I was startled. Above a serrated, black, rugged group of peaks which form the crater, the columns rose: one creamy white against an opening of exquisitely blue sky—delicate white, cirrus-formed flakes of vapor hung about the great cumulous column and melted away into the azure; the other, black and sombre, piled up in huge, rounded forms cut sharply against the dazzling white of the column of vapor, and, piled higher and higher, gradually was diffused into a yellowish tinted smoke through which would burst enormous heads of black smoke that kept expanding, the whole gigantic mass gradually settling down over the observer in a way that was appalling.

"I commenced a sketch of the effect, but constant changes rapidly followed and new beauties were revealed as the setting sun crested the black smoke with burnished copper and the white cumulous cloud with gold. At intervals of nearly four or five minutes an explosion took place; the first intimation was a fresh mass of smoke with sharply defined outlines, rolling above the dark rocks and followed by a heavy, rumbling sound which reverberated

Courtesy of Henry Fairfield Osborn

MOUNTAINS OF ECUADOR

Courtesy of the New York Public Library

COTOPAXI

Courtesy of William Church Osborn

CHIMBORAZO

Courtesy of the Metropolitan Museum of Art

HEART OF THE ANDES

about the mountains. I was so impressed by the changing effects that I continued making rapid sketches; but all the time I had, from the moment I saw the first of them until the sun set, was twenty minutes. Dense clouds again settled over the mountains and night took the place of day."

Church had made his reputation at a time of life when many another painter is only beginning to arrive at the maturity of his powers. A quarter of a century elapsed between his first South American trip and the culmination of his career as an artist. The path of achievement that seemed assured to him was barred through physical disability. His right hand could no longer guide his brush. Undaunted, he taught himself to paint with his left, but the inflammatory rheumatism with which he was coping took insidious hold upon that member, too, and rendered his gallant fight useless. Prevented from realizing his full ambitions, he nevertheless could contemplate with satisfaction the substantial contribution he had made to art and the appreciation which his works had won not only in this country but abroad.—H. F. Schwarz.

Courtesy of the Museum for the Arts of Decoration, Cooper Union

A page of botanical sketches made by Church during his journey to South America in 1853

Courtesy of Prof. Henry Fairfield Osborn

ALEXANDER VON HUMBOLDT

As he appeared at the time of his sojourn in Quito, Ecuador, in the early part of the nineteenth century

Alexander von Humboldt

SOUTH AMERICAN EXPLORER AND PROGENITOR OF EXPLORERS

"THE greatest scientific traveller who ever lived" and "the parent of a grand progeny of scientific travellers" were the terms Darwin thought fit to apply to Alexander von Humboldt in writing to J. D. Hooker in 1881. Humboldt had then been dead nearly a quarter of a century; and more than eighty years had elapsed since in the ardor of young manhood he had set forth with the botanist Bonpland on their voyage of discovery in the New World.

Sailing from Spain on June 5, 1799, and making stops at Teneriffe and at Cumana, Humboldt and his companion ultimately reached Caracas and from there, early in 1800, undertook their eventful trip into the interior, exploring the course of the Orinoco and tracing the network of rivers that finally link this great stream with the Amazon system. Four months were consumed in the journey, in the course of which the adventurous travelers penetrated the forests that lie between the Rio Negro, the Orinoco, and the Amazon to a depth five hundred miles greater than that previously attained by Löffler.

After a sojourn of several months in Cuba, Humboldt and Bonpland set sail in March, 1801, for Cartagena on the north coast of South America and made their way up the Magdalena River and across the cold wind-swept heights of the Cordilleras to Quito in Ecuador, where they arrived in January of 1802. In and about Quito the travelers made their abode for nearly eight months, during which they ascended the volcanoes of the region. Pichincha, Cotopaxi, Antisana, and Ilinica were studied; analyses were made of their gases, and measurements of their height and crater circumference were taken whenever it proved possible to do so. On June 9 the ascent of Chimborazo was attempted. The Indians that accompanied Humboldt, Bonpland, Carlos Montufer, and one of Humboldt's attendants on this exhausting climb, deserted before the final stage, declaring that the white men were trying to kill them in urging them on. Humboldt and his companions continued alone, weary but hopeful, until an impassable chasm blocked their ambitious effort and robbed them of the conquest of the summit.

The South American explorations of Humboldt were rounded out with the journey which he and Bonpland undertook by way of Riobamba and Cuenca to Lima, in the course of which they spent a month near the headwaters of the Amazon.

It has been possible to give only the barest outline of Humboldt's wanderings in South America, and to try to indicate the results of his explorations within a brief article presents even greater difficulties. In one of his letters Darwin speaks of him as "more remarkable for his astounding knowledge than for originality." It is because of the vast scope of his investigations—as comprehensive as his mentality—that it is hard to attempt even a summary of his work. Accustomed to the restrictions of an age of specialization, one feels amazement that Humboldt could apply geology, astronomy, meteorology, zoölogy, botany, and even linguistics in passing judgment upon the different phenomena that came under his observation. His painstaking study of the volcanoes of the New World was perhaps his greatest contribution to geology. His observations of the remarkable meteor shower at Cumana on November 12–13, 1799, laid the foundations of our knowledge of the periodicity of this phenomenon. He studied the effects of guano on the productivity of the soil, and to his writings is due largely the fact that this fertilizer was introduced into Europe. His researches on climate, pursued with vigor during the South American journey, were of the greatest scientific importance. Darwin wrote: "I have always looked at him as, in fact, the founder of the geographical distribution of organisms;" and in delivering this opinion gave recognition to one of Humboldt's principal claims to greatness. Three folio volumes of geographical, physical, and botanical maps; twelve quarto volumes, devoted to the nonbotanical results of the trip; and thirteen folio volumes regarding the botany, as well as many smaller publications, furnish additional evidence of the magnitude and significance of Humboldt's exploratory work in South America.

At the beginning of this article citation was made of Darwin's designation of Humboldt as "the parent of a grand progeny of scientific travellers." Of this progeny Darwin himself was the favored son. The inspiration of Humboldt's example had a determining influence upon his life. Writing to Wallace in 1865 regarding the progress of Wallace's journal of travels, Darwin remarks:

"I have always thought that journals of this nature do considerable good by advancing the taste for Natural History; I know in my own case that nothing ever stimulated my zeal so much as reading Humboldt's *Personal Narrative*."

In another connection he makes this statement:

"During my last years at Cambridge, I read with care and profound interest Humboldt's *Personal Narrative*. This work and Sir J. Herschel's *Introduction to the Study of Natural Philosophy*, stirred up in me a burning zeal to add even the most humble contribution to the noble structure of Natural Science. No one or a dozen other books influenced me nearly so much as these two."

One might go on quoting other references to Humboldt scattered through *The Life and Letters of Charles Darwin* and *More Letters of Charles Darwin*. Not all of these are so laudatory as the excerpts just given. In one Darwin expresses a certain degree of disappointment upon meeting Humboldt personally; in others there is qualified praise or divergence of opinion from some of Humboldt's scientific conclusions. Yet such phrases as "I venerate him" and a reference to Bates as "second only to Humboldt in describing a tropic forest" indicate Darwin's high estimate of his predecessor in the South American field.

The influence of Humboldt upon Darwin can be traced, furthermore, through the dozen or more references to him that occur in the South American portion of Darwin's *Voyage of the Beagle*. Imbued with the writings of Humboldt, Darwin compares his own observations with those recorded by the earlier scientific traveler or enters into brief discussions regarding the validity of his conclusions.

That the appreciation was not altogether one-sided, however, is evident from the following letter, which Humboldt wrote to Mrs. Austin some eight years after the "Beagle," its five-year cruise completed, had put into Falmouth:

"Alas! you have got some one in England whom you do not read—young Darwin, who went with the expedition to the Straits of Magellan. He has succeeded far better than myself with the subject that I took up. There are admirable descriptions of tropical nature in his journal, which you do not read because the author is a zoologist, which you imagine to be synonymous with bore. Mr. Darwin has another merit, a very rare one in your country—he has praised me."

The concluding sentence throws an interesting sidelight on Humboldt, whose vanity was so frank that it disarmed criticism, while the general tenor of the letter reveals another and more pleasing trait, namely, his generous encouragement of young scientists.

While Darwin was the heir apparent in that "grand progeny of scientific travellers," one must not omit mention of another nature student of conspicuous rank, Louis Agassiz, who came under the influence of Humboldt. Agassiz records that when he was a student at Munich he was filled with a passionate desire "to accompany Humboldt on his projected trip to Asia." Denied the realization of this ardent wish, he nevertheless had the opportunity later of meeting Humboldt and of learning from him "How to work, what to do, and what to avoid; how to live; how to distribute my time; what methods of study to pursue." In subsequent years Agassiz himself explored the Amazonian valley, passing so near the scene of Humboldt's field researches that he was able to check up his own results with those recorded in Humboldt's narrative and to recognize the extent of the great traveler's knowledge and the comprehensiveness of his views, even in cases where the progress of science led to a different interpretation of the facts.

A man whose fame in his own day was second only to that of Napoleon was naturally a favorite subject for portrait painter and sculptor. There is a statue of Humboldt in Central Park, and within the American Museum there are two reminders of him,—the bust by William Couper that occupies a niche in Memorial Hall and the painting by Julius Schrader that is on the left of the visitor as he steps out of the elevator on the second floor. This portrait, depicting Humboldt in old age (the very year of his death, 1859) but against a background of snowy peaks associated with his youth, is reproduced on p. 452. Among others who had the privilege of painting Humboldt in advanced life were Karl Begas, who made the celebrated portrait of him for the Gallery of Knights of the Order of Merit, Eduard Hildebrandt, and Madam Emma Gaggiotti-Richards—a young Italian artist of talent, who resided in Berlin during the closing years of Humboldt's life. It may not be without interest to quote from the record left us by the artist M. Wight, to whom Humboldt accorded sittings in 1852.

"Humboldt was at that time eighty-three years of age. The first interview was on the occasion of his sitting for the portrait in February of that year [1852]. I found him a man rather below the medium stature, dressed with the utmost simplicity, in black. His step was moderate, but firm and decided, with his head a little inclined forward. In conversation his face would glow with enthusiasm, and his small clear eyes sparkle with animation. He was apparently very tena-

PORTRAIT OF BARON ALEXANDER VON HUMBOLDT

PAINTED BY JULIUS SCHRADER

In the year 1857 Mr. Albert Havemeyer, of New York, being then in Berlin, called on Humboldt, then in his eighty-ninth year, and requested him to allow his portrait to be painted. Although the Baron had declined frequent solicitations for a similar favor, he was made to feel that his many personal friends in the United States would be gratified by his compliance and he consented to have the eminent artist, Julius Schrader, paint the picture here shown. The background was of his own selection, his remark to the artist being, "I will be painted sitting here," designating the spot with Chimborazo in the distance. The artist commenced the picture at once and at its completion in 1859 the Baron expressed himself as well pleased. It is Humboldt's last portrait and has been copied many times. It was presented to the American Museum by Mr. Morris K. Jesup and hangs above the president's office on the second floor cious of his time. There were five sittings. I found him always prompt to the minute. Knowing that he had received several decorations from crowned heads, I asked him if he wished me to represent any of them in his portrait; he replied that he preferred it should be painted without any ornament whatever."

The concluding sentence is of interest, for in the portrait by Julius Schrader, there is a similar absence of insignia.

More interesting from our standpoint than the pictures of the mature scientist—the man acclaimed by the world —is the portrait in color that serves as the frontispiece of this article, showing the explorer in the full vigor of his adventurous young manhood, at a time of life when he was making the discoveries and gathering the materials that, subsequently worked up, were to establish his fame. This painting, the work of a South American artist, Rafael Sabas, was secured by Frederic E. Church during one of his trips to the west coast of that continent and was subsequently presented by Mr. Louis P. Church to Prof. Henry Fairfield Osborn, by whose courtesy it is here included. The picture was executed in 1859 and bears the inscription that it is a faithful copy of a portrait of the explorer painted at Quito by José Cortes early in the century, at a time when Humboldt was climbing the snowy peaks of Ecuador and studying the volcanoes. Among those who went up Chimborazo with Humboldt was mentioned Carlos Montufar of the distinguished family of Aguirre y Montufar, with the members of which Humboldt was on intimate terms. Two of the ladies of this family were still living in 1859, and although more than half a century had elapsed since the time of Humboldt's visit, they had vivid recollections of the young explorer. Prof. Moritz Wagner interviewed them in that year, and in his account there is a reference to a portrait in the possession of the family. The reader is invited to compare Wagner's minute description of it with the details of the frontispiece of this article and see for himself whether it is not probable that the painting described served as the model for Rafael Sabas' copy, which might still be referred to as faithful even though some minor details—for instance, the book—have been omitted.

"The family of Aguirre have still in their possession a half-length portrait, life-size, of their distinguished guest, painted by a native artist, which is preserved in their country house of Chillo, half a day's journey from Quito from whence Humboldt used to make excursions in the pursuit of geology and botany. The young German baron, at that time (in 1802) thirty-three years of age, is represented in a court uniform of dark blue with yellow facings, a white waistcoat, and white breeches of the fashion of the last century. His right hand rests upon a book entitled *Aphorism, ex Phys. Chim. Plant.* His thoughtful brow is covered by long dark brown hair. The features in the youthful face are strongly marked, especially the nose, mouth, and chin. The peculiar expression of the eyes is the point of resemblance most readily traceable in this picture to Humboldt as I saw him fifty years later, then a venerable old man."

A SCENE IN THE VILLAGE OF BAÑOS, PROVINCE OF TUNGURAHUA

The climbing plant which covers the balconies of the small house in the foreground is *Passiflora ligularis*, the common granadilla. Its hard-shelled fruit, the size of a hen's egg, contains translucent pulp of delightful flavor and delicate aroma

Hunting New Fruits in Ecuador[1]

By WILSON POPENOE

Agricultural Explorer, U. S. Department of Agriculture

THE principal civilized peoples of pre-Columbian America,—Aztec, Maya, and Quichua,—were agriculturists of no mean order. Remarkable skill was shown by the Quichua, who converted into productive land the barren mountain-sides of their Peruvian home. On these rocky slopes they built series upon series of stone terraces, filled them with rich alluvium from the fertile valleys below, and irrigated them artificially from the mountain streams above. They brought many wild food plants into domestication and through conscious or unconscious selection carried some of them to a high degree of agricultural excellence, with the result that such plants as the potato and the sweet potato, the tomato, and the peanut are now cultivated and prized in many parts of the world.

We may be in danger, however, of giving the Quichua agriculturists too much credit. Perhaps they were fortunate, above other American peoples, in occupying a region where wild plants of potential economic value were particularly numerous. Even after many centuries of Quichua occupation, and the domestication of more than a score of plants, the highlands of Ecuador and Peru still contain many wild species of horticultural promise. It is this fact, together with the added circumstance that numerous cultivated plants of the Quichua have not yet received attention in other parts of the world, that makes the Andean region extremely attractive as a field for agricultural exploration.

One whose interests lie along pomological lines cannot imagine a region more replete with thrills than Ecuador. To begin with, there exists near Naranjito, not far from Guayaquil, one of the most remarkable collections of Asiatic fruits in South America. In fact, the only bearing mangosteen trees on the continent are to be found at this place —the Hacienda Payo. Those familiar with the mangosteen need not be told that it is the queen of fruits, and that it has long been famous as one of the finest products of the Malayan region. In relatively recent years, it has been transplanted to the West Indies, where a few trees are now in bearing.

During the first years of the present century, the elder Madinyá, owner of Payo, occasionally made trips abroad and, returning to Ecuador, brought with him seeds and plants of many rare fruits secured through nurseries in France and the West Indies. Besides the mangosteen, he established in Ecuador the litchi, the rambutan, and the carambola—all Asiatic fruits of extraordinary merit, little known in America.

Even more interesting than these are the native species which are found, wild or in cultivation, in the Ecuadorean highlands. Chief among them are the cherimoya, the capulí, the Chilean strawberry, the babaco, several blackberries and raspberries, and the naranjilla.

For years I have been familiar with the cherimoya. It is cultivated in

[1]Photographs by the author.

Mexico and Guatemala, and excellent specimens have been produced by trees planted in southern California. Not until I reached Ecuador, however, had I seen the cherimoya in its native home. As a wild tree, it grows in profusion along the valley of the Rio Malacatos, at the southern end of the country, and in neighboring parts of Peru. From this region it was carried to southern Peru probably before the arrival of the Spaniards, who took it northward to Central America and Mexico.

The cherimoya is a remarkable fruit. It has often been described as vegetable ice cream, because of its white flesh, which has the consistency of a firm custard, and is strikingly suggestive of delicate ice cream when

The cherimoya has been termed a "masterpiece of nature." For its luscious flavor, suggesting a combination of pineapple, strawberry, and banana, and the smooth texture of its white pulp, which suggests ice cream, it is entitled to rank among the best fruits of the tropics. Its native home is in southern Ecuador and the neighboring parts of Peru

chilled and served as a dessert. It has the combined flavors of pineapple, strawberry, and banana, and for sheer lusciousness is excelled by few other products of the vegetable kingdom. The cherimoya tree can be grown where the lemon flourishes. Its cultivation in California has proved practicable, but the several small orchards which have been established in that state have failed to yield their owners profitable returns, due to the fact that they have borne very scantily. The pollination of this fruit under cultivation in the United States will have to be solved before the cherimoya can become a familiar sight in our markets.

Blackberries and raspberries are generally looked upon as northern fruits. At least, this had been my own impression before visiting the Andean region, where I found to my surprise berries vying in excellence with the best produced in the United States.

Two years before visiting Ecuador, I had seen in Guatemala a remarkable berry, known to the Indians of that country as tokán uuk. The plant resembled a raspberry in growth and appearance, while the fruit was like our loganberry but less tart in flavor. On reaching the Ecuadorean Andes, I found this same species, *Rubus glaucus*, playing the rôle of an important cultivated plant in the gardens of many highland towns. In fact, the *mora de Castilla*, as it is there called, may be considered one of the favorite fruits of the Ecuadorean highlands.

Just why this berry has never received horticultural attention in other countries is beyond my comprehension. It is too fine a thing to be overlooked by any one who has an eye for fruits and, unlike certain other plants of the Ecuadorean Andes, its propagation is simple. To the end that it might be popularized, the Department of Agriculture propagated a large number of plants from seeds I secured in Ecuador and has distributed them in those parts of the United States where they seem likely to thrive. Already the Andes berry, as we have decided to call the *mora de Castilla,* has borne fruit in California and is doing well in the Gulf States and in the Southwest generally. It is remarkable for its immense growth, as well as for the fine quality of its fruit. A single plant will cover the side of a small house or, if left to itself, will form a mound of verdure ten feet high and fifteen feet in spread.

Under cultivation in Ecuador several horticultural varieties have originated. The common, or wild, one has berries of deep maroon color. A rose-red variety and a light pink one are occasionally seen in cultivation. Neither of these, however, is superior to the typical form.

Seventy years ago the English botanist Richard Spruce spent several years in the Ecuadorean Andes. He had been collecting in the Amazon Basin, where he did a remarkable piece of pioneering work. At the request of the British government, he came up the eastern slope of the Andes to Ambato and then went southward to Loja Province, where he carefully investigated the source of quinine, with a view to obtaining seeds of the trees which yield this product. His labors during a period of more than two years and his final success in transplanting the best quinine-yielding species to India form a romantic chapter in the history of plant introduction. Present-day botanical explorers who complain

The town of Baños, which lies at the foot of the volcano Tungurahua, is one of the most picturesque in the Ecuadorean Andes, and a classic resort of naturalists since the days of Richard Spruce. Close by are the magnificent falls of Agoyán. The Pastaza River, which flows past the town, is a tributary of the Amazon

The moist, fertile slopes of the Ecuadorean Andes are cultivated up to elevations of 12,000 feet. This photograph shows a prosperous agricultural community near El Angel, province of Carchi. The principal crops grown in this region are barley and potatoes

of the discomforts suffered in crossing the Andes should read Spruce's notes, and reflect upon the difference between Andean travel in the middle of the last century and that of today.

During his stay in Ambato, Spruce was struck by the excellent quality of the strawberries grown in that region and by the fact that they were on the market every day in the year. He told of large fields devoted to this plant near Guachi. This region still produces strawberries in abundance, and the traveler to Quito is certain to be greeted by the sight of large baskets of them, no matter what day or month he passes through Ambato.

The casual tourist assumes that these berries are of the same species as those grown in the United States. He does not know that they represent the Chilean strawberry, *Fragaria chiloensis*, which is cultivated only in South America. In 1714, a Frenchman named Frezier, who was voyaging on the Pacific, secured a few plants of this berry at Concepción, Chile, and carried them with him to Marseilles. Their progeny, when crossed with the small-fruited strawberries then cultivated in Europe, yielded the first large-fruited strawberries of the type now grown both in Europe and America. There is a Chilean strain, therefore, in our own cultivated varieties, but the fraction is probably a small one.

Previous to the Conquest, this berry was not known in Peru or Ecuador. It was carried to Cuzco shortly after the Spanish established themselves in that city, and later was taken to Ecuador, where it has been cultivated ever since and held in high esteem.

The Chilean strawberry is rather exacting in its requirements. It does not tolerate a moist climate. In Ecuador it bears all the year round, but this is not the case either in Peru or in Chile. This peculiarity can be attributed, therefore, to the lack of seasonal

A sphagnum bog on the páramo near El Angel, province of Carchi, at an elevation of approximately 13,000 feet. This is typical páramo scenery; the two characteristic plants are ichu, the bunch grass shown in the foreground (botanically *Stipa ichu*); and the thick-stemmed composite which fills the background, a species of *Espeletia* known locally as frailejón

Strawberry pickers at Guachi, near Ambato.—Large fields are given over to the Chilean strawberry (*Fragaria chiloensis*) in this region. The fruits, which are of good size and flavor, are remarkable for their ability to withstand shipment. They ripen throughout the year, and are grown on sandy soil without irrigation in a region where the annual rainfall is scarcely more than eighteen inches

THE ANDES BERRY

Rubus glaucus grows wild in mountainous regions from southern Mexico to Peru. It is cultivated in Colombia and Ecuador, where its dark maroon, juicy, richly flavored fruits are highly prized. They are used like northern loganberries, which they resemble except for the fact that they are sweeter in flavor and slightly different in form. (Natural size.)

CLUSTERS OF CAPULI

A cultivated form of the black cherry, *Prunus serotina,* is commonly grown in Mexico, Guatemala, Colombia, Ecuador, and Peru. Ecuador possesses better varieties than other countries; the one shown here, from Ambato, has fruits as large as California oxheart cherries, and of excellent flavor. (Natural size.)

THE ANDEAN BLUEBERRY

Vaccinium floribundum, called mortiño in Ecuador, grows profusely in northern South America at elevations between 10,000 and 12,000 feet. Its small fruits, while not more than a quarter of an inch long, are of pleasant flavor. The pink flowers and deep green foliage give the plant a handsome appearance. (Natural size.)

The granadilla de Quijos (*Passiflora popenovii*) grows along the tributaries of the Amazon in eastern Ecuador. It has flowers of unusual beauty, white, blue, and lilac in color, followed by good-sized oval fruits of delicate and aromatic flavor. (Natural size.)

changes in the Ecuadorean climate. Plants yield freely when grown without irrigation on the sandy plains of Guachi. but when grown on good garden soil and watered frequently, the berries are few, small, and of inferior quality. At Guachi they are usually an inch and a half long, of remarkably firm texture, and of sweet and peculiarly aromatic flavor. The texture is a characteristic of extreme value to plant breeders, for North American strawberries are much less firm and do not stand shipping nearly so well. It is for this reason that several breeders in the United States are now working with the Chilean strawberry in the hope of securing, through crossing it with our own cultivated sorts, varieties adapted to our climate, yet having the texture of the Chilean form.

The traveler in the Ecuadorean Andes—the region popularly referred to as the "Sierra"—soon becomes familiar with the capulí, a tree seen about cultivated places from one end of the country to the other. Teodoro Wolf, who spent twenty years in Ecuador and wrote an excellent book regarding the country, spoke of the capulí as characterizing the Andean region just as the coconut palm is typical of the coast.

I do not believe the capulí is indigenous to Ecuador, in spite of the fact that Ecuadoreans commonly claim it as their own. Strangely enough, it is a southern form of a plant well known in the eastern United States, extending as far north as Nova Scotia, —*Prunus serotina*, the wild black cherry of this country. History records

The babaco (*Caricā pentagona*), closely related to the papaya of tropical regions, is cultivated in numerous highland towns of Ecuador. The plant resists light frost, and the yellow fruits, which attain a foot in length, are made into an excellent preserve

that the Spanish first took it to Peru, where it is now as common as in Ecuador. In both these countries it is known under a name taken from the Aztec language, and its cultivation by that people in pre-Columbian days is a recognized fact. Assuming, therefore, that this plant was carried to Ecuador from Mexico, it is interesting to note that the first-named country now produces much finer capulís than does the native home of the species. I have never seen in Mexico or in Guatemala capulís more than half the size of the most luscious grown in Ecuador, nor any half so good. The Ecuadorean capulí at its best is a fruit nearly as large as the oxheart cherry of the Pacific Coast. It is borne in clusters of from two to ten, and is juicy, sweet, and pleasant to eat. How well I remember the afternoon spent by Abelardo Pachano, José Antonio Montalvo, and myself under the famous Gonzales capulí tree near Ambato! We picked and ate the fruits until we could eat no more, and I was convinced that the capulí is worth cultivating not only in the southern United States but also in all subtropical regions where European cherries do not succeed.

Ambato is the center of the greatest fruit-growing region in Ecuador and, because of its dry and relatively cool climate, it is suited to the cultivation of many temperate, as well as subtropical, species. Its elevation of 8000 feet will not permit the rearing of strictly tropical fruit-bearing plants since light frosts occur every once in a while.

In Andean villages several remarkable species of *Carica* are cultivated. These are related to the common papaya of tropical countries but, unlike the latter, will resist frost. The best of them is the babaco, grown principally in the Ambato region, but occasionally at Quito and elsewhere. The babaco is produced by a half-woody plant that attains a height of ten feet. The fruit is cylindrical in form, nearly a foot in length, and suggests a muskmelon in character. It has highly aromatic flesh and a large hollow cavity in the center, which one would expect to contain many seeds but which rarely has any at all. In fact, the babaco is a curiosity. The two sexes are or should be found in different plants. The pistillate, or female, plants bear fruits. In spite of having searched extensively, I have never found a single staminate, or male, plant. Apparently, the flowers produced by pistillate plants are never properly fertilized and, in consequence, no seeds develop. The usual thing in such cases would be that fruits also would fail to develop, but the babaco does not conform to the general rule in this respect.

Throughout the highlands are to be seen trees of a wild walnut, which resembles in foliage as well as fruit the black walnut of the United States,—more particularly that of California. The Ecuadorean species, *Juglans honorei*, however, is quite distinct from those of the United States. Its thick-shelled nuts contain richly flavored meats, which are made into delicious sweets by Ecuadorean housewives.

Most of the avocados grown in the Ecuadorean highlands are of the Mexican race, probably introduced by the Spanish in early days. There is an old tree in the Patate Valley, not far from Ambato, which, it is believed, was planted more than two centuries ago by Jesuit priests. *En passant*, it is worth mentioning that the priests and friars, who came to the New World along with the Conquistadores, were active in establishing the best European fruits and other food plants wherever they went, and in transporting native species, such as the avocado and the capulí, to regions where they had not previously been grown.

While at lunch one day in the Metropolitan Hotel in Quito, I was told by a fellow-traveler that the Chota Valley produced avocados of superior quality. Having found no avocados of value in Ecuador up to that time, I was loath to believe the story but unwilling to ignore it. So I rode to Ibarra and thence down to the Chota River, notorious as a hot and malarial region. I was rewarded by finding avocados of unusual character and quality. Three trips to the Chota resulted in my securing budwood of the best varieties and introducing five into the United States, where they are now being tested.

In the Chota Valley is another excellent fruit, cultivated elsewhere in Ecuador but not in such perfection. It is the pepino, related to the potato and the eggplant. The elliptic greenish-yellow fruits sometimes attain the size of small cantaloupes, and strongly suggest the latter in flavor. They are produced by plants which look like potato vines but live for three or four years and bear fruit during most of that time.

Another member of the same family popular in Ecuador and little known elsewhere, with the exception of Colombia, is the naranjilla, botanically known as *Solanum quitoense.* This fruit, which has the size and appearance of a small orange (whence the name *naranjilla*—little orange) is borne by a half-shrubby plant with enormous hairy leaves. The fruit is used to prepare *refrescos,* or cooling drinks, which suggest in flavor a mixture of pineapple and lemon. Attempts to grow the naranjilla in Florida have been unsuccessful. For some reason as yet unknown to us, the plant does not bear fruit in that state, though it grows quite satisfactorily.

Colombians, to a greater extent than Ecuadoreans, appreciate and use the tacso, but the latter are by no means blind to its merits. This fruit, which belongs to the passion-flower family, is of the size and shape of a small banana. It contains numerous seeds, each surrounded by juicy, acid pulp of aromatic and somewhat acid flavor. In Bogotá, housewives put this through a sieve and by adding sugar and milk make a delicious sherbet, which they

The favorite tacso of the Andes, *Passiflora mollissima*, is produced by a handsome vine, and is used to prepare excellent ice creams and desserts. Its orange-colored pulp is acid and highly aromatic

call *crema de curuba.* I did not come across this dish in Ecuador nor the equally delicious ice cream which can be made from ripe tacsos. Both for its fruit and the ornamental appearance of the vine, the tacso is worth cultivating extensively in California, where it has already been tried and found to succeed.

The Spanish early brought their own fruits to Ambato, and the descendants of the original trees are seen everywhere in that region. Peaches, apples, plums, and apricots are abundantly produced, while a few miles farther down the Patate River are small orchards of citrus fruits. Nowhere in the higher Andes, however, are good oranges produced. A few spots, such as the warm Chota and Guaillabamba valleys, are favorable for orange culture, but the best region is on the coast. Ecuador can produce excellent citrus fruits and some day may rank among the countries which export them. Ever since the production of cacao became less remunerative, due to increased plantings in Africa, Ecuadoreans have realized the necessity of diversifying their crops. Even now there is a small export trade in bananas, oranges, and pineapples, particularly the first-named, which are being grown on an ever-increasing scale for shipment to Peru and Chile. The pineapples of Guayaquil are famous; indeed, they probably equal in quality those of any other region, and they excel most. Fruit culture has come to the fore as one of the most likely sources of income, and within the next quarter of a century serious attention will certainly be devoted to the establishment of fruit industries both in the highland regions and along the coast.

The last gleam of the setting sun leaves a narrow pathway of molten silver between the unbroken darkness of the forest wall and its mellowed reflection. Even before the fast-moving clouds have cleared the ridges of distant Kamakusa mountain, this glistening streak will have been blotted out by the spreading darkness. What great discoveries still await the adventurous traveler below the canopy of forest that stretches for more than a thousand miles into the farthermost limits of the valley of the Amazon!

Into the Interior of British Guiana[1]

By HERBERT LANG

Associate Curator, African Mammals, American Museum

FEW other parts of South America can boast a more romantic history than the Guianas. Even today the lure of riches easily attained there still claims its victims. Far back, in the year 1616, so well seasoned a knight as Sir Walter Raleigh was blinded by the dazzling tales of the fabulous wealth of that phantom city of "El Dorado." Apart from personal disillusion and failure in his particular quest, his last heroic efforts were not altogether in vain. Did he not whet the appetite for the proverbial wealth of these lands and unwittingly lay the corner stone for England's only colony in South America—the present-day British Guiana?

That in olden times the Guianas were not without appeal as a field for colonization is evident from the councils of the Pilgrim Fathers, who considered the tropical luxuriance of these parts before they decided to exert their mighty influence upon New England shores. Still more memorable was the virtual exchange, after the Dutch war, of Guiana, or "Surinam," for what is now New York, under the terms of the Peace of Breda in 1667.

Later the sober-minded, laborious Dutch by skilful efforts succeeded in transforming much of the coastal strip of Demerara into rich plantations, relying upon the fertility of the alluvial soil, in some parts now known to be more than 1400 feet thick. After more than a hundred years of continuous subjection to the soil-impoverishing culture of sugar cane, and without stimulation of productivity through the use of fertilizer, the land still gives bountiful returns.

With the temporary collapse of the sugar industry after the World War and the incidental release of labor, those who were sufficiently energetic and enterprising tried their luck in the diamond fields of the interior. The results have been astonishing and a

[1]Illustrations, with the exception mentioned, from photographs by the author.

A typical diamond mine.—Sand piles and water holes surrounded by a chaos of tree trunks and bowlders in the midst of virgin forest are the distinguishing characteristics of the diamond mines of British Guiana. A fee of a few dollars paid to the government gives the prospector the right to stake out his placer claim of 800 by 1400 feet. Removing only three feet or so of overburden may uncover the loose, diamantiferous gravel, which is washed in the "tom," a rough wooden box having an iron screen with half-inch holes at the front of it. Through them the smaller particles are passed and hand-sieved. What remains in the sieve is carefully looked over for the precious stones.

There are no iron fences, guarded compounds, or burglar-proof safes as in South Africa. The entire police force consists of half a dozen negroes, in a region where about 4000 miners in 1922 dug out more than $4,000,000 worth of diamonds in the rough, valued at $25 a carat. No machinery, laboratories, or hospitals are provided, and everyone lives peacefully in temporary shelters. Trading companies supply the miners with salt pork, beef, fish, rice, beans, biscuits, and other goods, most of them paid for in diamonds, which in general the companies also purchase

Fifty thousand dollars' worth of British Guiana diamonds, in the rough.—This harvest was gathered by a crowd of fortune hunters of every description,—most of them negroes and mulattoes, some Chinese and Hindus, and a few whites. With unfailing hope and under the most trying conditions, these miners, generally called "tributors" or "pork-knockers," have struggled, toiled, and suffered hunger in order to add their part to this glittering pile. Some of these rough stones are of the "first water," without flaw or tint. Once lifted from the loam and rendered doubly attractive by cutting and setting, they become the most cherished of treasures. The largest stone pictured weighs sixteen carats; single stones of as much as forty-eight carats have been unearthed along the Upper Mazaruni River

Photograph by Wm. J. La Varre, Jr.

Makreba Falls, the head of navigation on the Kurupung River.—Between the rocky walls of forest-clad mountains that rise abruptly several hundred feet above the water are these falls, opposing farther advance by boat. From here famous Mt. Roraima can be reached within ten days. The route proceeds overland for some distance, with Indian "droghers" carrying the loads, and then by water in native "woodskins," or small boats made of the bark of trees, each accommodating eight or ten men. During the first few weeks of the stay, Mr. La Varre and the writer, who is shown in the above picture, made a preliminary reconnaissance and were fortunate in meeting many of the Indians who later joined the party at Kamakusa

Rapids below Kaburi Rock.—The gallant little craft "Kamakusa," in which the author journeyed, passed most of the rapids under its own power. Only a few times did this staunch "rift-climber" have to be taken in tow. Every year the Mazaruni River exacts its heavy toll in boats and men. Only strongly built canoes, not more than forty feet in length and manned by experienced captains and bowmen, are allowed to engage in the traffic. The ever-changing water level, depending on the season's rainfall, and an essentially rocky bed are the main hazards. Every crew has its expert swimmers who, going in advance, drag the ropes with which the boats are guided and pulled across the rocks whenever the drudgery of portage can thus be avoided credit to the adaptability of the negro population, which outnumbers all other races among the miners. It is true that extravagant hopes of fortunes easily made and many dismal failures are a part of the story, but native improvidence is happily linked with a ready desire to share good fortune with others and at any time to extend cordial assistance to those in need. From 1919 on, the production of diamonds jumped in three years from $478,555 (16,706 carats in 1919) to $4,126,425 (163,640 carats in 1922). As it happened, I was making the trip up the Mazaruni River[1] at the height of this great rush, when dozens of boats were on their way to the diamond fields in the interior.

One of the most surprising facts about diamond mining in British Guiana is its extreme simplicity of operation, with an equal chance for all. Ax, pick, shovel, a miner's pan, tom-iron, pail, and sieve are the only implements used to bring the precious stones to light. After the miner has successfully probed, by means of a tough sapling, the water-soaked ground to locate the harder layer of diamond-bearing gravel, the digging commences, continuing until the promising level a few feet below is reached. There is great expectancy as the first sample of ore or "pay dirt" is tested. There may be merely what the miners call "indications," pieces of tourmaline, crystals of quartz, and pebbles of various heavy minerals, also traces of gold. Should there be a diamond, however tiny, in the first pan, it is an encouragement for the "crew," as small parties working together are generally called.

Not many months thereafter the deserted square or oblong, water-filled holes in the ground, surrounded with embankments of soil, sand, and gravel, attest to the success achieved. The lucky miners stay at their task only a few months before returning to the coast and Georgetown. They usually escape fever, dysentery, and the host of other illnesses brought about by the extraordinary hardships, especially that of working hip-deep in water for an extended period. The journeying back and forth involves but little expense to the individual miner, who works his way up river by paddling boats engaged in transporting traders' merchandise, and for whom the homeward passage is usually free.

British Guiana's fame is linked with its great rivers: they are its network of communication in the interior. In former times no one but the daring and fearless would brave the thousands of swift channels, pilot between the hidden rocks, and cross the dangerous whirlpools. These pioneers needed courage and dexterity to ascend the torrential rapids and overcome the steeper falls. Even now considerable skill is required. After a few months of the monotony of the mining fields, however, one welcomes the excitement of river travel. There, at least, is the dare-devil joy of trusting to luck more than to experience. The return run is made with the hurrying floods and across swirling rapids in as many exciting hours as it took dreary days of toil to fight one's way upstream against the strong currents.

Along the rivers the solid walls of luxuriant vegetation are silent witnesses to the constant struggle of practically every leaf to reach the sunlight. In this spectacular mosaic flowers are richly scattered, decorating the green curtain like delicate embroideries. Tints of yellow and shades of blue in October are the prevalent colors,

[1]A preliminary Note, together with a map of the itinerary, appeared in NATURAL HISTORY for July-August, 1923, pp. 409–11.

bright red and white being scarcer. Tall palms are rare along the Mazaruni River, and even the slender manicole seldom waves its glittering fronds. In the foreground are floating grasses and stockades of giant arums, a maze of sedges and palms climbing upward over their more powerful neighbors.

Every day before nightfall we made fast to one of the few high places along the banks out of reach of sudden floods. Tarpaulins and hammocks were the only equipment needed for passing the night. Following the first roars of the howler monkeys at the coming of daylight, fires were kindled in preparation for breakfast. A bustling half hour saw our fifty men and their belongings ready to start again. Soon the busy purr of the boat's engine and the rhythmic stroke of paddles broke the quiet, continuing until noon, when a stop was made for luncheon.

As we landed and passed through the dense curtain of verdure, the mighty tree trunks loomed up like majestic colonnades. Innumerable leaves of all sizes and shapes, impenetrable thickets, and other objects limited the range of our vision. Glimmering shafts of light set off the graceful contours of the rows of saplings and tangles of bush ropes. In the diffused soft light fantastic flashes playfully danced upon the leaf-strewn ground. Clumps of white, orange, or brown fungi, flowers that had fallen from the trees above, and a scattering of dead leaves furnished delicate touches of color among the few plants that strove in vain to escape from the gloom and decay of the forest floor. The moisture-laden atmosphere and constant heat were overpowering. Yet the infinite beauty and matchless grandeur of the scene were impressive even though the minute details of so magnificent a tapestry were confusing.

Ever since I had returned from the Belgian Congo, where I had spent the years 1909–15 studying conditions in the West African rain forest, it had been my desire to see comparable South American forests. The opportunity, extended to me by Mr. William J. LaVarre, of visiting those of British Guiana was, therefore, most welcome. Furthermore, I was favored with an introduction from President Henry Fairfield Osborn, of the American Museum, to his Excellency, Sir Wilfred Collet, governor of British Guiana. From Director F. A. Lucas of the

This young male howler monkey (*Alouatta senicula macconnelli*) was photographed at Kamakusa in December. Most young monkeys in South America are not inclined to manifest the frolicking gayety or to indulge in the capricious and fantastic tricks that characterize the behavior of Old World monkeys of corresponding age and size. Their actions remind one rather of the slow, serious, well-seasoned manners of old people. Shortly after being taken these howlers refrain even from biting and become affectionate pets. But they should never be made captives as it is almost impossible to keep these leaf-eating primates in good health.

The adults are the strongest and most heavily set monkeys of the New World and evidently for this reason have been dubbed in British Guiana "baboons," a term which the negroes have brought over from Africa, where it is applied correctly to a large powerful ape of chiefly terrestrial habits. Troops of these reddish-brown howlers are especially famous for their vociferous sunrise serenades. Energetic in this performance, they show less virility in climbing about in their high leafy homes, seldom moving in great haste although they are by nature nimble-footed and are assisted by a prehensile tail

TREE FERNS ALONG THE TACOBA RIVER IN NOVEMBER

The gently drooping fronds of tree ferns are a strikingly pleasing feature in any landscape. The harmonious beauty of this shimmering grove, placed in an otherwise dismal swamp, sharply contrasts with the riotous variety of forms in the adjoining forest. Yet these graceful masses of foliage with their slender, fuzz-covered, brown stems, constituted a most forbidding thicket. Sharp, recurved thorns along the base of the leaves warned against approach

American Museum I received other valued privileges. At Kartabo, Mr. W. Beebe, director of the Tropical Research Station of the New York Zoological Society, extended his hospitality.

The more important ecological differences between the two regions are striking in their essential features. In both countries the temperature throughout the year is about the same, 85° Fahrenheit, with but slight changes day or night. The average annual rainfall also differs little, being always more than sixty inches, and the dry season lasting less than three months. In the formation of these forests, however, the relative amounts of rain and sunshine, humidity and heat, are significant factors.

In South America the generally more inundated condition of the ground is as marked as are the greater variety of plants and the denser and more united forest canopies. The larger number of palms and especially the conspicuous display of luxuriant epiphytic plants, such as bromelias, aroids, peperomias, orchids, ferns, and mosses have no equal in Africa, where the larger air plants—*Platycerium*, *Asplenium*, and other ferns that attach themselves to trees—are more widely scattered, and orchids are inconspicuous and few and far between.

Excluding the vegetation of mountainous areas and sections along rivers, the rain-forest formations in both regions can be roughly divided into three types: (1) the higher-lying, drier forest with magnificent columnar trees, about 150 feet in height, and relatively little undergrowth; (2) the intermittently inundated forests, generally considerably lower, with a more impenetrable and diversified flora, containing numberless climbers and air plants; and (3) the secondary forests on ground once cleared by man. Here there are a few predominant types. In South America the groves of "Congo pump" (*Cecropia*) and the "bastard plantain" (*Heliconia*) play the rôle assumed in Africa by the "umbrella tree" (*Musanga*) and what remains of plantains and bananas formerly under cultivation; and many large-leafed marantaceous and gramineous plants are common to both.

In equatorial West Africa, at least in the northeastern section of the Belgian Congo, where I spent several years, the rain generally falls within a few hours, and often this occurs during the night. At any season, therefore, there is an abundance of sunshine. In this area the gigantic trees are more scattered, the crowns of many reaching above the general leafy roof and appearing, as one looks down upon them from some height, like islands rising from a green sea. Such an arrangement admits more sunlight in the lower strata of the forest and rather favors the development of rapidly moving, gregarious, diurnal forms of monkeys. With the exception of a few lemurs the African primates are chiefly diurnal. They are much less specialized than their South American relatives and show no such parallel development with other groups as is indicated by different kinds of the smaller South American "squirrel monkeys."

In British Guiana, on the other hand, the rain, during what is called the "dry" as well as during the wet season, descends in frequent showers, and the hours of sunshine are considerably reduced by a more or less continuous drizzle.

These conditions may have brought about the peculiar arrangement of the vegetation. Certainly the dense clustering of leaves toward the roof of

LARGE-LEAVED AROIDS CLINGING TO TREE TRUNKS

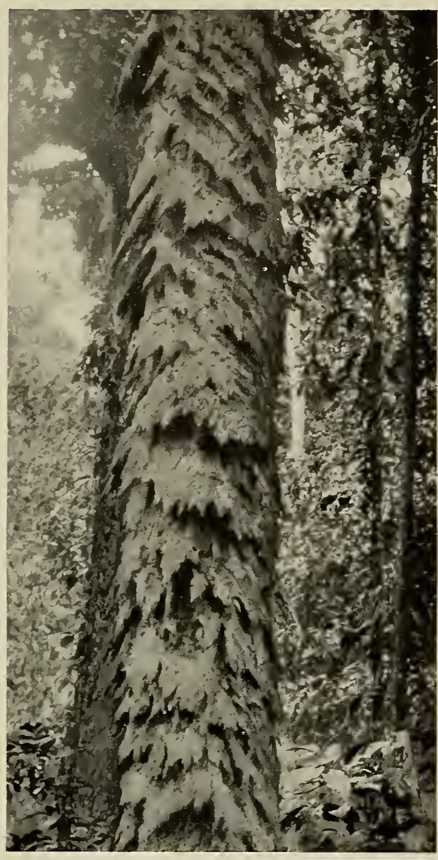
Sunny exposures on tree trunks are always apt to support clusters of air plants. Marvelous is the adjustment of the long-stalked, huge leaves, all placed so as to take advantage of every bit of sunshine. Were it not for their vertical position and remarkable surface structure these immense leaves—the larger are nearly two feet in length—could not meet the torrents of rain unscathed. Accidentally one of the vertical absorbing roots has been torn from the adjoining tree trunk to which it was previously attached by small, horizontal, anchoring roots, such as are seen on the tree trunk in the center

Long, pendent clusters of purplish young leaves in a leguminous tree.—In October and the months following, patches of bright foliage—green, pink, brown, and other colors—give pleasant variety to the otherwise somber forest walls. One is naturally reminded of the riot of colors in the woods of temperate regions during the renewal and the shedding of the leaves. The exceedingly rapid growth in the tropics of these freshly emerging leaves is probably correlated with their relative limpness and their propensity to cluster. Botanists have often ventured to delve into what is evidently one of nature's protective devices. Are these peculiar assemblages of drooping, tender leaves better enabled than would be scattered individuals to escape the ravages of heavy rain showers, strong sunlight, or excessive heat?

the forest in one unbroken canopy, or wherever there are open spaces, the situation of the air plants, abundant and luxuriant mainly on the sun-exposed side of the tree, and the large size of the leaves of many of them, as well as their position, would indicate adaptation for deriving the maximum benefit during the short time that the sunlight is available.

The gloom of these forests shelters a relatively large number of nocturnal mammals. Few are swift and many of the arboreal types in the different groups have a prehensile tail. The spider-, howler-, and woolly-monkeys, porcupines, opossums, and anteaters include characteristic instances. In Africa the only mammals which have any claim to a prehensile tail are two species of scaly anteaters, and they are really of Asiatic origin,—a region where a prehensile tail is a not uncommon appendage of mammals although less so than in Australia, where many of the marsupials are provided with such a grasping organ.

The peculiar environmental conditions in the tropical rain forests and their outliers of both Africa and South America have undoubtedly had still further influence upon the evolution, habits, and distribution of the principal types of their distinctive mammals. In West Africa the essentially greater extent of the higher-lying forests (those of the first type) allowed a variety of mammals of large size to become established. Thus we have there elephants, buffaloes, a host of antelopes, several large carnivores, and—most representative of all—the large endemic an-



Conspicuous in the midst of their leaf-bearing neighbors are the gigantic trunks of dead trees, often more than a hundred feet in height, covered with formations resembling reddish soil. Myriads of termites, or "white ants," burrowing in the tree, have transformed the dead wood on which they feed into these structures, the numberless tips of which, reminding one of the reversed points of a coronet, drain off the rain when it descends in torrents and thus assure the tiny builders a secure abode and shelter. Every particle the insects devour serves to reinforce their home externally and to extend the immense network of galleries through the tree, until the final collapse of the trunk seals the fate of the aërial abode of these ruthless tunnelers

thropomorphic apes,—the gorilla and the chimpanzee. In South American forests the swamp-loving tapir, a few deer, and a jaguar are the largest mammals. Most other good-sized terrestrial forms are either aquatic or cursorial in adaptation, which allows their rapid escape in times of flood, when the change in water levels sometimes amounts to more than forty feet. While in Africa the antelopes have produced through adaptive radiation a large number of different forms, in South America it is the rodents which exemplify such a development.

As a rule in the immense areas of contiguous tropical rain forests of the equatorial belt mammal and bird life appear much scarcer than along clearings and river fronts, and on the open, more diversified stretches, which help to foster the gregarious instincts of herds and flocks. In rain forests, however, the fauna is scattered over many levels, from the ground upward to as much as 150 feet in height. To the newcomer it may indeed seem that mammal life is totally absent. A white man's progress through such dense vegetation, no matter how careful, is generally heralded from afar, so that most mammals seek covert long before they can be discovered.

Peripatus is a most puzzling creature with the rare distinction of having been considered at different times a worm, a mollusk, and an insect, though, according to present belief, not far removed from the millipedes. Fond of darkness, moisture, and decay, it lives in or about hollow, crumbling pieces of wood. The dull, velvety brown, extensible body has in life a peculiar iridescent "bloom." When the creature raises the anterior portion of its body, the feelers take an active part in directing the course. Thus the *Peripatus* readily avoids obstacles and though moving slowly, assisted by the tiny, terminally clawed legs, can assume any kind of position. A secretion of slime, withdrawn into the buccal cavity whenever the *Peripatus* stops, marks the glimmering trail and apparently furnishes an indication to others of its kind. Its prey—insects and spiders—may also be captured with slime that can be ejected from the oral papillæ for a distance of about six inches. Sixteen of these primitive arthropods were secured

The black puff bird (*Monasa nigra*).—These birds loved the edge of the large forest clearing that faces the river at Kamakusa, and proved to be rather confiding. Seldom were there more than three or four of them in sight at one time, and even then they would perch at considerable distances from one another. They frequently remained in the lower branches of the trees, returning to a chosen site even after chasing passing insects. In both sexes the dark, slaty-black plumage with a grayish under side is sharply set off by the bright scarlet bill. During January the short but melodious song of these birds, resembling that of the European black-bird, was by far the best vocal performance in the jungle. Furthermore, one or another of these birds was apt to gush forth its sweet whistling notes at any time from sunrise to sunset,—even at noon when the noisiest of birds preferred to remain silent. Although their song was so prevalent, Mr. Lang was surprised to find that apparently they had not been given credit for it. Only their sharp call had previously been recorded. Evidently the beginning of the year, when Mr. George K. Cherrie and Mr. Lang enjoyed the singing many times, is the courting season of these birds on the Upper Mazaruni.

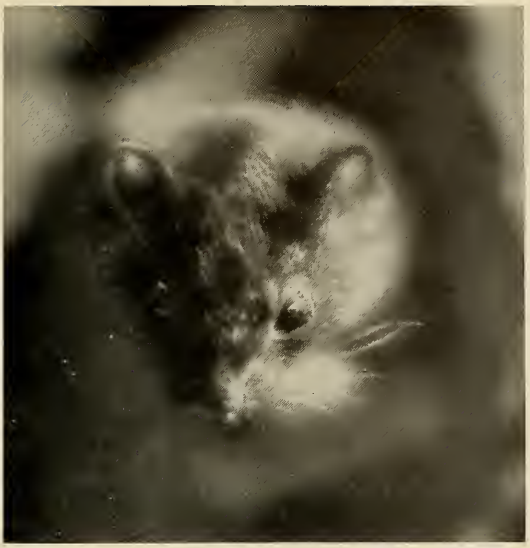
In the immediate neighborhood of much-frequented watercourses mammals are naturally scarce. It was a surprise to see the leisurely moving, reddish-brown howler monkeys, and the much quicker, small sakis. A few sluggish, rough-haired, three-toed sloths, resting huddled up in the fork of a tree might have been mistaken for a termites' nest. Never were we so lucky as to see herds of peccaries, a tapir, or a puma crossing the path of our boats, though later when on land we were more fortunate.

Time and patience, however, stood me in good stead. My efforts to secure comprehensive information about different groups of animals and about the forests were successful beyond my fondest hopes. I was also able to

These six tiny bats (*Rhynchiscus naso*) clinging to a snag were photographed near Kamakusa. On the Mazaruni, as on other rivers of tropical South America, several kinds of small bats rest exposed to daylight on the larger branches or roots projecting above the water near the banks. Though dark in color, they were not readily detectable until they fluttered up, disturbed by the approach of our boat. Some would shift to the opposite side of their perch, as they habitually do when bothered by the sun. This manner of roosting is peculiar to these small insectivorous bats of the Neotropical region. Such an unusual trait may be due to the abundance of bees and other hymenopterous insects that in South America preëmpt the available hollow trees and cavities which in other countries serve as the headquarters of bats of this type. In other respects these bats are as nocturnal as their close relatives in Africa, Eurasia, and Australasia, all of which seek retreat in dark or at least well-shaded places, although members of the family Megadermidæ are sometimes about during the day. At dusk they certainly prey upon the untold numbers of minute nocturnal insects on the great flowing highways. These bats have a body length of about one and a half inches enrich the collections of the American Museum in many different branches through the presentation of mammals, birds, turtles, snakes, frogs, fish, butterflies, ants and many other insects, as well as lower invertebrates, not to mention plants and a series of photographs and moving pictures. Some of the creatures proved new to science but all were most welcome, for from that part of the Guianas hardly anything had reached the Museum previously. What to some has been an awe-inspiring, fearful wilderness, to me was a magnificent playground. For months I was repeatedly thrilled with joy.

A female tree frog *Hyla evansi* with a cluster of twenty-four eggs on her back.—The future frogs, visible in some of the jelly-like spheres, are still in the stage of tailed larvæ with rudimentary limbs. According to Dr. G. K. Noble, they have a primitive type of air-breathing gill, to be described in a scientific paper that is in course of preparation. The eggs adhere to the frog's finely granulated skin by means of their gelatinous coverings that in the case of the outer ones form a narrow rim around the egg mass. The eggs are the size of a large pea, about one-quarter of an inch in diameter, and the body length of the frog is about three inches.

The frog was found at Kamakusa toward the end of January, sitting in the gloom of her self-chosen moist retreat, a large decaying tree trunk open on one side. Here she was probably able to feed upon the numerous insects always infesting such sites. Far from being hampered by her load of eggs, she could clear several feet at a jump without dislodging her burden. This species was previously known only from a single specimen in the British Museum



Photographed and copyrighted by H. H. Heller

Cholita, a little bigger than life size

Peruvian Pets

By HILDA HEMPL HELLER

Foreword.—Mr. and Mrs. Edmund Heller journeyed to the interior of Peru to collect specimens of mammals for the Field Museum of Natural History. Their route lay from Callao and Lima to Cerro de Pasco by rail, over the Andes, and down the Amazon. Several months were spent at different altitudes in the valley of the Huallaga River. The first collections were made at La Quinua and Chiquerin, a little below timber line at an altitude of about 12,000 feet. Ambo, a small town at the junction of the Yanahuanca River with the Huallaga, was then taken as a base. It is about 8000 feet in altitude and the climate is dry, not unlike that of southern California. Later followed a three months' expedition to the wet tropical valleys of the Chinchao and Cayumba rivers (2000–3000 feet) and to the flat plain below at Tingo Maria on the Huallaga. Collections were then dispatched from Ambo, and the expedition emerged from the valley of the Huallaga by way of the high Cordillera to the east. Pozuzo, at an altitude of 2000 feet in a rich tropical valley, was an excellent collecting site for a month. Then navigable water was sought at Puerto Mayro on the Palcazu, a raft was made, and the expedition fared down stream to Puerto Victoria on the Pachitea River, where additional collections were made. From Puerto Victoria down the Pachitea and Ucayali rivers to Iquitos on the Amazon, was a voyage of a week on a barge towed by the mail launch. Thence a two-weeks' voyage down the greatest of streams to Pará brought the travelers to the Atlantic Ocean.

IT is a very sad fact that if one is so devoted to animals that he renounces the world for the sake of studying them, he eventually finds himself in the unhappy position of killing the very things he loves. And though he kills for the sake of the science that is eager to know the shapes and sizes and colors of the wild things of remote districts, he ponders over the bodies of the beasts as he skins them by the lantern light, wondering how they lived and hunted, how they fed and loved, and how they reared their babies, and he wishes they were alive again. Always through his mind the thought runs, "We might have been friends, you and I, if things had been different.

The museum will be glad to get such a rare specimen as you, but what will it know of the real you from your skin and skull?"

My husband and I were two that loved animals. We hunted in the high bare mountains, in the wet steep forests of the eastern Andes, in the flat Amazonian plain. But the animals that came to us in sound condition, most of them by purchase, we kept alive, and made members of our household, giving them every comfort in our power and spending such spare moments as we could in observing their behavior and in photographing them. It was a rich experience.

CHOLITA

The houses of the Indians in the dry portion of the Huallaga Valley are solid mud structures with few chinks for the passage of small animals. Their kitchens are the dwelling places of innumerable guinea pigs. Under the doorsill or by the sash at night enter small yellow-bellied weasels to feast on the helpless rodents within. Sometimes a mother weasel is followed by a baby two or three inches long. The people love to catch these baby weasels; they tie a cord about their neck and tame them very easily. If taken young enough, it is said, the weasels will remain with their captors free of any restraint, but Cholita, who was caught half-grown by Old Basan of the neighboring village, was freed only when the room was carefully closed. Young Basan sold her to us. She was a beautiful creature. At first my heart did not warm to her, for she escaped from a close-barred parrot cage and very shortly buried her teeth in the scalp of Maria Louisa, one of our opossums. After that we kept her tied. She lived in a wool sock, turned double for warmth, and spent much of her time in sleep. Every morning we had breakfast at my bedside and Cholita's leash was transferred to a rod of the bed. Fried egg, placed on the edge of my plate, was her breakfast, and always she seized it and dragged it away.

After breakfast she played. To see her play but once was to love her. Sometimes she reminded one of a kitten, and was always lithe and graceful with a marvelous command of every movement. She had a pattering gallop about the counterpane, following a hand with incredible rapidity, or turned on her back and clawed and bit a finger gently, always very gently. With the whisking of a handkerchief she became madly active, transporting herself from point to point of its swing with almost invisible flashes of her brown body. Her joy in life was infectious; it made one long to be a weasel and to use one's muscles with her exquisite precision and grace.

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Cholita playing.—She would put her little forepaw on her string to balance herself

The day came when we had to take a long journey on mule back, and Cholita was chosen to accompany us. She traveled in a canvas game bag that contained her sock, and was slung on my back. At night she reposed in my sleeping bag, nose-to-tail in a ring of the proportions of a doughnut, and lay between my knees and chest as I was curled up in the army blankets. Sometimes, waking, I feared I had crushed her in turning while asleep. Then I would pick her up to see how she was. Always I had to manipulate her limp body for some seconds before I could find a sign of life. Such a sleeper! She never went to sleep in the open, apparently for good reason.

We found that one of Cholita's habits, perfectly harmless in the uplands, was very inconvenient in the montaña. She always dragged some portion of her meat into her sock with her in order to keep it for further feasting. Here in the tropics the ants soon found it and we were obliged always to remove all traces of meat when she was through eating. It was funny to see her attack food that was covered with ants. She would make a grab, shake the meat and drop it in a clean place, then shake it again till it was free. When the ants bit her hind feet, she stamped the floor rabbit-wise with both feet repeatedly.

Cholita did not defend her food from us. Neither did she thank us for it. She beheld it, grabbed it, almost saying, "That's mine," and ate ravenously. If we took it away, she made no threat. One day, however, I had a surprise. Her cord, as usual, was pinned to my blouse—I wore her much as one does a watch. In my left hand I held a tiny opossum; on my right, at the end of her leash, was Cholita, straining to reach her game. But this was not to be her game, and I took the opossum away. However, her mechanism of attack had been sprung, and she assailed blindly, not the opossum, but me. Her tiny mouth grabbed fully a chunk of skin on my wrist and then she started to kill that wrist. From side to side she wrenched her head and shoulders violently and with force incredible for a thing so small. For several seconds this continued till she came to her senses, let go, and "was friends" again. Her short teeth almost went through the skin, and points of blood appeared. I believed she had suffered a brain storm and did not punish her.

On another occasion, however, I tried to see if she could be trained at all. I wanted to have her with me, and was at work stuffing mouse skins. On the table lay a tiny skin well rubbed with arsenic and rolled tight. This she seized. I took it away and gently snapped her nose. She grabbed it two or three times more, each time receiving a snap, and once she threatened mildly by opening her mouth as a cat does. Then she let the skin alone and I had no more trouble.

We were always afraid diminutive Cholita might meet her end by some animal's attack, or by being stepped on. But we should have looked out for smaller enemies. The wet montaña was not her country, for she was a child of the desert. She abandoned her sock one day for a tunnel at the base of a stump. "How nice!" I thought, "Just the way weasels like to live." And I let her enter her hole and stay there for a time. The next day came a mad voyage down turbulent rapids in a ponderous dugout. Time and again we shipped water. My blouse was soaked; Cholita, inside my clothing, was none too dry. The following morning my husband saw her lying on the earth outside of her sock and began a loud lament. She was unable to move and he thought she had been stepped on. I felt the little body but nothing was crushed. She was breathing very fast. Pneumonia! I put her in my blouse and in five minutes she was dead. Two very sad people worked silently and tearfully at the skinning that day.

RUGUPI[1]

One of the first obstacles the traveling naturalist must overcome is that of vocabulary. Each valley has some animal names different from those of the next and each has some creatures distinct from those in the last. The people one encounters know some of the animals by sight and some by description. Occasionally these descriptions are very weird, for one may hear of a beast combining many of the attributes of a bush-running rodent and a tree-climbing carnivore. The naturalist must inquire constantly, weigh hearsay evidence carefully, and hunt for material evidence unceasingly.

Late in the afternoon of a perfect day of wandering we arrived at San Antonio, one of a string of coca *haciendas* owned by Don Agusto Durand. With the gentlemen of the *hacienda* we had a spirited conversation concerning the animal population of the valley. Suddenly the *administrador* of the *hacienda* turned to his companion, saying, "Shall we show them the animal?" And he sent for it.

It was a beast such as I had never dreamed of. About ten inches long, disproportionately wide and corpulent, with a massive rodent head, a curious chopped-off chunky tail, gray extremities, and a blackish-brown coat longitudinally striped with tan spots. Its manner attracted more attention than its shape. It was angry, and made a noise of great protest, more like that of a fox squirrel scolding a cat than anything else. It was set before us by the cook, a plump Indian girl. It objected to being introduced, fled to the skirts of the cook, and when I tried to pet it, charged my feet abruptly.

"That is called 'rugupi,'" said the *administrador*.

"That is called by the *científicos* '*Dinomys*,'" said my husband.

A month later we were the fortunate possessors of Rugupi. The kind *administrador* presented her to us in the interest of science and of friendship. I carried her up the mountain to our camp on horseback in a gunny sack, to which she objected and in which she fought. She was hot and winded and I put her in a dark corner and wet her head. Later she scolded me furiously when I approached her but, when I sat quietly without touching her, she fell instantly asleep.

Rugupi was a great prize and we guarded her carefully. First on the list of mammals desired by the museum was the *Dinomys*. For nigh fifty years the unique family of rodents to which it belongs was known by one solitary skin in the museum at Warsaw. Then there appeared at the Zoological Gardens in Pará two strange creatures that were greeted with great interest by the director, Doctor Goeldi. Frantically he searched his texts. "At last," he wrote, "I realized that I had before me the almost mythical *Dinomys branicki*." When an animal that until recently was "almost mythical" comes to eat with you, sleep with you, and travel with you, you start walking on air right away. I passed Cholita to my husband's cot, Rugupi slept on

[1]The word is spelled "rucupi" by the Peruvians, but the "c" is slightly voiced, and the spelling "rugupi" better expresses their pronunciation.

mine. We observed her every movement and spoiled her as one spoils only that which is given him by divine favor. We became obsessed with our research into the habits of rugupis in general and of our Rugupi in particular.

Rugupis are dwellers in cliffs of the wet forest country. They are Andean only, and cross to the western slope of the Cordillera solely in Ecuador, where the forests cover the western declivities. They can exist only in steep places, for to escape their enemies they must rely on their single acrobatic feat, which is to balance themselves cautiously where others cannot climb. Even when well grown, Rugupi's fastest pace was slower than our walk. Usually one could observe that whenever Rugupi placed a foot, she felt of the ground first before bringing her weight to bear. It irritated her terribly to be lifted or carried. She had little control over her ponderous body and always sought to remain on the firm earth.

Rugupis live in caves and rock piles, and want walls behind them. Once we camped by a cliff with caves in it and Rugupi deserted my couch for a cavity into which she fitted better than a snail fits its shell. She always loved the seclusion of a cupboard and if she ever saw one open, she observed which way its door swung and later gnawed the outside of the cupboard doors by the latch in order to open them, and did not gnaw near the hinges. In many other ways she showed a marvelous memory for location.

When we met Rugupi, she had a firm attachment for the cook which she was later able to transfer to me. She slept all day, but lightly. Although we left her apparently dormant in a remote corner, she soon started to gnaw the inside of the door once we were

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Rugupi had a firm attachment for the cook, a plump Indian girl

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Mr. Heller and Rugupi

outside. When I wished to extract her from her snail-shell cave, I sent the others away and remained silent near the opening. In three minutes she was out, calling, "Oop? oop?" Her fear of being alone was always apparent; she followed us in our walks, often at a rate unsuited to her short legs and shorter wind. She also loved smaller animals and was exceedingly gentle with them, which she was not with us.

Because they cannot run, the rugupis are intensely cantankerous and belligerent. Their signal of defiance is a loud sudden blast of air through the nose, sounding exactly like that of a bear. They wheel and charge on very slight provocation, but try to keep a wall at their backs. Rugupi's milder slashes, made in pettish moments, were like knife cuts ånd produced many scars, for her teeth were as sharp as broken glass. Once, in the night, I felt the full force of her angry bite. We were in a colder country than hers, and I wished to cover her when she crawled from her usual station at my feet up beside me. She did not understand and bit my thigh with all her power. She was then less than half grown. Luckily there were two blankets to protect me and the teeth did not cut through them. The pain was intense and the black and blue spot that followed was very long-lived.

Another local name for rugupis is *carron*, and yet another is *machetero*. The latter refers to theii habit of clearing their trails of branches; they trim away all the twigs and their trails may thus be distinguished from those of pacas. With us Rugupi had no trails to clear. So her cutting energy was diverted to whatever else she could reach. There was not a piece of furniture or harness, a boot or camera case or reachable trinket that did not show nicks or slashes or holes. Even the mud walls of our room suffered.

At table, if we gave her a plate with various vegetables, fruit, bread, and meat, she always ate the meat first, and was impartially devoted to the

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Mrs. Heller and Rugupi, whose glossy second coat is appearing other foods. I shall not venture to state how much she ate, as no one would believe me. In camp she wandered at will and preferred shrubs and the roots that she dug to grass. In the evening after a long day of travel she would go out in the brush and feed. At intervals of about three seconds she uttered a cozy little musical call that may be transcribed, "Oop?" and if we called to her, she invariably answered, "Oop." When we retired and the light was out, she promptly re-entered the tent and, if we slept on the ground, took her station for the night in a sitting posture between our heads, or, if I were on a cot, she slept under my head.

Most remarkable was her use of her tail, feet, and hands. She was almost as much of a tripod as is a dinosaur or a kangaroo. The tail was an indispensable part of her sitting equipment. I make no claim that it was prehensile, but she used it often in negotiating difficult places around rocks and would push with it, and to some extent balance with it, and even hook it on to rock edges for an instant. We found it exceedingly useful as a handle, and often remarked that Rugupi probably wished she were a paca. She was superplantigrade. Her hind feet were like rockers, she did not place the whole foot on the ground at once when walking, but used the front two-thirds of it. But if she stood on her hind legs and tail to reach, the higher she stretched, the higher her toes went into the air. All food except the veriest liquids she took into her hands. She made an awful mess of soup which she regarded as a solid. She usually picked up food in her mouth and then seized it with one hand if it were small, or sat up and grasped it in both hands if it were large. She was thumbless, but what would have been the ball of her thumb if there had been a thumb served very well instead.

I carried Rugupi five days on my back over the most difficult trails imaginable to Tingo Maria, and four days on the return journey over the same trail, and then on muleback to Ambo. When we started on the next expedition to the far-off Amazon, she was too big for me and we hired a man, then a horse, and later another man to bear her, and she was somewhat expensive as the journey was long. But she was worth it, and anyway we loved her and do yet. She is now in Lincoln Park Zoo in Chicago; her coat is sleek gray and black with white spots; she sleeps all day; and, sad to say, has no furniture or leather goods, toothbrushes or pencils to investigate at night.

TIMMIE

Timmie was a *zorro de las alturas*. *Zorro* means fox, and Timmie was much like a fox in appearance. His closest relatives, however, are the wolves, not the foxes, though his scientific name is not *Canis* but *Pseudalopex*. We called him a wolf.

Timmie came to us in the arms of the sturdy son of our former *arriero*, or muleteer, Maïs. The home of Maïs was high on the mountain above Ambo, perhaps at 11,000 feet. The family of Maïs had had Timmie for two weeks and the animal was well-nigh starved. Timmie's twin sister had died from lack of food. In addition to being famished, Timmie was covered with fleas and very dirty. I filled a large photograph tray with water, put on a rubber apron, sat down in a good light with Timmie and a box of pyrethrum powder, and did murder on innumerable fleas. Then I went to the sole practitioner of medicine in the village, a Japanese, and bought santonin of him, which I administered. After he had been a few days on a diet of milk and fresh birds there was a marvelous change in Timmie. From a shadowy bedraggled wisp of life he became a

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The son of our *arriero* brought us a starved wisp of life which he called a *zorro*

dainty brisk little wild thing that played about the room whenever he thought he was unobserved.

The keynote of Timmie's character was fear. His name Timmie was derived from *timido*, not *Timoteo*. He was an adept at hiding, and to win his confidence was a labor that I did not understand as well as my husband did. I was, for one thing, too interested in keeping Timmie clean. He did not want to be clean, he had not the remotest aspirations that way, and to clean him I had to handle him and comb him, and he did not want to be handled. Moreover, I made the mistake of supposing that he could be mildly chastised for biting, and early set about training him not to bite. It didn't work. Timmie was not a dog. His sole reaction to my caresses was to bite me; and to my slaps, to hate me. My husband started to handle him with gloves when he was ridiculously small. I laughed at him but he was right. Timmie bit him frequently, both in play and in fear, but as they grew better acquainted, there was more play and less fear; later Timmie grew to love and trust my husband and became a veritable one-man dog to him, but my husband never abandoned the gloves.

Only when we first had him, did Timmie utter any kind of call: a high-pitched clear succession of descending notes, only a few, that stirred the heart with memories of Wyoming hills. It resembled the opening notes of a coyote's call, but was high and faint.

When Timmie was first brought into the room, Rugupi beheld him from a considerable distance. "Woooo, woooo, woooo," she called, low and affectionately. We placed him before her and she buried her teeth in his wool caressingly. From that moment she appropriated him. She deserted my couch and slept with Timmie. She was infinitely patient with him and his nips at her heels spurred her on into playful lumbering gallops about the room. Rugupi was not built for gallops; invariably they ended in her colliding with some obstacle. Rugupi always defended her food from us. One morning at breakfast she was presented with a piece of bread, the first bite she had had since the day before. She rose on her hind legs, deliberately adjusted her balanced sitting posture, and bit into the bread. Timmie darted alongside, grabbed her breakfast, and made off with it. She accepted this as demurely as though it had been a favor.

Later we acquired another small wolf, that lived with Timmie. We journeyed to Huánuco to find transport for our next expedition. We lived in a windowless room that had not even a pane in the door. It was on the ground floor of the *patio* where everyone passed. We called it our *cueva de moscas*, or fly cave. Oh, the misery of that room! The two little wolves were, mildly speaking, dirty nuisances. The dainty opossums, immaculate Cholita, prudent clean Rugupi,—it was only a pleasure to live with *them*. We kept a trunk before the door to keep the wolves in. Their scissor-like teeth tore holes in my beautiful new highland wool blankets. They mauled each other all night. I would put Rugupi on my bed to save her from their too boisterous play, but she would walk the edge of the bed awhile and then jump down. One night Timmie killed the other wolf. He meant well, but didn't express himself tactfully enough. The next morning he disappeared, possibly in search of his missing companion. My husband walked the courts disconsolately seeking his beloved pet. I must tell no one he was lost, as *zorros* are very famous chicken thieves, and the place swarmed with chickens. In the afternoon my husband fell asleep. When he awoke, Timmie was beside him.

There was a boy from Llata that served our meals. One night he said, "That *zorro* will be very useful to you."

That Timmie could ever be of any use had not occurred to my most active imagination. "How?" I asked.

"When you travel, he will bring you chickens," he answered. "We raise

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Rugupi appropriated Timmie for her own

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Timmie, the *Pseudalopex*, in his woolly infancy

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Timmie was long in losing his bluish wool and changing to a reddish wolfling them for that. When you travel, you let the *zorro* free at night, and in the morning there will be a row of chickens by your bed, six, eight, ten."

"But how about your own chickens, at your village where you raise *zorros?*"

"Oh, one must have a permit from the sub-prefect," he answered, "And swear never to let them go free there. But when one travels, that is different." Oh, Peru, Peru, Peru!

In Pozuzo it was warm and Timmie grew fast and lost his downy gray wool and became a reddish-yellow, coyote-like beast. I loved Timmie, but he was such a trial! I banished him from our living quarters and he was tied near the schoolhouse opposite. My husband's ingenuity was taxed to the utmost to devise ways to keep him tied. His scissor-like teeth cut every rope, his lunges broke every available chain. He was a watchdog of the first order, growling and snarling at all passers-by. But to my husband he would come trotting to be petted. If he got loose, he hid till my husband called him, and did not molest any chickens.

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Timmie grew to be a fine little one-man dog to Mr. Heller

We traveled six days afoot to the Palcazu, Timmie in a box tied above that of Rugupi, and later reached the Pachitea. We had no cage for Timmie and he was tied in a launch towed on the right side of the mail launch, while we were in a barge on the left. One night as I slept a live mass of wriggling small wolf jumped on my ribs, then on my husband's ribs, and then on our boy's ribs,—leap, leap, leap from bed to bed. "Timmie's loose, tie him up," I woke my husband. But the knots he made were useless. Timmie cut them, and in the morning was gone, into the mighty Ucayali probably, and we were sad again.

SEÑOR HUAMÁSHU

When Cholita died, we missed her very much. On the trail from Tingo Maria as we stopped to rest and take Rugupi from her bag to let her walk about, my husband would say, "When we rested here before, I had Cholita, and let her run around on that log." We wanted another weasel if we could find one.

In the valley of the Chinchao we bought a couple of skins and skulls of a giant relative of Cholita's, black, with a gray-brown head, short legs, and a long tail. This animal was called by the natives *huamatáru* or *huamáshu*. The two names were usually given, both in the valley of the Chinchao and that of the Pozuzo. From the skins and meager textbook descriptions we made out that this animal must be the tayra, or *Galictis*.

There was a fascination about the black musteline skins from the Chinchao, and gradually my wish for another weasel transformed itself into a still stronger desire for a tayra. What would one be like: would it be gentle and playful like Cholita, and might we be friends with it?

We started on our second expedition for the montaña and one day reached a high valley of the puna, at 10,000 feet, and stopped at the pastoral village of Chaglla. There we were met by our contractor of *arrieros*, Don Antonio.

"There is an animal here, let us see if the Señora knows what it is." Questions were useless; he only repeated, "See if you know what it is," and led us to a mud hut. There on the floor was a small black animal, running free but with a string tied to his neck and, as he ran, he muttered, "Up-bup-bup, bup-bup-bup, bup-bup-bup."

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Rugupi and Timmie were carried by a coca-soaked *cargador* on the journey to Pozuzo

Delight filled my heart. Did I know? "*A huamáshu! A huamáshu!*" I seized him and showered him with caresses. I kept him with me and made too great display of my joy. Niséfero, his owner, lent him to me for two days and then asked three pounds as his price. I beat him down to one and a half pounds, and paid for my treasure.

"*Mejor pagar primero, cariñar despues,*" (Better pay first, show your affection afterwards) was the pat remark of Don Antonio.

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WHAT NEXT?

There is no happier-natured creature than a tayra unless it be a baby tayra

I passed Rugupi to my husband's care and took the baby creature for my own. The little tayra's home had been in the high forests over the great divide that lay before us at an altitude of about 8000 feet. Niséfero's brother had shot the mother, and on her back, a little before the tail, found a tiny baby, blind and helpless except for the fact that it was able to cling tightly to the mother's hair. The man was bound for the highlands, a long journey, but he kept the baby warm and, when he arrived in Chaglla, it was still alive. Niséfero had a large bitch with puppies; he killed the latter and gave the mother the tiny black stranger, who, blind though he was, had not the slightest doubt as to what course to pursue. When we arrived, he had just been weaned because his teeth were injuring his foster mother, and he was on a diet of crackers and coffee.

Soon we learned what an appetite, a hearty genuine appetite for food, was like. Never did a creature defend his property so savagely and blindly from all comers as did little Huamashu. A dish of crackers was set down; he pounced on it and began gobbling furiously but, as he gobbled, there was a constant accompaniment of coughlike sputtering sounds—one could hardly call them growls—and if a hand approached him, it was immediately seized and bitten with a tenacious mangling bite.

At other times our new pet was the most amiable, jolly, affectionate, and lovable creature it has ever been our pleasure to know. He would not be a musteline if he were not playful, and he played all the time that he was not engaged in sleeping. Like Cholita, he slept very soundly, and it took seconds to wake him, but unlike her he slept curled up in the open and only sought cover for warmth. His play consisted in climbing wherever he could climb to; he was able to proceed sloth-wise upside down as well as right side up, and to do so much faster than a sloth. A hand he always seized in all four feet and mouthed, closing his teeth on it, biting it and shaking it, always gently. Toys were a great delight to him, and once, when he had embraced a roll of paper and was clawing and biting it, I started to remove his plaything and that strange frenzy of defense of property took possession of him; he gave my thumb a terrible punishing.

The mustelids, which include the weasel, mink, fisher, martin, skunk, wolverine, and otter, respond to the presence of a possible victim by a blind furious attack, during which they are electrified by an all-compelling power, and perform unbelievable muscular feats. So strong is this instinct that it often lures them to their own destruction. They frequently attack creatures larger than themselves and can endure a terrific amount of battering. It was impossible for us to punish Huamashu. Any slaps we felt cruel enough to inflict were taken cheerfully as part of the game and had no disciplinary effect whatever. One night Huamashu was tied to a balcony on the third floor of the high-ceilinged hotel in Iquitos. A thunderstorm frightened him and he leaped. His head slipped the collar and he fell to the ground. The next day I found him in a shop more than half way around the block (he would not cross streets) and his only hurt gave him a slight limp.

Although many of his relatives are strictly carnivorous, our new friend was anything but that. The tayras are known as chicken thieves, but are also famous fruit eaters. Along with their omnivorous habit goes a marked social one; there is food available for families traveling together. An elderly woman of Pozuzo told me that in her youth she had seen twenty-five *huamáshus* in one *Annona* tree, eating annonas. Probably like the weasels they are great wanderers—the fact that a blind baby rides in his mother's fur would indicate such a habit. Huamashu ate any fruit, cooked vegetable, bread, or rice. He defended a banana with more courage than a piece of meat, but freshly killed game with more ferocity than a banana.

Tayras have comparatively narrow skulls and broad heads. A gigantic masseter muscle curves over the skull; in the adult the middle of the top of the head shows a deep depression between the masseters. I often wondered what the killing bite of a grown tayra would be like when I remembered Huamashu's formidable baby efforts, made with undeveloped muscles and milk teeth. The jaw is very short and broad, the muzzle does not resemble at all that of a weasel or fisher. When a tayra bites your finger, the feeling of great power is behind the grip. He nervously shifts the bite frequently, but in such short time intervals and for such short distances that, even though you hold him in one hand and pull on your tortured finger with the other, it is some time before you can free it. The tayra is the bull dog of the mustelids.

The neck is powerful, almost as large as the head, and built for shaking heavy prey. The shoulders and forearms are well muscled; heavy muscles reach to the wrist. I never saw Huamashu dig or grub in the earth like a coati, but frequently that which could not be reached with the jaws could be touched with the claws, what could be touched with the claws could be hooked closer and grasped with the hands, and brought to the mouth. Huamashu was always reaching for,

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Looking out and below.—At the time this picture was taken Huamashu's tail had already become an effective balancing organ

grasping, and holding things; he also explored cracks with the claws of his middle digit. I shall never forget what happened to a georgette crepe dress that one night in the dark floated within his reach.

Some of the tayra's morphological adaptations are exceedingly puzzling. In eastern Brazil and the Guianas the tayras are quite different from our Huamashu. Their tails are much shorter and not so heavily haired; their country is frequently inundated, while Huamashu's is not,—he came from the mountain-sides. A long bushy tail is an excellent balancing organ but an impediment in the water. When I told a zoölogist that Huamashu was not particularly aquatic, that he had learned to run through puddles but refused to enter deep water, the gentleman was surprised, saying that the animal's feet are webbed. The feet are not webbed like those of an otter or a duck, but the broad flat fore paws are somewhat loosely built and the toes are connected by skin to a more distal joint than are those of dogs and cats. Perhaps we may conclude that our Huamashu belongs to a species derived from one of mixed aquatic and climbing habit—a habit almost necessary to a hunter in the Amazonian country—and that his branch of the tayra family has become more strictly one of tree dwellers. I have no doubt his broad paddles would have served him very well in the water.

He was entirely plantigrade in front, and the whole front sole was covered with a pad clear to the wrist, whereas the hind foot was padded only half way, and he trod only on the padded portion.

Huamashu's tail was not prehensile but he could push strongly with it, exerting force along at least half its length. When he was frightened, which was whenever he saw a horse or cow or automobile, his tail hair stood on end like that of a cat, giving the member a tremendous size, but he did not elevate the tail as a cat does hers.

When he was not excited, especially in his youth, Huamashu's attitude toward other animals was exactly what it was toward us, friendly and playful. Rugupi and he were great chums and he played with such dogs as were willing to play with him, and with our ocelot, Tammany. His play was, however, always a little too rough and persistent for the other fellow. He and the pet coati, Nita, played joyfully together, but Nita must be free and Huamashu tied, otherwise it was not safe for Nita. So long as another animal showed no fear or fluster he had no inclination to attack it but, if it tried to elude him, he grasped it in play and, if it struggled, he then became excited and was transformed suddenly into a magnificent killing engine. Thus a small or defenseless animal had no chance with him. Nearly every time he got loose he killed something. The bill that we had to pay for pet parrots and monkeys amounted to quite a sum. He was never permitted to eat any of them, though to separate him from his prey the protection of a pair of jaguar-skin gloves was needed.

When Huamashu was three months old and about nine inches long, not counting his tail, we took a six-day journey on foot through the drenching forests over a trail criss-crossed by fallen logs. Most of the way he walked, following a porter and pulling me by a string. His endurance was astounding, his vitality magnificent. I taught him to climb the logs instead of going beneath them by lifting him a bit on the string but, when he got on top, he recognized the log as his natural highroad and usually started to run along it. After a few miles in the rain and puddles he consented to go to sleep in a sack on my back for an hour.

In Pará Mr. Fisher made a cinematograph of him and some of the other animals for Mr. Newman, the lecturer, and in Chicago Mr. C. T. Chapman photographed his playful antics for the Pathé Company, who exhibited the film in their weekly news. Huamashu lived for ten months in the Lincoln Park Zoo in Chicago and never lost his affection and gentleness toward his friends, though I confess one had to be rather hardy to call his play gentle. The Field Museum is about to mount him for exhibition purposes, and I hope his expression of bright interest and friendly playfulness will there greet all lovers of vital, hearty, affectionate wild animals.

Photographed and copyrighted by H. H. Heller

There never was a better companion than little Huamashu

Photograph by U. S. Army Air Service

BARRO COLORADO, IN THE PANAMA CANAL ZONE, VIEWED FROM AN AËROPLANE

As this picture indicates, the island is covered with a dense mantle of jungle,—a protective armor, it might be called, for it has enabled Barro Colorado to escape the casual despoiler and to preserve intact objects of interest for the visiting biologist

Hunting Stingless Bees

WHERE EAST SEEMS TO BE WEST[1]

By FRANK E. LUTZ

Curator of Entomology, American Museum

ONE of the numerous advantages of the study of insects is that interesting and important material is near at hand wherever we may be—on land, at least. When hundreds of different species in our own back yards are living as yet unrecorded lives, probably full of curious ways that possibly man may never quite understand, journeys to distant lands are not essential to success. Fabre, the most widely known of all entomologists, showed what a stay-at-home can do; his work illustrates also how narrow such an one may become and how desirable it is to see beyond the confines of Sérignan.

At any rate, a museum man does not always have a choice in this matter. It was my task to get the nests and young of several species of stingless honeybees, as well as notes on their habits. Such tropical creatures as *Trigona* are not to be expected in New Jersey even though I did once catch in the northern part of that state an equally tropical bee, a magnificent *Euglossa,* feeding at my petunias. Such being the case, I started for Panama. We called at ten Haitian ports on the way, and the cordiality of the people at these ports and the attractiveness of the country would under different circumstances have strongly tempted me to cancel the rest of the trip; but, while Haiti is noted for many things, I could not persuade myself that the particular kinds of stingless honeybees I had set out to get were to be found even there.

In due course of time, I reached the hotel at Ancon and, putting my little "Sunday net" in my pocket—it being really Sunday—started to explore. Interesting insects are to be found even in cities. It is just as I said in my opening sentence and here is a proof of it. Not a hundred yards from the Tivoli I saw a stingless bee—a red-bellied *Trigona*—fly up from the edge of the cement pavement; then another and a third.

As a matter of fact these bees had a nest under the pavement, and the surprising thing about its location was that the species concerned was supposed to nest in hollow trees. I wanted not only specimens but a close look at the entrance to the nest. Thirty-odd years of collecting insects has somewhat hardened me to the gaze of passers-by, but this was my first day in the country and it was Sunday and the streets were rather crowded and, what is more, it really is not quite the thing for a dignified, bearded American to be seen on his hands and knees on the pavement that close to the boundary between Ancon and Panama city. People might not understand.

Fortunately, there was a low iron rail along the edge of the walk, so I sat on the rail as though I were resting or waiting for some one. It is all right to do that. And if one drops something in the grass, it is all right to stoop over to hunt for it. Watching my chances, I was frequently able to take my net out of my pocket, catch a bee, and put the net back again without attracting much attention. Once or twice I even had a chance to blow tobacco smoke down the hole in order

[1]Photographs by the author

Where the ocean liners now cross from the Atlantic to the Pacific, there was formerly a barrier of jungle. A dwindling, denuded remnant of this forest still shows above the surface of the water. Note the bird perched on one of the forking branches of the most conspicuous tree, undisturbed by the approaching steamer

to make the bees come out in greater numbers.

The next day I suggested to Acting Governor Walker that it would be nice to have the cement pavement taken up so that I might get the nest. Although he had already granted me many favors, his only reply to this suggestion was a cordial hope that I might find a nest of the same species in some less expensive place. This seemed reasonable and, with the kind help of Mr. James Zetek, I made arrangements to go to Barro Colorado.

On the left is Mr. James Zetek, to whom the expedition of the American Museum to Barro Colorado is indebted for counsel and other aid in carrying out its plans. Mr. John English, on the right, also gave valued assistance

Before the Canal, including Gatun Lake, was constructed, Barro Colorado was a high hill. Flooding the surrounding country made it an island, the largest in the Canal. Recently the government has set it aside as a biological reservation, and steps have been taken to establish there a station for students of tropical animals and plants. The nearest point on the railroad is Frijoles, the location of a plantation in charge of Mr. John English.

Mr. English came to Panama from Jamaica to work with the French on their canal and, except for short intervals, has been in Panama ever since. His skin is black but, like many of his

Unrelaxing attention to problems of sanitation, epitomized in the campaign against the mosquito, made possible the building of the Canal. Today the construction of ditches for the purpose of drainage and in the interests of disease-prevention still goes vigorously on under the direction of Mr. J. B. Shropshire, Sanitary Inspector of the Army; and others

race, he is "white" in his dealings; kind, efficient, interested in nature, and eager to help. It was through him that I bought a *cayuca*, or native dug-out canoe, and hired Murillo. Murillo was also black and kind, but not much else.

The *cayuca* having been loaded with our camping outfit and other duffel, Murillo and I started for the island late one afternoon. However, when we reached the more open water of Frijoles Bay, we found that a wind was ruffling the surface of the Canal to

Murillo paddling a native *cayuca* near the scene of his initiation into the trials and tribulations of an assistant in scientific collecting

such an extent that riding in an overloaded *cayuca* was exciting. Murillo assured me that he was not afraid for himself but that he did not want anything to happen to me. Neither did I, so we went back to Frijoles and I stayed with Mr. English until the next morning.

On our second attempt we reached the island after about two hours of pleasant paddling in the early light of the sun, rising in the east, to be sure, but out of the Pacific, this confusing phenomenon being due to the twisted position of the isthmus. Mr. Shannon of Washington had been working on the island earlier in the season and had built a small shack at the head of an inlet, which we named Shannon's Cove. The shore of the island, being the old mountain-side, is steep. "Barro" means clay in the dry season and slippery mud in the wet, the season in which we were there; and, although Mr. Shannon had been gone but a short time, the trail to his shack was already partly overgrown. However, we made a landing after unintentionally disturbing an alligator or one of its near relatives, and Murillo started to clear the trail. He had gone only a few yards when he yelled "*Pica! pica!*" and came back running, jumping, and sliding. He had cut into a bush containing a wasp's nest, and *pica* means sting or something of the sort. I was having a little *pica* of my own because I had carelessly caught hold of a prickly stem to keep from slipping, so he received scant sympathy and a request to leave the wasps' nest alone until I had time to collect it. This was a new angle to him, for he had never before been out with an entomologist.

The shack had a floor and a roof. The three open sides were screened with copper mosquito netting except for the doorway, and there was no door in the way, so that, on the whole, the enclosure made a rather good trap for

SHANNON'S COVE

This inlet Doctor Lutz named Shannon's Cove in honor of Mr. Shannon of Washington, who earlier in the year had constructed a shack at its head. The view shown on the left is that on which the eye rested as one looked out from the shack. The picture gives a good idea of the sculptured coast of the island with its many indentations.

Before the construction of the Canal, Barro Colorado was a hilltop, and although water today covers its base and reaches far up on its side, its mountainous character is still traceable in the steepness of the banks up which the traveler scrambles —often painfully, for the support at which he grasps to steady himself may easily prove to be a prickly growth

THE CAMP IN THE COVE

The unoccupied shack of Mr. Shannon, discernible in the center of the picture on the right, simplified the housing problem of the expedition, affording a roof overhead, even if a leaky one, and plenty of fresh air, which, along with sundry other things, found free admission through the doorless entrance. Indeed, due to the fact that the shack was screened on three sides, it proved an excellent insect trap, being visited even by the stingless honeybees which the expedition wanted particularly to study.

The incisions made in the jungle by trail-cutting are quickly healed, and in time not even a scar remains, abundant verdure covering over the area laid bare by the machete. The trail to Mr. Shannon's shack, which had been only recently cut, was partly overgrown at the time of Doctor Lutz's visit

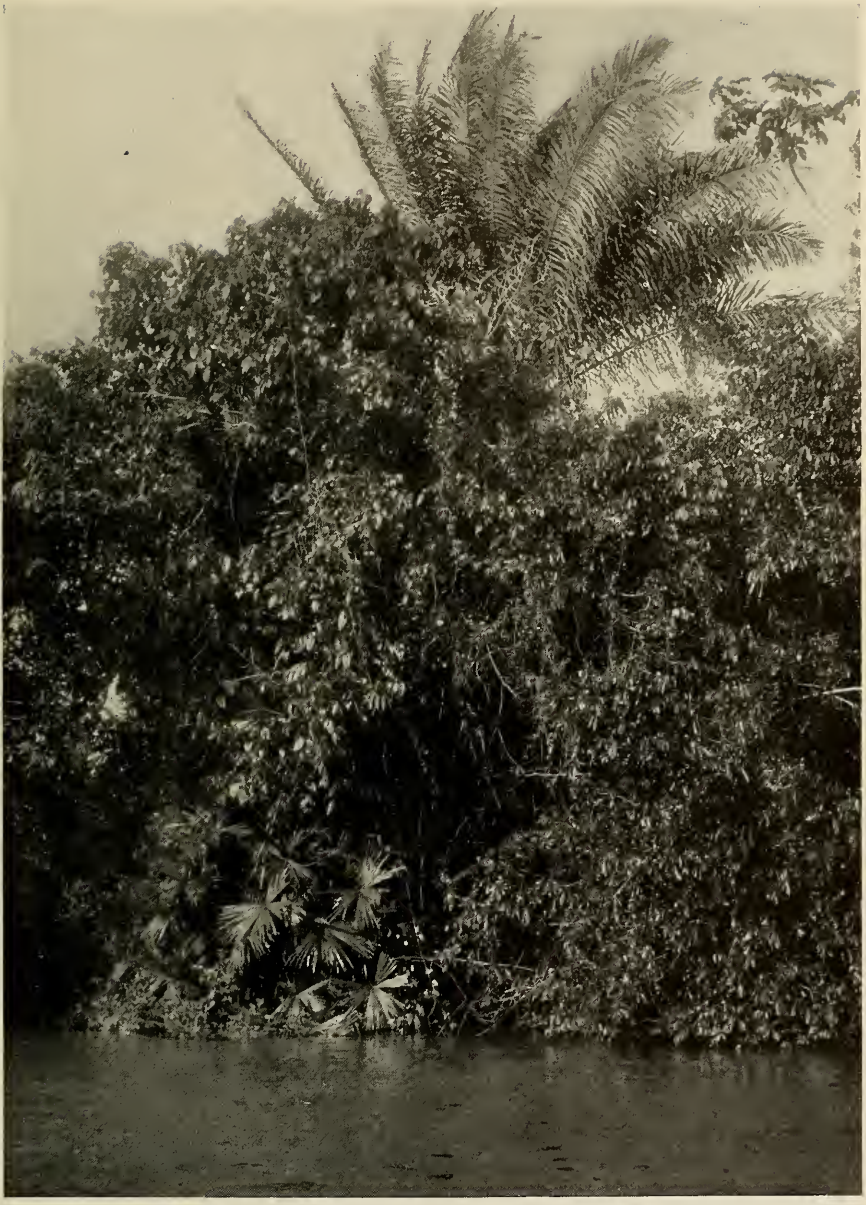
The thorny protuberances with which the trunk of this tree is armed are suggestive of the spikes of ancient armor, and it is easy to yield to the temptation of thinking that their function is protective. The bulbous formation near the base is a termites' nest. The structures made by these insects are now and then occupied by stingless honeybees—sometimes as joint tenants with the builders, at other times as their successors

insects. As the roof leaked, I pitched a tent inside of the shack and, with an air mattress to sleep on, was very comfortable indeed. There were no mosquitoes. When night came, Murillo was somewhat disturbed by the absence of a door and he was quite alarmed when he discovered that I had no gun. He blocked the doorway with a poncho and took his machete to bed with him.

The vegetation of Barro Colorado is jungle of the hilltop type; and a tropical jungle gives us a feeling which is difficult to describe. Apparently it is not possible to describe even the jungle itself so that those who have not been in one can understand. It is more than monotonously varied dense woods bound together with vines, many of which become trees. Its essential features are not moisture-dripping leaves and gloom. Monkeys may swing from the branches and brightly colored birds may make noises that are as unpleasant as the appearance of the birds is pleasing, but they are not the jungle. Life's struggle seems, but may not be, more strenuous there than elsewhere, but jungle is more than all of these. It is *jungle*, indescribable, fascinating, and, to the biologist, an environment of extreme interest.

However, travelers in the tropics have been so impressed by the jungle and have so impressed their readers with it that many people think of the tropics as one vast jungle except where man has made a clearing which he must continually defend against the jungle's return. That is not the case. Savanna, grassland, desert, and open swamp in the tropics are just as truly a part of the tropics, and each has its interest.

Another mistake is the idea that one cannot get about in a jungle without cutting a trail. Usually one can, but a trail is a great convenience. Making



A wall of verdure rising from the water's edge and crowned by the graceful, spreading fronds of a palm

one's way through a jungle is sometimes almost or even quite as bad as going through a tangle of cat briers or a swamp thicket in New Jersey, and when you have a negro whose chief virtue is his ability to swing a machete successfully, it is foolish not to have a trail. Furthermore, many jungle insects gather in such open spaces and are more easily caught there.

Accordingly, I set Murillo to cutting a trail straight across the island,

JUNGLE CONFLICT

Plants of many kinds are competing for a root hold and are crowding one another in an attempt to win a place in the sun

CLIMBING PLANTS OF THE JUNGLE

Climbing plants use tree trunks as their ladders; and lianas, like taut tent ropes, hang from the upper branches of the lassoed trees directing his course with a compass. This trail led us up hill and down gully. Even when completed, it was not exactly a place for a thoughtless stroll, especially at that season of the year when the almost continual rain made

A section of the trail which was cut from one side of Barro Colorado to the other under the direction of Doctor Lutz

barro slippery, but it did serve as a good collecting ground and I swung the net as Murillo cut. In fact, whenever I started back for camp, he came too, assuring me that he was not afraid to be on the "mountain" alone but that it was safer when we were together, especially as we had no gun.

The second evening on the island I collected the wasps that had so frightened him when we arrived. Apparently he had been watching me during the day because, after we had gone to bed and I was nearly asleep, he asked if he might speak to me about something. He recalled that out on the trail I had held my hand so that a large and "very bad" black ant crawled on it and then I had let this terrible creature walk up my bare arm while I examined it with my glass. I not only did not die but did not seem to suffer any pain. Then I caught hundreds (a gross exaggeration) of wasps and took their nests without being stung. What he wanted —and if I gave it to him, he would work for me without further pay—was some of the "medicine" I used to keep from getting hurt. I told him the only medicine I had was a moderate amount of "gray matter" and that I could not spare any, but, as my Spanish was not much better than his English, he did not understand. In following days, when I was not quite so sleepy, I tried to show him that wild things are not dangerous if you act properly toward them, but still he did not understand.

Stingless bees of several species were common on the island. A certain kind, a small black one, was very abundant and very fond of our foodstuffs, getting into everything from bacon grease to sugar and condensed milk. These bees would enter the shack and then buzz against the wire netting like flies on a window pane. This was an opportunity for large ants like the one that did not hurt me to pounce upon and eat the bees, thereby securing a combination of meats and sweets that must have been very good. However, though these bees were abundant, they were of the same species that occurred on the mainland; the density of the jungle on the island made it difficult to locate nests; and the dampness made it necessary to keep all specimens of insects on a rack over a slow fire so as to prevent molding. In Ancon a very convenient, electrically heated drying closet was available and the cooking at the restaurant was somewhat better than either Murillo's or mine; so, after about a week, I returned to Ancon.

Another reason for leaving the island was that in our trail-cutting we had found nothing but jungle. Other types of environment also were desirable. Realizing that our trail covered only a small part of the ten or twelve square miles that constituted the island, I thought it would be well to explore Barro Colorado from the air. Accordingly, through the great courtesy of the Army Air Service, Lieutenant Foster took me up in a plane after I had signed a lengthy document which clearly and definitely placed upon me all blame for any unfortunate thing that might happen and told survivors what to do with my remains. The flight was disappointingly pleasant and without thrills, but I satisfied myself that the island's vegetation is fairly homogenous except for several small plantations along the edge. It is a magnificent piece of Panamanian hill jungle and, in view of the rapid extension of cultivation in the Zone, it is most fortunate that such a place has been set aside for future generations. The fact that it is now an island makes preservation particularly easy.

Returning to Frijoles, I heard of a large nest of some very vicious hornets on a tree in the plantation. They turned out to be of a sort that inspires caution, but I wanted some of them and, as I could not reach them with my net without placing myself at a tactical disadvantage by climbing the tree, I threw a stick against the nest by way of inviting them to come down. They came, directly and numerously. Swinging my net around my head like an Indian club I easily got all the wasps I wanted and, fortunately, did not get stung. When things quieted down, I looked around the horizon for Murillo, but I was mistaken. Instead of trying to match his speed against that of justifiably enraged hornets, he had dropped face-down on the ground. His dirty clothes were a good match for the earth, and his head seemed to be a rock covered with black moss. He was certainly "protectively colored," but his immobility was what counted and he maintained it until repeatedly

To prevent molding in this region of much rain the insects that had been collected were placed on a rack and dried over a slow fire

assured that all was well. I really think Murillo was relieved when his term of employment with me ended.

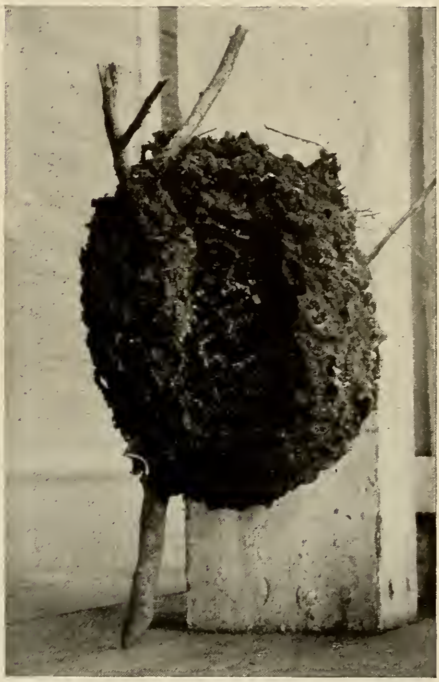
On a tree near the one which contained the hornet's nest there had

MAKING THE MOUNTAIN COME TO MAHOMET

Attached to the lower surface of the left limb of the tree (topmost picture) is a large hornets' nest. It was so situated that an inspection at close quarters would have placed the collector at a tactical disadvantage, even though the surface appearance of the nest (picture on lower left) showed no signs of the stinging hordes that inhabited it. Then a stick was tossed with well directed aim and struck like a bombshell on this citadel of the wasps. Instantly an enraged host of insects poured out (picture on lower right) and the collector secured several specimens that flew to attack him been two nests of stingless honeybees, the same small black species which was so abundant on the island. Some one had cut off the branch holding one of the nests but, although the nest was lying sideways on the ground, the bees were still using it after having made certain interesting alterations. These nests had been made by ants but the ants had moved out and the bees had moved in. Curiously enough, the entrance which the bees make to the interior of the nest is on top and funnel-shaped as though designed to catch rain, and this seems foolish. The brood cells are arranged in horizontal layers within. Now, the nest which had fallen and was lying on its side had two entrance holes: the old one, which was on what had been the top of the nest, and a new one, which was on what was subsequently the top. Furthermore, when the nest was opened, it was found that the layers of brood cells were in two planes: one the old horizontal and the other the new.

Some stingless bees make use of termite nests. Beautiful examples of such use were seen in a swamp jungle near France Field, which I visited through the kindness of Mr. J. B. Shropshire, Sanitary Inspector of the Army. There the termite nests were two or three feet in diameter and built on the trunks of trees not far from the ground. The termites were still using most of the structure, but the bees had made an entrance of their own and were using the remainder.

Some stingless honeybees are not very choice in their diet. Raids on our larder in camp have already been mentioned but the garbage cans in Panama City were also popular and I have caught such bees on manure and on dead snakes. As far as I know, all of these bees obtain most of the material for making honey from flowers. An observation made near Sabañas was therefore of interest. While waiting for a car I noticed many *Trigona* flying in and out of a brush pile in which grew a rambling *Solanum*, a plant related to our potato and tomato. Thinking

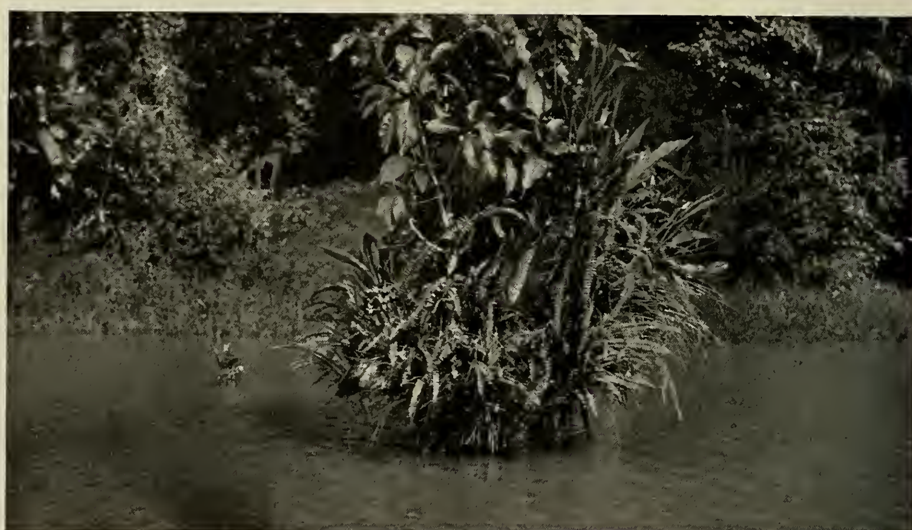


A nest of stingless honeybees.—The nest covering has been removed on one side to reveal the arrangement of the combs within

there might be a nest there, I carefully parted the brush and found not a nest but the thing that was attracting the bees. It was a colony of immature "insect Brownies," small, curiously shaped creatures belonging to the family Membracidæ, that were feeding on the *Solanum* and having their secretions fed on in turn by the bees. Some of our ants attend colonies of plant lice in much the same way.

Just before leaving the Zone I made

a trip, again through the kindness of Mr. Shropshire, to old Fort Lorenzo, with its damp and dismal dungeons still bearing evidences of the Spanish tortures, its battlements, and, from my standpoint not the least interesting, its bees peacefully nesting in the ruined masonry. A better than Murillo was my guide. Mr. Shropshire had told him I was coming and what I wanted, so he had located numerous nests. In taking me to them he saved the best nest for the last, and the fact that it was necessary to wade through swamps with water nearly to our waists in order to get to it was of little moment because the rains had soaked us already. The nest belonged to that red-bellied species of *Trigona* which the Acting Governor had hoped I would find in a less expensive place than under a pavement in Ancon. Here it was and in a hollow stump as it should be. Unfortunately, my guide, in an excess of righteous but misguided zeal, had opened it the day before in order to make certain that it was worthy of the attention of one of Mr. Shropshire's friends. In doing so, he had broken the large entrance funnel but the pieces were still there and from the nest itself I obtained some interesting biological material. There was also a quantity of rather acid honey with which we refreshed ourselves before wading back to higher ground—and home.



The protruding top of a submerged stump, upon which a number of different plants have established themselves, forming a beautiful natural jardinière. A wasp's nest of elongated shape is seen near the center of the picture. This nest was collected with the hesitant cooperation of Murillo, who paddled the unsteady canoe in which the approach was made

Into a little-known area of western Panama the expedition of the American Museum penetrated during February and March of 1924. After gathering valuable data, Mr. Griscom and his associates were compelled to make a hasty exit due to the hostile attitude of the Indians. Their route is shown on the map, which was prepared under the supervision of Mr. Griscom by W. E. Belanske

Bird Hunting Among the Wild Indians of Western Panama[1]

By LUDLOW GRISCOM

Assistant Curator, Department of Birds, American Museum

BETWEEN the Volcan de Chiriqui and the Pico Calovevora in Veraguas lies a mountainous country unexplored and unvisited by white men, inhabited only by wild Indians. No knowledge exists regarding its topography. The courses of the rivers of the interior and their tributaries are pure guesswork, the location of the higher peaks varies from map to map as much as twenty miles, and their altitude as much as 2000 feet! While the avifauna of the Volcan de Chiriqui is essentially that of the Costa Rican highlands, Arcé secured sixty years ago many peculiar types in the mountains of Veraguas, and this has stimulated curiosity as to what kinds of birds occur in the intervening unexplored country.

With Dr. Frank M. Chapman's cordial coöperation and approval I left New York February 5, 1924, accompanied by three assistants, to make a preliminary reconnaissance of the region. Mr. Rudyerd Boulton, of the University of Pittsburg, an experienced student, was invaluable not only because of his scientific knowledge, but also in his capacity as photographer of the expedition. Mr. George A. Seaman, a young collector of promise, was

[1]Photographs by Rudyerd Boulton

to remain in Veraguas to make thorough collections at the localities of special interest. Mr. J. Manson Valentine, of Yale University, was a volunteer, who excelled all of us in his ability to make an artistic and perfect birdskin. In Panama I was fortunate in securing friend, Don Rafael Grajales, the leading citizen of Remedios, who telegraphed most emphatically that the trip to Cerro Santiago in the unfrequented region was possible, that he could obtain guides, and that his house and assistance were at my disposal.

The Indian chief in front of his hut at Cerro Iglesia, Mr. Benson on his left, the author on his right. Huts of this type never have side walls. The rain is kept out effectually by means of a very thick, overhanging thatch of dried banana leaves and stalks. When the thatch leaks, it is usually due to the tunnels made by rats, a colony of which can be found in almost every hut

the services of Mr. R. R. Benson, who had lived for years in Veraguas, and acted as a most efficient *mayor domo*. At Balboa Mr. James Zetek, the government entomologist and director of the recently created research station at Barro Colorado Island in Gatun Lake, was most kind in helping me secure the necessary permits and other papers from the Panamanian government. He happened to have an intimate

It was a great relief to arrive in Remedios after a hard five days' ride with the pack train from Santiago. One of the inconveniences of an ornithological expedition is the bulk and weight of the baggage, and poor Benson almost tore his hair in his efforts to reduce the loads of the few animals he had been able to find. Nothing could have surpassed the hospitality and cordiality with which we were received by Señor Grajales and his kind lady. But our fond hopes of at last obtaining definite information about the mountains of the interior were doomed to disappointment. Nobody in Remedios had ever heard of the Cerro Santiago, and they called the mountain back of the town the Cerro Flores. Nor had anybody ever been in the interior, and two years before a couple of Panamanians who had gone there to take a census of the Indians had been killed. Unless the Indians themselves, therefore, would guide us into their own country, there was not the remotest prospect of our reaching the mountains, much less of making a sojourn there.

It was in this connection that Señor Grajales was able to be of the greatest assistance. A certain number of the Indians had been coming for years to Remedios to trade and some among them spoke Spanish. Señor Grajales, by dint of years of fair and honest dealings with them, had won their confidence and respect; they trusted his word and accepted his recommendations when they would follow the counsel of no one else. He knew the chief of the whole district, who lived at Cerro Iglesia, a particularly intelligent man, who had been at Remedios a good deal and spoke Spanish fluently. To him he wrote a letter introducing us, stating the purpose of our visit, and that we were friends of the President of Panama. The important part of the letter, however, was that we were North Americans from a distant country, that we were not looking for gold, that we would stay in his country not more than thirty days, and would then leave *never to return again.* This will acquaint the reader with the main objections of the Indians to strangers. Poor victims of the white man that they are, we certainly appreciated their point of view. For four centuries bitter experience has done nothing but confirm it. Their association with strangers has invariably resulted in trouble and disaster. The craze for gold has led to inrushes of outsiders, who by some extraordinary hocus-pocus, declare they own the land which the Indians have considered theirs from time immemorial. All too frequently the arrival of strangers in their midst has been attended by more flagrant types of outrage and abuse, and they know that the stores in the coast town systematically cheat and rob them, though they are too ignorant to devise ways to prevent it. May they long enjoy the quiet possession of their country in their primitive simplicity, undisturbed by a civilization which they cannot assimilate and which would probably destroy them!

Armed, then, with our letters and documents, we set out on February 28, conducted by a friendly alcalde to the hut of an Indian on the border of the Indian country. This Indian was to guide us next morning to his chief. It was with the greatest difficulty, however, that he was induced to do so, and it was obvious that our presence was strongly resented. The following day an arduous trail brought us to the Cerro Iglesia, where we were to have the all-important interview with the chief. In spite of the fact that we had cut down weight by every possible expedient, and that our provisions were reduced to little else than rice, beans, coffee, sugar, and lard, my two mules and five horses were barely able to make the 70° grades of the trail, which was a mere footpath for bare-footed Indians. The loads were constantly slipping or tumbling off altogether, the tired animals were forever falling, and were exhausted at the end of the day.

View from the chief's hut of the country penetrated by the expedition.—The Indians have repeatedly cleared the country for agriculture, but the low invading scrub in the foreground, full of ticks and "jiggers," has tended to defeat their efforts

Our arrival at Cerro Iglesia occasioned no surprise. The chief, whose Spanish name was Aquile Sanchez, received us with all hospitality, for he had been informed three days before that we were coming. Indeed, I had occasion increasingly to admire the remarkable manner in which news traveled among these Indians. Aquile was less squat and low-browed in appearance than the majority of his compatriots, and his face was ornamented with blue paint.

Indian hospitality has its decided drawbacks. These people live very largely on corn prepared in various ways, one of the commonest being that of soaking the cracked kernels in water until the fluid becomes milky. The drink of ceremony is made from this mash, and is known by the Spanish nameof *chicha*. The mash is thoroughly chewed and spat into a fresh calabash, and then put in the sun and allowed to ferment. The taste is nasty and, needless to state, the drink is the reverse of appetizing, due to the manner of its preparation; but it is a mortal insult to refuse it or to show disgust. An Indian of proper spirit would have drained a whole calabash filled to the brim, but I satisfied requirements with a few mouthfuls. As leader of the expedition I was forced to "sound off" under the critical eyes of my lieutenants, but as I succeeded in maintaining outward calm and equanimity, was in the strategic position of requiring them to do the same under threats of dire penalty. They trooped up in line, for all the world like children to take their castor oil, though my opinion of the latter

This photograph is virtually a continuation of the view on the opposing page. The higher mountains, covered with clouds, show dimly in the distance, about thirty miles away. The bird life in the intervening area proved to be very scant because of the deforestation

beverage has soared since sampling Guaymis Indian *chicha!*

After the proper interval of small talk that etiquette demanded—for undue haste would have been most unseemly—we addressed ourselves to the business in hand. The letters were read to the chief, and our business and desires were explained; but he could scarcely believe we really were interested in birds, never having heard of any such lunatics, and he wanted to know if my prism glasses were not gold detectors that would reveal the presence of the precious metal at a distance or underground! But learning that I was a scientist, he asked me to cure one of his wives who was sick. The fact that she was a day's journey away, and that he was quite unable to describe her symptoms, did not appeal to him in the least as handicaps, and I suspected he thought that failure to effect a prompt cure would prove I was not a scientist after all. Experience in Nicaragua had taught me, however, that most ailments among such people were of a very simple kind. I accordingly produced ten grains of aspirin, ten grains of quinine, and a powerful laxative pill, confident that one of them would fit the case, and the other two do no harm. My orders were to take the whole lot before going to bed! They were given and accepted with the greatest solemnity on each side, and the Indians were impressed with my portable medicine case, which I produced with as many airs and flourishes as possible. I had the satisfaction of finding out later that the following morning the patient was cured.

In the meantime we had found Aquile a more and more likeable and trustworthy fellow, and made a strong bid for his friendship. I exerted myself to the utmost to persuade him to come along as guide, philosopher, and friend, and see for himself that we were really going to do what I said. As an inducement I offered him about twice as much in the way of wages as a Panama Indian ever received before. He would have no duties to speak of, but I calculated that his presence would insure our safety, and that he would obtain food for us when the Indians would sell us nothing. He finally promised to join us in three days, and in the interval assigned us one Toribi as guide. As it turned out, the trip could not have been made without Aquile.

The next three days we spent in a ceaseless struggle to get the pack train over the narrow Indian trail, which did not deviate from the crest of the ridge, as though it were insistent upon following the path of adventure. It was probably centuries old, as in places it had been worn down to a cañon ten feet deep and three feet wide, and at such depressions the packs had to be unloaded and the baggage carried through piece by piece. The farther into the interior we advanced, the drier the country became and the steeper the slopes. Water was at the bottom of the gullies, and after one had obtained a drink it required a half hour's exhausting climb to return to the heights. Our compensation was a magnificent view. The whole country to the east, west, and south lay open before us, the shimmering Pacific in the distance, and some sixty miles to the northwest the gigantic Volcan de Chiriqui loomed purplish in the haze. The last day the country became positively arid; there were practically no trees and the slopes, excessively steep, were sparsely covered with brown grass, while the escarpments of red sandstone were naked. This section formed a belt or zone about ten miles wide just before the main range was reached. Here conditions changed with startling abruptness. Influenced apparently by the cloud-and mist-zone above, the barren, stony slopes became covered with heavy forest without the slightest zone of transition, and this forest stretched unbroken to the Caribbean. The photograph shows this condition of affairs near our base camp, which was pitched just inside this forest, marking the northern limit of the Guaymis country. Aquile informed me that on the other side of the mountains dwelt other Indians, who were very wild, bad people with whom they had nothing to do!

Penetrating the barrier of dense forest, we camped on the slope of the Cerro Flores at 3700 feet, and here we spent ten fruitful and fascinating days. We were in the heart of the subtropical zone, and the avifauna was entirely different from that of the lowlands. Every morning the party scattered in four or five directions, and it was very exciting to meet at noon, and see what the combined bag contained, and who had done the best collecting. Every day brought additional species, or another specimen of some choice rarity, such as a thrush, tanager, or quail dove.

Collecting was, however, difficult. The ground birds were shy and secretive and exceedingly hard to find in the dense jungle. Most of the others were in the tops of the tallest trees, practically out of gun shot, or scarcely visible because of the abundance of the intervening leaves. Thus while the

This photograph shows the abrupt change from the open grassy slopes to heavy primeval forest. Note the steepness of the slope. The camp of the expedition was just inside the forest area at the left of the picture

A view of the camp at 3700 feet in the heavy mountain forest shown in the preceding picture. The blackness of the shadows and the intensity of the light in the little clearing made photography difficult bell bird was common, and its extraordinary note, like the clang of a hammer on an anvil, rang out constantly over the forest, only two specimens were secured. One day a great flock of giant swifts was discovered darting around the summit of a bare peak, their wings making a humming sound, audible for a mile. The difficulty of shooting ducks on the wing paled into insignificance beside the feat of hitting these arrow-swift darters, which, as though shot from a bow, were carried by their momentum for several hundred yards. That day we tried giant-swift pie for lunch, as every morsel of meat was precious. Although quite tender, it tasted like a cross between ashes and string, which I trust did not impair its nutritive value.

In the meantime I spared no effort to devise some way of reaching the cloud forest above us. A day's scouting trip with Benson and the Indian chief furnished experiences which any naturalist might envy. We reached the continental divide at 6000 feet, and could look off forty miles or so to the northwest, where lay the Caribbean lowlands. To the west about ten miles away rose a cone-shaped peak about 1000 feet higher than the crest on which we were standing, with a big break in altitude between. Perhaps it was the real Cerro Santiago. The forest had changed with the altitude to a gnarled and stunted one, and every tree was loaded with parasitic plants of many kinds. Above 5000 feet the very ground had been left behind, and we struggled upward in a gigantic bed of moss of unknown depth, with manholes between the roots of the trees, through which we could have dropped as much as fifteen feet. Everything dripped with moisture, everything was slimy and moldy, and everything gave way at one's touch. The slopes were markedly precipitous, with the result that water was unreachable in some gully 1000 feet below. There was not a square yard of even gently sloping hillside and there was no dry wood. A camp in the cloud forest was impossible.

The bird life was utterly unexpected. Not a single one of the mountain species found farther east occurred here. Instead, the fauna was obviously that of the Costa Rican highlands, but with this difference, that isolation and remoteness were accompanied by a certain amount of variation. Several at least of the birds obtained are new subspecies. Benson shot a new species of *Scytalopus*, small wrenlike birds of secretive habits, and I collected a very distinct new species of a peculiar finch (*Pselliophorus*), hitherto the only member of its genus. It was the reward of the explorer that, at the very least, every bird found automatically extended its range far to the east.

The highest point at which a camp could possibly be established was 4500 feet. Here Valentine and I spent two days, ascending to the cloud forest and collecting each day. An Indian runner carried our birds to the base camp to be prepared by those remaining below. At the end of the second day we returned to the base camp for a rest, expecting that two of our party who had remained below would have their turn up above. But our reduced food supply was sufficient only for five more days, our three Indian porters had melted away, and the chief was leaving at dawn. Something was wrong! Next morning, when I paid off Aquile, I added a considerable gratuity with my expressions of friendship, hoping he would be induced to say something definite. His response was to send back a message by means of a boy from the nearest Indian hut to say that we must not leave camp and to keep watch night and day. Our muleteer was dispatched to the hut, and came back with the information that the whole country was seething over the fact that strangers were in their midst. The chief was accused of betraying his country and of having sold the Cerro Flores to us for the gold it was supposed to contain! Poor people, they could not believe we were collecting birds, and our tents and belongings were so much better than anything they had, that they were convinced we were permanently settled. So the chief was to be killed and we were to be gotten rid of. But the chief's brother, overhearing these plans, slipped out the night before to bring Aquile word. While it was impossible to verify these rumors, common sense and the fate of our two Panamanian predecessors compelled us to take them into consideration. To stay at all, would have necessitated splitting the party to obtain more provisions. Benson and I would have had to make a flying trip to Remedios, meantime leaving the three younger men alone. Under the circumstances this would have been sheer folly. The council of war had no trouble, therefore, in reaching the conclusion that there was nothing to do but depart at once, and run no risk of jeopardizing the equipment and our precious collections, not to mention our own lives.

Sending to the Indian pasture for the horses started the word that we were leaving. We broke camp at once and packed up in a pouring rain. I had to ascend to the higher camp and bring it all down on my back. Toward evening a significant event was the sudden return of the chief and three other Indians, who helped us load the animals. At 11 P.M. in bright moonlight the retreat started. The Indians dropped off to their homes about 1 A.M., and Aquile turned off, too, to pick up his wife, whom he had left in some hiding place, promising to catch up with us later, by means of a short cut impassable for our pack train. Going all that night and all the next day, we arrived at Cerro Iglesia about 5 P.M., men and animals thoroughly worn out. A brief stop for coffee was made during the morning, and here Aquile and his wife overtook us. All during the night we had heard the Indians hallooing and calling in peculiar tones and cadences from ridge to ridge, and we felt sure they were signalling our departure. The following day we were glad to reach the hospitable quarters of Señor Grajales at Remedios. To our surprise, the chief insisted on accompanying us. Once out of the Indian country, he talked freely. The rumors proved to be absolutely correct, and we had the satisfaction of knowing we had done the right thing. In fact, so trustworthy did the rumors seem to the chief, that he had not the slightest intention of returning home without various documents from officials, restating the objects of our visit, the services he had performed for us, and the fact that we had gone home, *never to return again.*

After several days' rest at Remedios, we proceeded to Santiago, chiefly by boat so as to see more of the country. After re-outfitting we proceeded by launch to the San Lorenzo River on the coast. Here for two weeks we were the guests of Mr. A. R. Wilcox, president of the Tropical Lumber Company, who could not have done more to make our stay a success. The camp was in the heart of a heavy

A superb mahogany tree on the land of the Tropical Forest Products Company.—Mr. Wilcox measured this tree, which, he ascertained, was 7 feet in diameter 6 feet from the ground, and 152 feet from the base to the first limb. It took a gang of laborers nearly a day to clear the forest growth about the tree so that a picture might be taken, and a platform 15 feet from the ground had to be constructed to enable Mr. Boulton to include the first limb in his negative. The perfectly symmetrical trunk had all the grandeur of a cathedral column. There were bigger trees near by with even thicker trunks, but they were more irregular in outline and branched much nearer to the ground

primeval forest, and one of the commonest trees was a recently discovered species of mahogany of gigantic size. The photograph above gives an excellent idea of the superb proportions of one of these trees. Another was 13 feet in diameter 6 feet from the ground. In this forest wild life abounded. At least 200 species of birds occurred in the surrounding country. Howling monkeys were heard daily, and wild peccary was a welcome addition to our bill of fare. When tired of the forest we took the launch, and had an interesting day with aquatic birds and sea snakes.

My reconnaissance work was now concluded, the objects of the expedition had been attained. Seaman and Benson are now actively collecting, on a schedule that will take a year or more to complete. Three days later in the bustle of Panama City, the mountains and the wild forest seemed far away, like the incidents in a pleasant dream.

Brown pelicans inspecting the boat in which the expedition made its return over the Gulf of Panama

Ageniella bombycina, like other psammocharid wasps, specializes in the capture of spiders. Her long legs enable her readily to drag her prey along the ground

The Huntress of Spiders, Ageniella bombycina[1]

By WILLIAM M. SAVIN

TO one unfamiliar with the fact that related insects are frequently of widely divergent size, it is somewhat surprising to learn that the little *Ageniella bombycina* belongs to the same group as the large *Pepsis,* the tarantula-killer of our West. Both are solitary wasps of the family Psammocharidæ,—the Pompilidæ of the older classifications. All the female members of this family specialize in capturing and paralyzing spiders, but in their method of carrying the helpless victim as well as in the technique of nest construction they differ somewhat from species to species and sometimes even from individual to individual. Many of these wasps drag their spiders as they make their way walking backward through a forest of grass, over irregularities of the ground, or even up the sheer wall of an embankment,—mountain-high when compared with the size of the insect; others manage to carry their burden by half-running and half-flying, but without rising from the ground, while of one species at least it has been recorded that in crossing a body of water the wasp will fly close to the surface, "trailing the spider and leaving a wake that is a miniature of that of a passing steamer."

A number of species of Psammocharidæ dig burrows in which the wasp entombs the spider, destined to be devoured piece-meal by the wasp larva that presently emerges from the egg attached to the victim. But other species, instead of excavating in the ground, establish their nursery in the crevices of stone walls, under loose bark, logs, or rocks, in the mud nests of *Sceliphron,* their competitor in spider-hunting, and even in the interior of an oak gall!

When digging the tunnel the wasp often leaves the spider in the crotch of some near-by plant, or on the ground close to the nest, or hidden under a lump of earth, and during the work of excavation, she frequently visits the captive to inspect it.

[1]Illustrations from photographs by the author.

Mud nests of *Ageniella bombycina* attached to the underside of a log lying in a field.—Each cell has been stocked with a single spider left there by the mother wasp as food for the larva which, if all goes well, will emerge from the egg that she lays on the spider. When these cells were opened, it was found that four of them held spiders and three of them wasp larvæ which had devoured the food provided. After pupation the wasp emerges from the flat end of the cell

The underside of three cells removed from the log to which they were attached by the mother wasp. The pupa, in the silken cocoon spun before pupation, is visible in each cell

Psammocharid wasps have chosen a difficult and at times perilous occupation in limiting their captures to the spiders. Certain solitary wasps of other families specialize in seizing flies, beetles, grasshoppers, caterpillars, etc., none of which offers any serious resistance. Of all the psammocharids, the *Pepsis* of our Southwest runs perhaps the greatest risk, for she attacks the tarantula, which inspires almost universal terror. A false move on her part, giving an opportunity for the spider to bite her, would mean certain death.

The little *Ageniella bombycina*—the psammocharid to which this article is primarily devoted—often secures spiders larger than herself. She is indeed a skillful huntress, for one year in a cluster of nests that I located under a log I found a grass spider (*Agelena nævia*—in every cell in which a victim was present. This spider, thanks to the character of its nest, seems better able to protect itself than most arachnids, and of the many nests of the mud-dauber wasps (*Sceliphron* and *Chalybion*) that I have opened none contained a grass spider, yet this little wasp was able to capture a number of this species.[1] The following year when I found another cluster of cells of *Ageniella*, all contained *Lycosa* spiders. In each instance one might be tempted to think that the wasp had come upon a spider cocoon from which the young were just emerging, but the size of the victims made that belief untenable. All the spiders were adult and must have been long separated from their brothers and sisters.

Lycosa spiders which were taken from two cells of *Ageniella bombycina;* one spider has an egg on the dorsum, the other a larva which has hatched and is devouring the spider.

Before placing the captive spider in a cell this wasp removes some or all of its legs. One of the spiders here shown has had all of its eight legs severed from the body, the other one only four. The two leglike appendages (called pedipalps) near the mouth of the spider were unharmed

Ageniella bombycina breaks most, if not all, of the legs of the captive spider. There may be some good reason for this but it is not apparent. It may be simply to enable the wasp to pack the spider in the nest more readily. The spider's legs are long and there is not much spare room in the cells.[2] Most of the spiders that I have found in the cells had some of their legs removed, but the wasp had not damaged the pedipalps, leglike appendages near the mouth of the spider.

[1]Phil and Nellie Rau mention in *Wasp Studies Afield* (p. 125) that on four occasions they have found dead *Chalybion cæruleum* in the webs of spiders.

[2]George W. and Elizabeth G. Peckham in their account of *Pompilus fuscipennis* on p. 143 of *Instincts and Habits of Solitary Wasps* ascribe the corresponding habit of this huntress to the fact that "she makes a very small nest in comparison to the size of her prey."

NOTES

FISHES

Encomia for "The Bibliography of Fishes."—In the May-June issue of Natural History a review and an historical sketch were presented of the recently completed *Bibliography of Fishes* and it is not necessary to retrace the facts that were there set forth, but by way of supplement there should be some indication of the reception accorded this monumental work by the scientific world, as evidenced by the reviews prepared by the foremost ichthyologists. It is a tribute to the comprehensiveness of the Bibliography and its adaptability to the needs of special investigators, that it should have been praised by authorities representative of a number of different branches of research, each viewing it critically from his own angle of interest. These reviews, could they be printed in full, would constitute a significant expression of approval, but even the few excerpts from them for which space is available cannot fail to convey the unanimity of the judgment regarding the Bibliography,—a judgment which sustains the steady faith maintained by President Henry Fairfield Osborn throughout the years of its preparation that the completed work would prove one of the greatest scientific undertakings in the history of the American Museum.

J. Graham Kerr, professor of zoölogy in the University of Glasgow and leading student in the British Empire of the embryology and the morphology of the vertebrates, points out in *Nature* that "The great Bashford Dean Bibliography . . . will form an admirable guide to the investigator and learner through the otherwise impenetrable labyrinth of detail," and refers to the work as "one of the most important contributions to zoölogical science which has been made in recent years."

Dr. David Starr Jordan, president emeritus of Leland Stanford and the dean of American ichthyologists, contributes to *Science* a review in which he characterizes the Bibliography not merely as monumental but as "majestic, commanding, and, above all, insistently useful," adding that "no one in the future can attempt research in ichthyology without having these volumes at his elbow."

The leading American student of the osteology of fishes, Dr. E. C. Starks, commenting on the Bibliography in *The American Naturalist*, says that "It might well serve as a model for a bibliography of each of the vertebrate classes" and expresses the opinion that "not only will the men interested in fishes be under great obligations to Doctor Dean and his colleagues, but comparative anatomists will be also, for the anatomy of the primitive vertebrates is fundamental to an understanding of all anatomy."

In the *Bulletin* of the New York Zoological Society Dr. C. H. Townsend, director of the New York Aquarium, pays tribute to the Bibliography as a work "of such a character that all students of fishes and fishery subjects must turn to it, if they would know what has already been accomplished by those who have preceded them."

Mr. H. T. Sheringham, leading authority in Great Britain on angling, and angling editor of the *Field* contributes two spirited reviews, one to the periodical just mentioned and another to the London *Morning Post*. In the latter he refers to the salutary effects of studying the Bibliography, which has disclosed to him the fact that "besides the trickles of printer's ink in which I have been able to wade without discomfort [pursuing the fish] there is a 'great and wide sea also' where you want charts, and lighthouses, and pilots, and, I begin to think, lifeboats as well." The multiple services rendered by the Bibliography to him who starts on a voyage of discovery in the domain of ichthyology could not be more pithily and picturesquely summarized.

Mr. William Radcliffe, author of *Fishing from the Earliest Times*, in which are presented a host of interesting facts bearing on the folklore and mythology of fishing among the ancients, opens his review in the *London Times Literary Supplement* with the comment "This is a great and thorough work. If its title ran 'The Bibliography' instead of 'A Bibliography' few could object, for it differs from all its predecessors in that it is concerned with but a single subject—fishes and all particulars wherein they touch the life of man. Further, of no other branch of the animal kingdom does there apparently exist so complete a compendium of its literature or one so minutely digested for the reader."

A bibliophile's opinion regarding the work is registered in *Public Libraries* by Mr. H. M. Lydenberg, reference librarian at the New York Public Library. Referring to the section containing the pre-Linnæan titles, he says, "Biologist, anthropologist, student of folklore, historian, psychologist, any student of beliefs of former days will have far to go before he finds so extensive and accurate a guide to the sources for scientific thought of yesterday."

Dr. R. P. Cowles, associate professor of zoölogy in the Johns Hopkins University closes the appreciative review he contributes to *The Johns Hopkins Alumni Magazine* with these words: "I can not praise too highly the Subject Index, which makes it possible for any zoölogist to get in touch quickly with the literature dealing with almost any phase of our knowledge of fishes." Dr. Arthur Willey, professor of zoölogy in McGill University, contributes a thoughtful review to *The Canadian Field-Naturalist* in which, after expressing his general approval of the work, he adds "But mere words can hardly do justice to an arduous undertaking such as this, although its merits are conspicuous."

Not only in English-speaking countries is the Bibliography winning adequate recognition but from other parts of the world as well are coming emphatic expressions of approval. Dr. Ernst Ehrenbaum, leading student in Germany of the migration and distribution of fishes, opens his review in *Die Naturwissenschaften* with the comment "A mighty work lies completed before us, the fruit of most intense labor throughout years, carried on by a group of highly qualified experts with a penetrating grasp of the subject, and resulting in a survey of the literature of a particular field of knowledge that from the standpoints of finality and completeness would be hard to duplicate in any other subject." Jacques Pellegrin, foremost French ichthyologist, closes his review in *Bulletin de la Société Centrale d' Aquiculture et de Pêche* with a special word of recognition for Dr. E. W. Gudger, editor of the Index Volume: "One cannot praise too warmly Mr. E. W. Gudger for having brought to completion such a work, which will greatly facilitate the task of those engaged in research by enabling them quickly to orient themselves regarding the bibliography of all questions concerning ichthyology which they desire to approach." Finally in *O Jornal* of Rio de Janeiro, the leading student of the fishes in South America, Alipio de Miranda Ribeiro, from the fullness of his knowledge concludes that "*The Bibliography of Fishes* is going to be of great service to students of the subject."

The Daniel Giraud Elliot Medal.—The warm approval accorded *The Bibliography of Fishes* by the scientific world finds summary expression in the award to Doctor Dean, its originator and editor, of the Daniel Giraud Elliot Medal. This coveted distinction, bestowed each year for a published work of outstanding zoölogic or palæontologic interest, was given to Doctor Dean as of 1921. The prize for 1922 was awarded at the same time to Dr. William Morton Wheeler for a work that, like the *Bibliography of Fishes*, was a Museum undertaking, namely his monumental *Ants of the American Museum Congo Expedition*. Dr. Ferdinand Canu, of Versailles, France, was honored with the medal for 1923. Of the seven awards made since the institution of the prize, three have been bestowed upon scientists connected with the American Museum, the previous recipients being Dr. F. M. Chapman, curator of birds in that institution, Mr. William Beebe, Mr. Robert Ridgeway, and Prof. Othenio Abel.

"Description of Eighteen New Species of Fishes from the Wilkes Exploring Expedition Preserved in the United States National Museum" by Henry W. Fowler and Barton A. Bean.—We are doubtless warranted in calling this paper a *belated* report, since the fishes described as new—and to these the authors have confined their attention—were collected more than eighty years ago. So far as localities are given, the species described are, with two exceptions, from South America and Polynesia. Having been taken before the days of deep-sea dredging, they are naturally species belonging to the shore region. The exploring expedition under the command of Wilkes was afloat from 1839 to 1842. While other zoölogical material from this important expedition was reported upon long ago, and in the case of some groups very fully, the collection of fishes seems to have been disregarded by the naturalists of that day. This paper, is, however, only preliminary! A timely letter from Mr. Bean conveys the information that the authors have already prepared a full report for publication. This is of decided interest to students of fishes, especially as accounts of the fishes of Polynesia, where the expedition did its greatest work, are decidedly limited in number. It appears that fishes were collected in all regions visited by Wilkes, including both coasts of South America, many of the islands of Polynesia, and from New Zealand and Australia westward to Ceylon. The collection is a large one and many of the specimens are still in excellent condition.—Charles H. Townsend.

VERTEBRATE PALÆONTOLOGY

Charles W. Andrews, for many years a distinguished vertebrate palæontologist of the British Museum staff, assistant to Keeper Arthur Smith Woodward, passed away on May 25, at the age of fifty-eight. When last in the British Museum he was engaged in mounting and describing a gigantic skeleton of the straight-tusked elephant (*Elephas antiquus*), which may some time appear as his last published contribution to vertebrate palæontology.

The work which will give him an enduring reputation is his share in the discovery and description of the Upper Eocene and Oligocene fauna of the Fayûm, Egypt, following the original discovery of Hugh Beadnell. With the coöperation of Beadnell, he visited Egypt and made the great collections for the Egyptian and British museums, which formed the basis of his remarkable memoir: *A Descriptive Catalogue of the Tertiary Vertebrata of the Fayûm, Egypt*, published by the British Museum in 1906. This is a monumental work, establishing for the first time in the history of science the original home of the Proboscidea, as well as the probable center of evolution of the Hyracoidea and of the Sirenia. The principal conclusions reached in this great volume will stand as a monument to his keen perception of the affinities and relationships among the vertebrates. The names which he gave to these animals, *Palæomastodon*, *Phiomia*, *Mœritherium*, and *Sagatherium*, were sagaciously chosen.

Vertebrate palæontologists the world over will mourn the untimely loss of this genial and helpful fellow worker, and will extend to his colleagues on the staff of the British Museum and to his family their sincerest sympathy.

President Henry Fairfield Osborn of the American Museum has been notified by Dr. Serge d' Oldenburg, permanent secretary of L'Académie des Sciences de Russie that, "filled with high regard for his scientific works" the academy has inscribed Professor Osborn's name upon the list of its corresponding members and that the diploma signalizing this appointment will be sent to him soon.

THE FAUNTHORPE-VERNAY EXPEDITION

Gaps That Are Being Filled in the Museum's Collections.—Until very recently the greatest gaps in the bird collection of the American Museum were among the avifauna of tropical Asia and the islands south of that continent. Almost one-third of the genera the Museum lacked were those of birds inhabiting that general region. A very great service is therefore being rendered the institution by the Faunthorpe-Vernay Expedition, which has now collected a total of 847 birds from localities extending from the southern foot of the Himalayas to the southern end of the Indian Peninsula and eastward to Tenasserim and Siam.

The first three shipments were from the northern part of this area, comprising 220 skins prepared by Messrs. Jonas and Kinloch in 1922 and 1923. They represented approximately 128 species, and formed a most welcome and important addition to the collection of Indian birds in the Museum.

Mr. Vernay next sent a dozen specimens (partridges, sand grouse, and a Macqueen's bustard) collected by Major Stockley in Sind and Hissar, and a great Indian bustard from northwest India.

Still more remarkable are the collections recently received from Tenasserim and Siam, where Mr. Vernay is accompanied by the veteran collector for the British Museum, Mr. Willoughby P. Lowe. First came a couple of Burmese peacocks, the male of which is being mounted for exhibition, and two gigantic hornbills, of which one will also fill a gap in the mounted collection.

Two cases recently unpacked contained 596 bird skins, giving a wide representation of the avifauna of the Malayan region, from the smallest flower-peckers to the pheasants and eagles. A great variety of families and genera was included, and it was noted with special pleasure that the shipment contained the falcon-like *Poliohierax*, several beautiful pheasants of the genus *Polyplectron*, some exceedingly large nightjars, not less than fifteen species of woodpeckers, one of the very rare Indian honey guides, and a splendid series of passerine forms. The broad-bills are especially well represented (by five species), as are also the babbling thrushes (Timeliidæ), the bulbuls (Pycnonotidæ), and the thrushes (Turdidæ).

Mr. Arthur S. Vernay seated in front of his grass hut.—At the left is the head of one of the two buffaloes that he succeeded in securing for the American Museum

A Malayan tapir in the Rangoon Zoo.—Among the prizes obtained by Mr. Vernay was a specimen of this species, which he shot by moonlight

Among the mammals obtained by Mr. Vernay unusual interest attaches to a specimen of the Malayan tapir, which was secured in the northernmost part of the range of this species. Sureness of aim such as that required to lay low this animal has few parallels in the annals of marksmanship, for Mr. Vernay shot the tapir by moonlight as it was splashing about in a water hole near his camp.

A cable from Mr. Vernay dated April 24, later confirmed by letter, contained the important announcement that two splendid specimens of the buffalo had been secured,—a bull with horns that, measured from the tip of one horn downward along its wide curve, then across the skull and upward in similar manner to the tip of the other horn, registered 110 inches, and a cow with a horn expansion only one inch less.

Keen interest was aroused by the statement in yet another communication that not only the American Museum, but the New York Zoological Society as well was to be the beneficiary of Mr. Vernay's enterprise and devotion. Two young male gibbons, the one black, the other white, are on their way to New York to join the menagerie in the Bronx. Mr. Vernay writes that they became so tame after a week of kind treatment that when he released them from confinement, they would climb the highest trees only to return at meal times and in the evening, when they would enter the box that was provided for them. "The black one," he adds, "is called Myonk (the Burmese for monkey) and the white one Disha (Deeshah) after one of our elephant men who resembled the ape." Two small crocodiles are also being shipped at the same time.

A summary of the number of different specimens secured by the Faunthorpe-Vernay Expedition discloses the fact that there is a total of 246 mammals, subdivided among the following orders: Insectivora 7, Carnivora 37, Artiodactyla 58; Proboscidea 3, Perissodactyla 5, Rodentia 101, Chiroptera 4, Primates 31.

Asiatic Rhinoceroses Secured by the Faunthorpe-Vernay Expedition.—Under date of May 27 Mr. Arthur S. Vernay cabled President Henry Fairfield Osborn that he had succeeded in obtaining a female and young male of the rare Sumatran rhinoceros (*Dicerorhinus sumatrensis*). Few specimens of this interesting form have reached museums, though one lived for some years in the London Zoological Gardens. Contrary to what one might expect, *D. sumatrensis* is totally different from the great, one-horned, Indian rhinoceros (*Rhinoceros unicornis*). In the structure of its cheek teeth it shows a closer relationship to the black, or hook-lipped, African form (*Diceros bicornis*). Like the latter it has two horns and in connection with its life in the

A skeleton being conveyed to camp for ultimate shipment to the American Museum

forest has adopted similar browsing habits. It is the smallest of living rhinoceroses, remarkable for its fairly dense hairy coat and the slight development of the folds of its rough granular hide. The Sumatran rhinoceros inhabits the countries east of Bengal, ranging from Assam through certain parts of Burma and Siam into the islands of Sumatra and Borneo. The equally rare, but more widely distributed, lesser one-horned Indian, or Javan, rhinoceros (*Rhinoceros sondaicus*) has extended its haunts into the island of that name.

Not only are the life histories of these three Asiatic rhinoceroses rather imperfectly known but the specimens preserved in museum collections are inadequate and scientists have consequently been handicapped in their efforts to solve many vexing questions concerning these animals. Such valuable contributions as those made by the Faunthorpe-Vernay Expedition are, therefore, of the highest importance.

For many years Professor Osborn has devoted himself to the study of rhinoceroses and has published extensive works upon the different problems presented by them, especially those of the relationship and evolution of fossil forms. Continued comparison of recent with prehistoric forms is most necessary. Only in this way can one satisfactorily interpret the habits of rhinoceroses of the past, now known only through skeletal remains, often incomplete.

In the evolution of different groups of heavy, gigantic mammals a variety of grotesquely shaped horn structures has been developed, partly to clear a way through the jungle, partly as a means of defense against enemies, and finally as weapons in the competitive battles among the bulls during the rutting period. Guided by these facts Professor Osborn suggested that the great Indian rhinoceros also may use its horn, which sometimes attains a length of as much as twenty-four inches, for purposes of defense.

It is most interesting that his belief is confirmed by a naturalist so well versed in the habits of Indian big game as Colonel Faunthorpe. This sportsman has no doubt that occasionally the Indian rhinoceros uses the horn to inflict wounds upon adversaries such as elephants. He himself shot a rhinoceros in Nepal which had a large deep puncture in the abdomen, as well as other injuries in its hide. These looked as though they were the result of a contest in which horns played the important rôle. They did not resemble wounds inflicted by the triangular, forward- and upward-directed, two lower incisors, generally called the tushes, which are of service also in partly cutting to pieces the tubers and other vegetation on which the animals feed.

For a long time it has been known that the tushes are the chief weapons upon which the great Indian rhinoceros relies in an attack against its enemies including man, as Mr. Roderick T. Mackenzie has kindly pointed out in a letter to Professor Osborn. Mr. Mackenzie states, furthermore, that the horn is always more or less worn away by digging up roots. As the animal rushes forward, head up, muzzle and lower lip drawn back, and mouth open, the tushes are bared for action. Considering the tremendous impact of the body and the unwonted rapidity of motion of the head under such circumstances, a rhinoceros is liable to inflict terrific wounds. Indeed, it makes a boar's ripping look like the effects of a mild display of temper when it puts into action these sharp, chisel-like weapons. It even cuts open the legs of elephants employed to force it from its retreat.

The mode of attack of the great Indian rhinoceros is, therefore, totally different from that of the two African rhinoceroses, which, deprived of incisors, depend entirely upon charging with head lowered, occasionally goring their enemies with their often sharp-pointed horns. Bulls of the African "black" rhinoceros may fight to the death. Bronsart von Schellendorf gives us the following account of such a contest: "In the next moment both bulls rushed around each other in a circle, furiously snorting, and each one trying to plunge its horns into the body of the other. The older of them suddenly stumbled. Immediately he received two deep thrusts in the breast and belly. The long, sharp, dagger-like horn of his adversary had entered him for about two-thirds of its length. In vain did he try to raise himself. Quick as a flash he received another well aimed thrust in the middle of the neck. After several piercing shrieks he lifted his heavy head up and down, trembled and died."—H. L.

PUBLIC EDUCATION

The Expedition of the American Museum to Sweden and Lapland has begun its work under conditions that are an assurance of success. Thanks to the friendly assistance of Legationsrådet Hendriksson, a letter was secured from the head of the educational department (Eklesiastik Departementet) of Sweden, requesting all those connected with the schools, colleges, and universities to give Dr. G. Clyde Fisher every assistance within their power. Doctor Fisher is, furthermore, being aided in his visits to the schools by Miss Staël von Holstein, who in addition to her knowledge of the Swedish language and of Swedish educational institutions has a viewpoint regarding American educational standards gained through several years spent at Columbia University. One of Doctor Fisher's main purposes in visiting Sweden is to obtain an insight into the Swedish educational system, regarding which he will lecture before the Museum on his return, and there can be no doubt that, as a result of the privileges extended to him, he will accomplish more even than he had ventured to hope.

Many attentions have been shown Doctor Fisher and his associate in the expedition, Mr. Carveth Wells, by eminent individuals. They have been entertained, among others, by Baron De Geer, the distinguished geologist, and Baroness De Geer, and also by Mr. Cord Meyer, secretary of the American Legation, who invited for the occasion Dr. Robert Andrews Millikan, upon whom was recently bestowed the Nobel prize in physics, and Mrs. Millikan. A dinner was tendered the representatives of the American Museum by the Swedish-American Foundation, of which Professor Arrhenius is president, and at the banquet Doctor Fisher had the honor of being seated beside Mrs. Arrhenius. The public press, reflecting the popular interest, has devoted many a column, with portrait insertions, to the expedition.

The Teacher and the Museum.—In conformity with its established custom, the department of public education, American Museum, tendered a reception to the faculty and the graduating class of the New York Training School for Teachers on June 19 and to the corresponding groups of the Maxwell Training School for Teachers on June 20. It is of prime importance that prospective educators should know of the various ways in which the Museum is prepared to assist them, and at these gatherings the graduating classes have the opportunity, not only of establishing contact with those within the Museum who are engaged in educational work, but also of seeing through the illustrated addresses that are a feature of the day's entertainment the facilities in the way of slides and similar lecture materials that are at their disposal. Members of the Museum staff guide the visitors through the exhibition halls and the department of education, and the activities terminate with the serving of tea.

MAMMALS

Mr. G. H. H. Tate, field collector of the department of mammals, American Museum, has returned to the United States for a brief sojourn after an absence of fourteen months in Ecuador. The progress of his work, both independently and in collaboration with Mr. H. E. Anthony during the latter's recent visit to the west coast of South America, has been referred to from time to time in Natural History, and readers of the magazine are, therefore, conversant with his record up to November, 1923. Since that time he has taken three field trips: (1) from Ambato to Guayaquil, for the purpose of making a cross-section of the region to the north of Mt. Chimborazo, (2) to the Island of Puna, off the coast of Ecuador, (3) to the Oriente side of the Andes.

It is the last-mentioned trip that deserves especial emphasis, for it consumed a period of three months and yielded valuable specimens and interesting observations. Mr. Tate established eight camps in all, lingering at each for a sufficient number of days to study the faunal conditions. The first two camps were in the high temperate forest, the second being pitched at the base of the volcano Tungurahua, which erupted violently some years ago and sprinkled ashes even during Mr. Tate's sojourn.

From this altitude he worked down the Pastaza River, past the falls of Agoyán, which, 30 feet in width, tumble from a height of about 150 feet, on to the third camp at Mirador at an elevation of approximately 5000 feet. This spot is the subtropical type locality worked by the old collectors Simons and Palmer. The fourth camp, established at La Palmera, was maintained for two weeks and yielded important collections.

Thence Mr. Tate moved down to Mera, the center of the wet belt, where there is rain nearly every day of the year and the traveler wades about in mud that is perennial. Several interesting forms were discovered in this locality. Due to the forbidding character of the country mules could not be depended upon beyond this point and it became necessary to send to the Indian settlement at Canelos for bearers.

The first day's travel beyond Mera brought the party to Puyo, a place somewhat disliked by the Indians on account of the prevalence there of vampire bats that make their insidious attacks at night. On the second day a stop was made at Indillama, a station erected by the Ecuadorean government for the convenience of travelers. On the third day the party reached Canelos.

Canelos is an Indian settlement with a population of 300. Large well-thatched houses are scattered about in the forest, and each accommodates several families. The floors are earthen and the principal articles of furniture are beds and cots of bamboo. Each house contains at least a half dozen *bodoqueras* (blow guns), on which the Indians rely for their meat supply. The work of preparing the soil and the planting of *yuca* and *platano* is left to the women.

Mr. Tate collected for ten days at Canelos and then, through the kind arrangement of the resident Dominican priest, was conveyed by canoe to Sarayacu, a similar settlement three days' travel down the Rio Bobonaza. From this point a journey was made overland to Rio Copataza, another type locality, where Mr. Tate had the assistance of six Indian collectors.

The rainy season was now drawing to a close and accordingly a return was made to Mera. After eleven days of continuous travel Mr. Tate reached this spot and, securing riding animals, made his way over the Andes back to the coast. During the three and a half months consumed in this trip to the Oriente, Mr. Tate collected about 550 mammals, not to mention reptiles, batrachians, and plants.

"The Allen Memorial Volume."—In recognition of the important services of Dr. J. A. Allen during the thirty-six years of his curatorship in the American Museum, President Henry Fairfield Osborn and the Trustees have decided to devote one of the volumes of the *Bulletin*, under the designation of "The Allen Memorial Volume," to the publication of the posthumous papers of the distinguished mammalogist. Two of the four articles proposed for inclusion—that on the insectivores and the one on the squirrels collected by the American Museum Congo Expedition —made their appearance two years ago. To these has now been added the third report, dealing with the large collection of Congo carnivores, and only one more report, therefore,—that concerned with the primate collection from the same region,—is necessary to round out the volume. This fourth report is nearing completion.

The carnivores were one of the last groups among the Congo material to which Doctor Allen gave his attention. After the author's death the manuscript was arranged for publication by Mr. Herbert Lang, associate curator of African mammals, who had had the privilege of assisting Doctor Allen in the working up of the report.

Among the 588 specimens of Carnivora represented in this West African collection Doctor Allen recognized two genera and eight forms as new to science. In view of his conservative attitude in the matter of new descriptions, the proportion is large. Though he considered that some of the specimens, temporarily referred to forms already known, were worthy of subspecific distinction, he did not feel justified in thus designating them at the time, due to a lack of adequate comparative study material. Throughout the report stress is laid on the great need for a satisfactory basis of differentiation. In extensive series of a single form collected in one locality or district, it is remarkable how great can be the range of individual variation.

One of the noteworthy discoveries figuring in the report on the carnivores is that of a fish-eating genet, *Osbornictis*, illustrated by an excellent color plate showing the uniform dark-brown tone of its pelage. This genet is one of the many examples of adaptation peculiar to African mammals. The new genus which it represents Doctor Allen named in honor of Professor Osborn, who made it possible for him to devote his entire time during the last years of his life to the working up of the Congo material. As a result of this generous provision Doctor Allen was able to complete his study of so large a proportion of the mammals collected by the Congo Expedition.

The other new form requiring generic distinction, *Xenogale*, falls within the herpestine group. In external appearance it so closely resembles *Atilax* as to have been mistaken for it in the field, but in cranial characters and dentition the two forms present little similarity.

A feature of this report is the extensive series of comparative drawings of the skulls of the various genera represented. Complementing these drawings are the many photographic illustrations, for the most part taken in the course of the expedition. They enhance the value of the report, especially for those who desire to make use of it as a guide for future study in the field.—H. L.

East African Trophies Given by Mr. E. Mallinckrodt, Jr.—The American Museum recently secured through Mr. Edward Mallinckrodt, Jr., the first specimens from the eastern limits of Lake Victoria Nyanza, near the Mara River, that have found place in its collections. Among the objects presented are the skull and scalp of an especially fine bull eland (*Taurotragus oryx pattersonianus*)—the largest of antelopes and a member of the tragelaphine group,—a fine long-haired pelt of a spotted hyæna (*Crocuta crocuta germinans*, and—even more desirable—an exceptionally large skull of the hook-lipped, or "black," rhinoceros (*Diceros bicornis*) from the neighborhood of Lolgorien.

HISTORY OF THE EARTH

La Société Géologique de Belgique invited the American Museum to participate in the semi-centennial celebration of the founding of the society, held at Liége, July 27–30. President Henry Fairfield Osborn requested His Excellency J. Malfeyt, a life member of the Museum, to represent the institution on this important occasion, General Malfeyt having evinced his interest in the Museum through the great assistance he rendered some years ago to its Congo Expedition. The geology of the Congo and of the regions bordering upon it was one of the principal topics presented during the gathering, another being a survey of the activities of the society during the fifty years of its existence. Excursions to points of interest and a banquet were other features of the celebration.

CONSERVATION

A National Conference on Outdoor Recreation, called by President Coolidge, was held in Washington, May 22–24, and as an outgrowth of its deliberations there has come into being a permanent organization, made up of associations that are interested in wild life and out-door activities and that through such a super-organization can best correlate their efforts. A meeting is planned annually at which the constituent associations will pass upon the common policy, each association irrespective of the number of its delegates present having but a single vote.

That the organization has started with every prospect of continued success is indicated by the standing of the men who attended the conference and the earnest spirit and desire for harmonious coöperation that characterized the gathering. President Coolidge delivered the address of welcome and the honorary chairmen of the successive sessions were the Hon. John Wingate Weeks, Secretary of War, the Hon. Henry C. Wallace, Secretary of Agriculture, the Hon. Hubert Work, Secretary of the Interior, the Hon. Herbert Hoover, Secretary of Commerce, and the Hon. James J. Davis, Secretary of Labor. The executive chairman of all the sessions was the Hon. Theodore Roosevelt, whose vigorous and stimulating qualities as presiding officer were reminiscent of the leadership exercised by his father before him. Official delegates representing more than one hundred associations interested in wild life, in the park and playground movement, in child welfare work, and related activities, were present and listened to addresses on different phases of the common problem that designated speakers had been invited to contribute. Dr. Frank M. Chapman, of the American Museum, delivered an address on "Birds and Man" in the session devoted to the "Wild Life Resources of the United States."

Four Hundred Years of Growth Destroyed.—In constructing a road to the North Grove of Calaveras "big trees," the highway engineer found confronting him a magnificent specimen of a sugar pine,—a species that Muir has designated "the noblest pine yet discovered." In height it grew to 240 feet, in circumference it measured more than 25. With an estimated age of 400 years, it must have begun life about the time when Balboa first gazed upon the Pacific; but the centuries had not robbed it of its storm-defying strength. The unimpressionable engineer was not deterred by consideration for its beauty or its age. The tree had no message for *him*. Not even the thought that the road he was commissioned to construct was to serve as a highway to the lofty splendor of one of the world's most magnificent groves of trees could win respectful treatment for the age-old sentry that stood just outside of the precincts. A slight curvature to the right or left, and the tree would have been spared. But no, the road must follow its undeviating course, and the merciless swings of the ax in short time laid low a firmly rooted giant that the tempests of the past had failed to budge.

One is glad to note that indignation over this thoughtless act of sacrifice has been widespread. The *Stockton Record* has voiced its protest in a vigorous editorial and the *St. Paul Daily News* writes trenchantly of the incident under the heading "He Sawed Down 400 Years' Work." Even if a new sugar pine were planted on the spot where the old tree stood and succeeded in withstanding all of the vicissitudes of the centuries, generation upon generation of men would grow from childhood to manhood and wither away in old age before the new tree could reach the venerable stage represented by its predecessor. But if we cannot conjure back what is destroyed, an awakened public conscience can at least take measures to render less likely a repetition of such inflexible destruction.

In contrast with this incident may be cited one for which The Shevlin-Hixon Company of Minneapolis deserves honorable mention. Along the highway leading into Bend, Oregon, was a growth of timber controlled by this lumber company. The company would have been within its private rights if it had chopped down this stand to the last tree, but this corporation had a *soul* that responded to the appeal of beauty, and in the public interest set aside a strip of very handsome timber. In addition, it gave as a memorial to the late Thomas Shevlin a whole grove of trees in the Tumalo Cañon in Oregon, and thereby aided the Save the Redwoods League in its struggle to preserve the scenic beauty of our Northwest. Another recent gift which the League deeply appreciates is that of the Pacific Lumber Company, which on February 4 deeded to the State of California a magnificent tract of 289 acres of Redwood timber located in the heart of the State Redwood Park and known as South Dyerville Flat. The grove is a memorial to Simon J. Murphy, founder of the Pacific Lumber Company. Through this gift and the purchase of an adjoining grove known as North Dyerville Flat, there has been completed a stretch of twelve miles of highway lined by giant trees and set aside for all time for the enjoyment of visitors to the region. Finally, through the generosity of a donor who modestly withholds his name the League has been able to acquire 113 acres on which are some of the largest and most perfect trees of the entire region.

Important as these donations have been, the League wants to extend its activities and looks forward to the day when a National Redwoods Park, containing at least 20,000 acres, may be an accomplished fact.

ARCHÆOLOGY

"Our Forerunners."—Of all the various branches of scientific research there is none that excites more general interest than that concerned with the origin and development of prehistoric man. The recent attacks upon the doctrine of evolution—especially as it affects man's ancestry—have greatly augmented this interest and increased the demand for trustworthy and understandable accounts of the life and times of those peoples who lived before the dawn of history.

A notable contribution to such literature is *Our Forerunners*[1] by Dr. Miles C. Burkitt, presented by its author to Prof. Henry Fairfield Osborn and recently placed in the Osborn Library of the American Museum. This brief account of the civilizations of Palæolithic man in western Europe and along the shores of the Mediterranean gives, as it were, a bird's-eye view of man's prehistory. Within the covers of a small and inexpensive book that will easily slip into the average pocket, the author has contrived to outline the history of discovery, the geologic conditions, the climate and fauna, the technique of working flint, the principal types of tools, the main and minor cultural divisions, the fossil human remains, and the art of Palæolithic times. And with all this, he is yet able to devote a chapter to the motives for Palæolithic art, as they may be conjectured from the practices and beliefs of existing primitive tribes, and to present vividly picturesque descriptions of the course of daily life during the Stone Age.

In order to achieve such condensation only main outlines of the principal features of prehistory could be given, and much that is of great interest has necessarily been omitted. It is, perhaps, a little surprising that the paragraphs on "Mousterian or Neanderthal Man" fail to mention the skull of Gibraltar found in 1848, as this is not only the earliest known discovery of Neanderthaloid human remains, but also the best preserved female skull of that type. On the whole, this little book gives a careful, conservative presentation of our present knowledge of Palæolithic man, and in its simple, non-technical language is admirably calculated to make the results of recent research available to readers unfamiliar with scientific terms but none the less keenly interested in all that concerns Our Forerunners.

THE MARSH DARIEN EXPEDITION

Under date of March 24, Mr. C. M. Breder, the representative of the American Museum on the Marsh Darien Expedition, wrote from Yavisa, Panama: "As soon as the boat comes to take our stuff and this letter,

[1]Burkitt, M. C. *Our Forerunners.* Williams & Norgate, London. 1923.

we shall leave for parts unknown." The Cuna country, the objective of the expedition, has had an evil reputation. It has been said that parties that entered it in the past have not returned from its fastnesses and the belief prevailed that they had been killed by hostile Indians. It was the possible danger from this source that was uppermost in the minds of those who followed with interest, mingled with concern, the progress of the expedition.

Serious obstacles on the part of the natives were not encountered; but the evil reputation of the Cuna country is nevertheless justified on other grounds. A more sinister foe than savage man has claimed its victims among those who dared to cross the boundaries of this forbidden territory. The first to succumb was a representative of the Panamanian government assigned to the expedition, whose death may possibly be ascribed to disease contracted before the journey was undertaken. Overstrain, infection through the bite of an insect, and the tropical climate completely undermined the health of Mr. John L. Baer, the ethnologist of the expedition. For a time the hope was entertained that it might be possible to carry him, fever-racked as he was, out of the interior to Caledonia Bay on the Atlantic Ocean and thence take him by ship to some port where he might receive medical attention. But this hope proved vain. Mr. Baer died a martyr to science in a region the mysteries of which he had set out to penetrate.

Mr. Breder himself did not escape unscathed. He developed a case of typhoid and malaria, which necessitated his return to Colon. For a time grave anxiety was felt by his family and friends, but in answer to their hopes for his recovery, he is today restored to health and strength.

While the results attained by the expedition cannot be weighed in the balance with the sacrifice of life that it has entailed, it is, nevertheless, some consolation to know that the brave men who faced disease and death in their devotion to science have helped to attain the objects for which the expedition set out.

The chief purpose was to locate the blond Indians which, it was known, lived somewhere in the area selected for penetration, and to inquire into their origin and mode of life. Complete success attended this search as indicated in the following cable received by the department of anthropology, American Museum, under date of June 18:

"Marsh arrived Colon with three white Indians, golden hair, hazel blue eyes, white tender skins: two boys with liver spots, girl comparatively clear; gums pink, skulls unusual in size and shape, large, round, decidedly different from typical San Blas.

Breder."

Early in July these Indians were brought to New York and anthropologists from leading institutions were invited to meet them and give collective consideration to the problem presented by their physical peculiarities. The public interest in these abnormal representatives of the "red" man was indicated by the number of newspaper articles devoted to the *white* Indians.

Though other phases of the work of the expedition yield in spectacular appeal to this anthropologic investigation, much of scientific interest was discovered also in the field of zoölogy. Brief mention may be made of some of the results achieved by Mr. Breder during the week spent at Yavisa prior to the penetration of the interior. Here he had a rare opportunity to make an intensive study of a small section. When he first arrived, all the frog streams save one were dry, waterless beds, and the outlook was discouraging. But two solid days of rain transformed the scene, and before his departure he was able to obtain life-history data regarding seven species of frogs, as well as photographs and specimens. Of four of the species he managed to secure a developmental series. After leaving Yavisa he gathered data regarding several other species.

Mr. Breder's collecting is not confined to amphibians. He has been taking also reptiles and fishes, and incidentally birds. Preliminary examination of the material he has brought together indicates that there are included at least several new species of fishes and reptiles.

AMPHIBIANS AND REPTILES

A Sphenodon Group for the American Museum.—After more than ten years of correspondence and efforts on the part of a number of scientists, the American Museum is at last to have a group illustrating the home life of the *Sphenodon*—that "living fossil" which has the appearance somewhat of a lizard but is actually more closely allied to the crocodiles. The final arrangements for securing this material were made by Doctor Hovey during his recent trip to New Zealand.

Sphenodon is the only living representative of that order of reptiles known as the Rhynchocephalia, a group which apparently reached its ascendancy during Mesozoic times. *Sphenodon* is found today only on some of the small islands off the coast of New Zealand, where it frequents the burrows of a petrel (*Puffinus carneipes*). This association of reptile and bird has probably, to a large extent, permitted the survival of *Sphenodon* to recent years, for the reptile not only secures the protection of the petrel's home but feeds to a large extent upon the food that the parent birds bring to their young. Although some writers have claimed that these odd companions get along in perfect harmony, other investigators report that the petrels frequently try to drive the reptiles out of their homes. The group of *Sphenodon* in the American Museum will represent just such a home scene, for, thanks to the kindness of Doctor Speight and Mr. Sladden of New Zealand, the American Museum now has specimens of the petrel and its eggs as well as *Sphenodon* and its eggs, and all accessories necessary for such a group. In addition to illustrating a curious case of parasitism, the *Sphenodon* Group will have interest because of the extreme scarcity of the specimens.

Today *Sphenodon* is rigorously protected by the New Zealand Government; it is, nevertheless, almost extinct, for a large hawk (*Circus gouldi*) has become naturalized on the island and feeds to a large extent upon this reptile. Formerly the natives of New Zealand considered *Sphenodon* a great table delicacy, and as the reptiles are easy to catch, these people made great inroads upon them. It is highly doubtful whether *Sphenodon* will survive in spite of the present strict protection enforced by the government.

Amphibians of the Congo.—Dr. G. K. Noble, curator of the department of amphibians and reptiles, American Museum, has recently issued his report on the Amphibia collected by the American Museum Congo Expedition. The report constitutes Part III of *Contributions to the Herpetology of the Belgian Congo*, the two preceding parts, devoted respectively to "Turtles, Crocodiles, Lizards, and Chameleons" and to "Snakes," having been prepared by Mr. Karl Patterson Schmidt.

Doctor Noble's report treats of 2170 specimens, distributed among fifteen genera and fifty-three species. Of the three species described for the first time, one (*Hymenochirus curtipes*) comes from the open country near the mouth of the Congo, and differs conspicuously from Cameroon specimens of *H. bœttgeri*, which have much greater leg-length, enlarged lateral tubercles, broad heads, and indented webbing of the digits. The other two are known only from the forests of the Ituri district, many miles farther inland. One of them, *Hyperolius langi*, named after Herbert Lang, leader of the expedition, is reddish brown above with an indistinct stripe of pale yellow about the eye and the shoulder. The other, *Rana Chapini*, named in honor of Mr. James P. Chapin, Mr. Lang's associate in the expedition, proves to be larger than any related form.

While no comprehensive work on African Amphibia has appeared since Boulenger's catalogue was issued in 1882, papers on the subject have been appearing with considerable frequency during the four decades separating that date from the present and the bibliography incorporated in the report will, therefore, be a welcome aid to many. Another outstanding feature of the report is a check list of the Amphibia of Africa. The accepted opinion as to the status of the various species is indicated and the ranges are given in so far as it is possible. Finally, mention should be made of the series of batrachian portraits taken in the field by Mr. Lang, which constitutes a striking pictorial contribution to the report.

The reports dealing with the American Museum Congo Expedition, several of which are still in course of preparation, will require, it is estimated, twelve *Bulletin* volumes for their presentation. It is the plan to adopt for the completed work a series title: *The Zoology of the Belgian Congo.*

MARINE LIFE

Diving for Corals at Andros Island.—Dr. Roy W. Miner, curator of lower invertebrates, American Museum, writes from Andros Island in the Bahamas, that on a beautiful calm moonlight night the expedition of which he is in charge crossed the sixty-five miles that separate Andros from Nassau, arriving off the reefs south of Mangrove Cay at daybreak on June 17. The purpose of the expedition is to obtain material for the coral group that is to be a feature of the projected hall of ocean life, American Museum. The equipment required, including the Williamson tube, is of an elaborate character, as may be inferred from Doctor Miner's description of the strange assortment of craft that were towed in Indian file to the scene of operations:

"En route our fleet consisted of the 'Lady Cordeaux,' which is the government tug, and without which it would have been impossible for us to have negotiated 'The Tongue of the Ocean'; second, the submarine tube barge, 'Jules Verne,' with its odd-looking tower and ventilator; third, the pontoons bearing the chain hoist, an extremely important unit in the fleet; fourth, the 'Bitter End,' a heavily built lifeboat containing a motor; fifth, the 'Standard,' our floating headquarters, Captain Joe Bethel's fine 45-foot gasoline launch, with sleeping quarters for seven people including the captain; sixth, the 'Nautilus,' a small but powerful gasoline tender for the barge; and finally, two dinghies."

Such a fleet would occasion remark even in New York harbor; imagine, then, the furor its arrival must have created in a little settlement where nothing usually occurs to break the monotony except the biweekly mail schooner, an occasional hurricane, and the periodic deaths among the oldest inhabitants!

On June 19 the members of the expedition saw the outer side of the Andros reef from the tube for the first time and its beauty thrilled Doctor Miner, who thus describes it:

"The main reef is composed of a dense forest of *Acropora palmata*, for all the world like an orchard of apple trees but much more closely set with interlacing branches rising from the reef platform from twelve to sixteen feet and breaking the water surface at low tide,—a jungle of marble trees fading into the opalescent blue of the watery fog. Clearings in this stony woodland are dotted with clusters and clumps of postlike growths of Orbicellidæ combined with symmetrical fronds of deerhorn corals and gorgonians. Large tracts of the reef floor in front of the forest are completely covered with grotesquely branching elkhorns, their weird spikes contorted and interlaced like a defensive barrier. Troops of brilliantly colored fishes filed past in solemn processions, and a great trumpet fish glided past in solitary state.

"Into the midst of this strange world Williamson floated down in his diving helmet and advanced with peculiar half-gliding strides among the coral clumps. An immense crowbar was lowered to him on a rope. Poising this as an armored knight might place his lance in rest, he attacked the base of a coral clump and it fell at his touch. He then attached the cluster to a rope lowered by the men above, and the corals became a part of our collection.

"We have also used the 10-ton chain hoist most effectively. In fact, it is only by means of this apparatus that we can get up the heavier and larger pieces. It permits a direct pull and the corals are drawn up between the two parallel pontoons. These have a very shallow draft and the corals are easily floated to the beach irrespective of their weight. There Mr. Mueller takes them in charge and starts the bleaching process, while the sea fans and gorgonians are hung up on lines to dry.

"We have to take our chances on the outer reef as the wind often rises and prevents operations there until calm weather again prevails. At other times we work inside the reefs and in the more protected channels. Williamson has spent hours under the water in his diving helmet and has been indefatigable in the securing of specimens. The Museum owes a great deal to his coöperation and unquenchable energy."

BIRDS

At the annual meeting of the National Education Association held in Washington, D.C., Dr. Robert Cushman Murphy, assistant director, American Museum, addressed an audience composed of eight hundred teachers of geography, gathered from all of the states of the Union, on the achievements and prospective work of the Whitney South Sea Expedition under Mr. Rollo Beck,—an expedition which has been making a painstaking study of the bird life of Polynesia and in the course of its cruises has contributed incidentally to making more widely known the interest of the island-dotted ocean that lies beyond the reach of the generality of travelers. The lecture was one of two which the National Geographic Society arranged in honor of the gathering.

NEW MEMBERS

Since the last issue of Natural History the following persons have been elected members of the American Museum, making the total membership 7693:

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A room on the third floor of the Museum, equipped with every convenience for rest, reading, and correspondence, is set apart during Museum hours for the exclusive use of members. When visiting the Museum, members are also privileged to avail themselves of the services of an instructor for guidance.

THE AMERICAN MUSEUM OF NATURAL HISTORY has a record of more than fifty years of public usefulness, during which its activities have grown and broadened, until today it occupies a position of recognized importance not only in the community it immediately serves but in the educational life of the nation. Every year brings evidence—in the growth of the Museum membership, in the ever-larger number of individuals visiting its exhibits for study and recreation, in the rapidly expanding activities of its school service, in the wealth of scientific information gathered by its world-wide expeditions and disseminated through its publications—of the increasing influence exercised by the institution. In 1923 no fewer than 1,440,726 individuals visited the Museum as against 1,309,856 in 1922 and 1,174,397 in 1921. All of these people had access to the exhibition halls without the payment of any admission fee whatsoever.

The EXPEDITIONS of the American Museum have yielded during the past year results of far-reaching importance. The fossil discoveries in Mongolia made by the Third Asiatic Expedition, the representative big-game animals of India obtained by the Faunthorpe-Vernay Expedition, the collections of fossil vertebrates made in the Siwalik Hills by Mr. Barnum Brown, the achievements of the Whitney South Sea Expedition, and of other expeditions working in selected areas of South America, in the United States, in the West Indies, and in Panama, are representative of the field activities of the Museum during 1923. Many habitat groups, exhibiting specimens secured by these expeditions, are planned for the new buildings of the Museum.

The SCHOOL SERVICE of the Museum reaches annually more than 5,000,000 boys and girls, through the opportunities it affords classes of students to visit the Museum; through lectures on natural history especially designed for pupils and delivered both in the Museum and in many school centers; through its loan collections, or "traveling museums," which during the past year circulated among 472 schools, with a total attendance of 1,491,021 pupils. During the same period 440,315 lantern slides were loaned by the Museum for use in the schools as against 330,298 in 1922, the total number of children reached being 3,839,283.

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

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Vol. XXIV SEPTEMBER-OCTOBER, 1924 No. 5

NATURAL HISTORY

THE OCEANS

THE WHITNEY SOUTH SEA EXPEDITION BY ROBERT CUSHMAN MURPHY—THE OCEANS BY WILLIAM MORRIS DAVIS—THE NORTHERN ELEPHANT SEAL AND THE GUADALUPE FUR SEAL BY CHARLES HASKINS TOWNSEND—A TRIP TO GUADALUPE, THE ISLE OF MY BOYHOOD DREAMS BY LAURENCE M. HUEY—THE SEAL COLLECTION OF THE AMERICAN MUSEUM BY FREDERIC A. LUCAS—HUNTING CORALS IN THE BAHAMAS BY ROY WALDO MINER—THE CORAL GARDENS OF ANDROS PICTURED BY ROY WALDO MINER AND J. E. WILLIAMSON—A SUBMARINE CABLE AMONG THE CORALS BY CHARLES HASKINS TOWNSEND—"PEARLS AND SAVAGES," A REVIEW BY WILLIAM K. GREGORY

BIRD BANDING BY MAUNSELL S. CROSBY

The oceans unite all shores and bring the world more closely together. The expeditions of the American Museum have ranged over many seas and have enjoyed the aid and hospitality of maritime nations from the poles to the equator. To all of these the appreciation of the Museum is hereby extended.

JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

EXPLORATION·RESEARCH·EDUCATION

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NATURAL HISTORY

THE JOURNAL OF THE AMERICAN MUSEUM

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THROUGH THE MUSEUM

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From a painting by Courtenay Brandreth

A NEW KINGFISHER FROM THE TUAMOTUS

Todirhamphus gertrudæ, a hitherto undescribed kingfisher obtained during the Whitney Expedition at Niau Island of the Tuamotu Group, South Pacific Ocean. The bird at the right is an adult male, the other a female in not quite fully mature plumage; the reproduction is one-half natural size. The Polynesian kingfishers previously known to science are chiefly native to more or less mountainous islands. This species, however, inhabits a wooded atoll less than five miles in diameter, which encloses a mouthless lagoon.

The kingfisher has been named in honor of Gertrude Vanderbilt Whitney (Mrs. Harry Payne Whitney)

NATURAL HISTORY

VOLUME XXIV SEPTEMBER-OCTOBER NUMBER 5

The "France" under motor power among coral islets of the Tuamotus

The Whitney South Sea Expedition

A SKETCH OF THE BIRD LIFE OF POLYNESIA

By ROBERT CUSHMAN MURPHY

Assistant Director (Scientific Section), American Museum

THE PHOTOGRAPHS USED AS ILLUSTRATIONS OF THIS ARTICLE WERE TAKEN BY ROLLO H. BECK, LEADER OF THE WHITNEY SOUTH SEA EXPEDITION

EASTWARD from Australia and New Guinea, stretches the greatest assemblage of islands upon earth. The separate archipelagoes, which lie mostly between the outer borders of the tropics, are too varied to be considered as a unit and, like Gaul, are divided according to racial characteristics of the native peoples into three major parts, of which the easternmost is Polynesia or the domain of "Many Isles." Roughly speaking, this group comprises land areas of the Central Pacific Ocean which are situated east of a diagonal line connecting New Zealand with Hawaii.

Although all share the blood-stirring tradition of the true "South Seas," the Polynesian isles are by no means of one type; rather, they illustrate three or more stages in the birth or disintegration of oceanic land. Some, like certain of the Marquesas and Austral islands, are little more than bold rocks rising from profound depths. Others, such as Tahiti, are lofty, heavily forested, volcanic peaks, rimmed successively by narrow coastal shelves, sandy beaches, coral fringes, moatlike lagoons, and barrier reefs. Still others, like the majority of the Tuamotus, are low-lying bars and atolls, upon which mangroves and coconut palms make up the conspicuous vegetation. The several types occur, too, in hybrid stages, and they are sometimes further complicated by upthrusts from the sea bottom which cause such coral formations as Makatea and Mangareva of the Tuamotus, and Rurutu of the Australs, to resemble superficially the product of outpouring lava.

But whether a mere spit lying in perpetual jeopardy of engulfing waters, or a green and craggy mountain in the sea, each isle of Polynesia seems to have inherited some of the spell of Eden. "Few men who come to the islands leave them," said Stevenson, who exemplified his own belief; "they grow grey where they alighted. The palm shades and the trade-wind fans them till they die, perhaps cherishing to the last the fancy of a visit home, which is rarely made, more rarely enjoyed, and yet more rarely repeated. No part of the world exerts the same attractive power upon the visitor."

THE SOUTH PACIFIC AS A FIELD FOR EXPLORATION

With the continual dwindling of unknown areas on the continents, the Pacific islands stand, in a sense, as the last rich field for scientific exploration. This does not mean that many islets, however insignificant, remain to be found and christened by adventurous voyagers. Most of them, indeed, have been pricked, generations ago, on well-worn charts, and have been named and renamed from two to ten times by seafarers of five centuries! Perhaps no tiny spot of land now exists the shores of which have not shown the ephemeral footprints of half a thousand freebooters, explorers, slavers, whalemen, and beach combers from the white man's world. But the greater part of whatever spoil or impressions these wanderers brought away has passed with them into oblivion.

True geographical science, in the words of Sir Archibald Geikie, is not a "chronicle of marvellous and often questionable adventures by flood and fell. . .

"It requires more training in its explorers abroad, more knowledge on the part of its readers at home. The days are drawing to a close when one can gain undying geographical renown by struggling against man and beast, fever and hunger and drought, across some savage and previously unknown region, even though little can be shown as the outcome of the journey. All honour to the pioneers by whom this first exploratory work has been so nobly done! They will be succeeded by a race that will find its laurels more difficult to win—a race from which more will be expected, and which will need to make up in the variety, amount, and value of its detail, what it lacks in the freshness of first glimpses into new lands."

These comments apply with particular force to Polynesia. Pacific exploration has, in fact, only begun to go beyond its primitive stage. Discovery, high-handed annexation, the claims and bickerings of world Powers, travel for its own sake, missionary activity by numerous sects, phosphate digging, agriculture, commerce in copra, pearls, and trepang—these have gone on here and there for a hundred years, but the increase of exact knowledge has been relatively small. Whole tribes of splendid aboriginal peoples have melted away under the blights of civilization before their traditions could be recorded or their relationships determined. With the decimation of the native Polynesians, some of their culture plants, such as many varieties of breadfruit which require human nurture, have also tended to disappear. Abnormal concentration of copra gatherers or pearl fishermen upon small islets has worked its evil effect upon the face of nature. Moreover, the acclimation of alien fruits, and of weedlike shrubs, such as the guava and lantana, has changed the entire aspect of the flora on certain islands. Nor has the fauna suffered less severely. In the path of the heedless white exploiter many a defenseless ground-living bird vanished so long ago that it is now only an obscure name in the annals of ornithology. Foreign animals, domestic or wild, have added to the destructive changes. The introduction of sheep, dogs, cats, and even of the mongoose, into islands which had no indigenous mammals, together with the rapid spread of starlings and weaver finches, and of a hawk transported from Australia, makes it inevitable that still more of the original Polynesian birds are doomed to go the way of the lost species, perhaps even before they are known to science.

In short, from earliest times the study of natural history in the Pacific has been subordinate to other aims. The all but mythical Spanish navigators of the sixteenth century, such as Alvaro Mendaña de Neyra, who discovered the Marquesas Islands about 1595, carried no savants in their galleons. So far as we know, their travels were spurred on by the incongruous medieval motives of conquest and sal-

ROLLO H. BECK, LEADER OF THE WHITNEY SOUTH SEA EXPEDITION

Mr. Beck is seen, notebook in hand, recording a find on Fakarava Island. The nest is that of a brown booby (*Sula leucogaster plotus*). The "France" is in the offing vation, both to be ruthlessly imposed upon all the brown-skinned infidels. The voyagers of the Golden Age of exploration, like Bougainville and James Cook, were accompanied by naturalists who brought back to Europe the first examples of many historic plants and animals, but their expeditions were mainly concerned, nevertheless, with pure geographic discovery and with observing as-

Mr. Quayle and his Polynesian guide searching for the breeding ground of the *nohuá*, or Tahitian petrel (*Pterodroma rostrata*), among lofty, forested ridges on which Titian Peale first discovered the species more than eighty years ago

tronomical phenomena such as a transit of the planet Venus. Subsequently, land collecting of an incidental sort has been undertaken by oceanographic expeditions, such as those of Darwin's ship, the "Beagle," the fleet under command of Wilkes during the United States Exploring Expedition of 1838–42, or the Bureau of Fisheries steamer "Albatross" during her several Pacific voyages. Finally, naturalists on long yachting cruises, or working entirely as free lances, have added sporadically to our knowledge of the Polynesian groups. Most of the South Pacific collections in modern scientific museums consist of fragmentary material derived from such sources, and, so far as birds are concerned, no other part of the world still affords so many species either inadequately represented or totally lacking in *all* museums.

So much for the opportunity—an opportunity which it was necessary to seize within the span of the present generation if it was not to slip away irrevocably.

THE WHITNEY EXPEDITION IS LAUNCHED

Four years ago, Dr. Leonard C. Sanford, a Trustee and Honorary Fellow of the American Museum with an ardent interest in oceanic birds, induced Mr. Harry Payne Whitney to support a notable project in the Pacific. The choice of a leader in the field was fixed by virtue of former accomplishment upon Mr. Rollo H. Beck, a veteran exploring naturalist who had previously served the Museum on expeditions in South American waters and elsewhere. Fortunately, the plan appealed to Mr. Beck, and so, in August, 1920, the Whitney South Sea Expedition was launched.

Space will not permit an account of the argonautic travels of Mr. Beck and his successive associates, Messrs. Quayle and Correia, but brief glimpses of their experiences have been given by the leader himself in various issues of NATURAL HISTORY.[1]

Suffice it to say that after a reconnaissance of the classic isle of Tahiti, and of several neighboring parts of Polynesia, Mr. Beck purchased the auxiliary schooner "France," a step which made the expedition independent of sailing schedules and trade routes. Flying the burgee of the Museum, the "France" has since visited more than a hundred islands of the Society, Marquesas, Line, Tuamotu, Austral, Cook, and Samoan groups, and has now proceeded to the rich field of the Fijis, in Melanesia. Collection and study of the birds of the South Seas have been the primary objects, but many other animals and a large assemblage of plant specimens have likewise been obtained. The camera, moreover, has been brought constantly into use, and the photographs illustrating the environment, the animal life, and the appearance and customs of the human inhabitants, are of utmost value,

[1] "Visiting the Nests of Seabirds by Automobile" (July-August, 1921); "A Visit to Rapa Island in Southern Polynesia" (January-February, 1922); "Bird Collecting in Polynesia" (November-December, 1922); "The Voyage of the 'France'" (January-February, 1923).

especially those made at localities—regrettably numerous—in which the state of the fauna and of the people is altering materially in response to external transformations.

Enjoying the coöperation of the Bishop Museum of Honolulu, present-day headquarters for Pacific research, and with courteous assistance from French, British, and American officials among the far-flung archipelagoes, the Whitney Expedition has been enabled to carry out its mission in a manner hitherto impracticable owing to problems of time, distance, and expense. The specimens and notes thus far received at the Museum provide data for comprehensive reports upon Pacific birds, and for distinctly new exhibits; they also put us in the happy position of being able to supply sister institutions in other parts of the world with species which they might otherwise never acquire.

Although several thousand birds have been collected in the course of the field work of the Whitney Expedition, emphasis should be placed upon the fact that no excessive destruction of life has been countenanced. In the case of sea birds, the specimens have been taken mostly on the open ocean or in colonies made up of thousands of their kind. The majority of the land birds have had a natural protection in the rough country or almost impenetrable jungle in which it has been necessary to seek them. Moreover, the determination of Mr. Beck to collect as many *kinds* of birds as possible at each island, has in itself limited the representation of any one species from a single locality. In the past, most ornithologists have shot two or three warblers, flycatchers, doves, or what not, at the first island in their itinerary, and have thereafter been content to record in their notebooks that the same sorts were "present" at islands subsequently visited. But it is now known that many Polynesian birds vary unaccountably from island to island, and that distinct species, or geographic forms of the same species, are often mutually exclusive occupants of two bodies of land so close together that they may be within sight of each other. Mr. Beck's instructions were to take nothing for granted, but to obtain examples of the entire avifauna at every islet on which he landed, regardless of whatever duplication this might seem to involve. The procedure has been thoroughly justified by the results: duplication has been relatively slight, and the collections illustrate the extraordinary plasticity of numerous types of both land and sea birds,—a truth not generally suspected until recent years, even though Darwin long ago described similar phenomena evident at the Galápagos Islands.

SEASONAL VISITORS FROM THE ARCTIC

The birds of Polynesia naturally exemplify a wide variety of both marine and terrestrial forms. Dividing the avifauna in another way, we may distinguish the indigenous breeding species from seasonal migrants which come regularly to the South Seas from nesting grounds in Alaska or Siberia, or which wander northward from south temperate or subpolar regions. To these travelers we can here give only passing attention, but it is a marvel how such shore birds as our familiar sanderling, the turnstone, wandering tattler, bristle-thighed curlew, and Pacific golden plover, make almost incredible flights from the Arctic tundra to smiling islands far south in the greatest of oceans. The golden plover is as much at home in dry uplands of the Marquesas as it once was on the downs of Montauk. The eggs of the wandering tattler have only recently been discovered in Alaska; who would suspect the distance of its birthplace if he saw the little gray snipe skimming above the thundering reef of Raiatea? The boreal breeding ground of the bristle-thighed curlew is still wrapped in mystery, although the bird was made known a century and a half ago from the heart of its winter range, a fact commemorated by its specific name—*Phœopus tahitiensis*.

Besides the snipes and the plovers, a few birds of more pelagic life make the long journey from the Arctic.

Both the parasitic and the pomarine jaeger, for example, come to Polynesian waters to harass the native terns. From the opposite direction, certain albatrosses and petrels retreat before the Antarctic twilight at least as far as the southerly border of the area.

TROPICAL WATER BIRDS

The resident water birds of Polynesia belong to the families of the petrels, terns, sandpipers, the Steganopodes or oar-footed swimmers, the herons, ducks, and rails. The make-up of several of these groups is as notable for its omissions as for its representations. Gulls, cormorants, pelicans, geese, and plovers, for instance, are wanting at all the southern oceanic archipelagoes, although some of these occur in New Zealand or Hawaii.

A gadfly petrel (probably *Pterodroma neglecta*) on its breeding ground at Ducie Island

Tropical types of petrels, shearwaters, and Mother Carey's chickens—the most truly oceanic of all birds—are common throughout Polynesia. Many kinds nest in burrows, either in the coral sand of atolls or in the moist soil of mountain rain forests. When the United States Exploring Expedition visited Tahiti in 1839, the naturalists worked their way through the jungle-covered steeps to altitudes above six thousand feet, and there found the homes of a new species of brown and white petrel which Titian Peale named *Procellaria rostrata.*[1] This bird, the *nohuá* of the Tahitians, was rediscovered by Beck and Quayle in the same mountain ridges after many weeks of hunting, and subsequently was dug out of its burrows on the western Society Islands.

A smaller though similar petrel, likewise described by Peale, is *Pterodroma parvirostris,* which seems to be confined to islands of scanty vegetation, thus avoiding competition for nesting sites with the preceding species. It has been obtained during the Whitney Expedition at Christmas Island, close to the equator, and among the Tuamotus, as well as on the leeward or dry slopes of some of the Marquesas.

Several exceedingly rare relatives of these two birds—rare in the sense that they have always been poorly represented in museum collections—are the "gadfly petrels" of somewhat more southerly latitudes, which nest upon the surface of the ground. The descriptive appellation is derived from the genus name *Œstrelata,* by which these birds were formerly known, and relates to the fact that their swift, twisting flight suggests the actions of creatures goaded to madness by such an insect as Hera sent to torment Io. Among the Austral Islands, especially at Bass Rocks, the last outpost between eastern Polynesia and the Antarctic, members of the expedition found several species of gadfly petrels in great abundance, while at the uninhabited islands of Henderson, Oeno, and Ducie, not far from Pitcairn—lonely home of the "Bounty" muti-

[1]This species is now called *Pterodroma rostrata.* All but a few copies of the work in which it was described—Volume VIII in the reports of the United States Exploring Expedition, *Mammalia and Ornithology,* 1848, by Titian R. Peale—were destroyed by fire before distribution. The volume was never reissued, but was replaced ten years later by a work of the same title from the pen of John Cassin, who quotes much of Peale's text. Peale's own work, which is filled with the original descriptions of birds and mammals, has therefore always been one of the rarest and at the same time one of the most important reference books on systematic zoölogy. Until last year the American Museum Library did not possess it, when an extraordinarily fine copy was purchased at auction and presented to the institution by Mr. James B. Ford.

Sooty terns (*Sterna fuscata*) above the great breeding colony on Kauehi Island, Tuamotu Group

The eastern coast of isolated Henderson, or Elizabeth, Island.—Uninhabited by man, its tangled woods are the only home in the world of four species of birds: a flightless rail (*Nesophylax ater*), a rose-crowned fruit pigeon (*Ptilopus insularis*), a red and green lory (*Vini stepheni*), and a warbler (*Conopoderas taiti*).

neers—the soil beneath thickets of gnarled and stunted trees was covered with tens of thousands of the white eggs or powder-puff chicks of the birds.

Of smaller petrels, the swallows of the sea, numerous interesting species from many localities have been sent to the Museum. Some of the specimens have already thrown new light upon classification and distribution, and have shown that the demarcation of ranges is no less sharp on the supposedly uniform and "boundless" ocean than on the highly varied surface of a continent. Winds, water temperatures, differences of salinity, and other physical characteristics, with all that they imply in the ecology of oceanic life, are the fences of the sea; and maritime birds of specialized feeding habits cannot stray outside their own peculiar sphere any more regularly or successfully than birds of mountain woodland can thrive on grassy plains or desert-dwellers in the marshes. We can stop to speak of but a single one of the Mother Carey's chickens of the Pacific, namely, the historic, streaky-breasted bird known as Peale's petrel. The type specimen was taken at Samoa in 1839, and only one or two additional examples had been reported during the decades that intervened until Mr. Beck shot one off the Marquesan island of Huapu on September 15, 1922. The species had been known hitherto by the generic name of *Pealea*, created especially for it, but a comparative study now discloses the fact that the bird is in reality closely akin to various other small Pacific petrels instead of being a highly aberrant offshoot. Only the dearth of pertinent material in museums prevented an earlier appreciation of this fact.

The absence of gulls among the islands is offset by the abundance of terns, no less than ten different members of this family being found in eastern Polynesia. One, the crested tern (*Thalasseus bergi*), is as large as some of the gulls. The others are smaller, two of them, the blue and the gray ternlets, being among the tiniest of terns. Noddies of two kinds, one prevailingly brown, the other black, are extraordinarily numerous at practically all the Pacific islands, while the size of the breeding colonies of the sooty tern, or wideawake (*Sterna fuscata*), beggars description. Suffice it to say that the Yankee whalemen, who were accustomed to gather the eggs of this bird for food, reckoned the population by "acreage" rather than by numbers, and so recorded the extent of the colonies in their log books.

THE WRAITHLIKE FAIRY TERNS

Antitheses of the dark noddies are the exquisite fairy terns of the genus *Leucanous*, perhaps the most delicately beautiful and ethereal of all sea birds. The Spanish voyagers likened them to the dove in which the Holy Spirit became incarnate. The adults are pure white, with dark bills and feet, and exceptionally large eyes. When their wraithlike forms flutter overhead, it seems as though the sunbeams or the glow of the tropical sky were penetrating their bodies like x-rays, for the thinly covered bones of the wings become visible through filmy plumage.

The fairy terns have reacted in a subtle manner to their environment, for a distinct race of very small size seems to be peculiar to certain of the Marquesas Islands, while those inhabiting southern Polynesia, beyond the zone of trade winds, differ in other ways from the ordinary equatorial representatives. All, however, are tree or shrub dwellers, as are also the noddies. But the noddies build platforms which, by courtesy, may be called nests, while the fairy tern lays its single egg upon a broken stub, the bark of a bare limb,[1] or even on the slippery shaft of a palm frond.

MAN-O'-WAR AND TROPIC BIRDS

In the rather heterogeneous order of sea birds known as Steganopodes, the Polynesian members comprise three species of boobies, two of tropic birds, and two of man-o'-war birds. All of these belong to wide-ranging species, with forms of close affinity in other warm oceans. The Pacific man-o'-

[1]For a photograph of such a precarious nest site the reader is referred to the issue of NATURAL HISTORY for January-February, 1923, p. 40.

A fairy tern of Fakarava, Tuamotu Group.—This species (*Leucanous albus*), with its snowy plumage, blue and black bill, extraordinarily large eyes, and unsuspicious mien, is one of the loveliest of sea birds. It is a perching tern, usually alighting on twigs or crags. Its single egg is deposited on the rough bark of a horizontal limb, upon a broken stub, or even on the shaft of a palm frond. More rarely it is found in a niche of a coral ledge

war birds are of two kinds, one considerably larger than the other, but their habitats seem not to be sharply differentiated, for sometimes both nest upon the same islet. The boobies are more definitely separated in their manner of life, for the red-footed booby nests in trees, whereas the

Man-o'-war birds resting above the shimmering waters of Eiao Island, one of the Marquesas

brown booby and the blue-faced booby lay their eggs on the ground. Thus in breeding habits the red-footed booby is associated with the man-o'-war birds, while the other species align themselves with the handsome red-tailed tropic bird (*Phaëthon rubricaudus*). The latter, which is garbed in rosy plumage of satiny sheen, can neither perch nor stand up. It nests on the ground, often in good-sized communities, and it must shuffle away on its breast before taking flight. The long red plumes of this tireless flyer have always been prized ornaments of the South Sea people. Readers of Herman Melville may recall that when the Marquesan chief, Mehevi, sought to impress the captive author of *Typee*, he came to him with his head gloriously crowned with the erect, crimson feathers. Bennett and other voyagers tell us that islets prolific in this special source of wealth, such as Tubai of the Society Islands, were monopolized by the royal Polynesian rulers, and considered the hereditary lands of their families. It may be added, however, for the benefit of more civilized wearers of avian millinery, that the islanders never took the life of the bird which supplied the treasure; they merely plucked out the tail of the fearless or stolid creature while it sat upon its egg, causing no damage whatsoever, unless the bird's pride be taken into account.

The genus of the tropic birds has been appropriately named after that daring son of Apollo whose sky-riding ended in a headlong plunge. Just so the birds drop like arrows from the blue vault, to disappear—but only for a moment—beneath the water. Much smaller than the red-tailed species is the yellow-billed tropic bird (*Phaëthon lepturus*), which has broader, white tail plumes, and which differs also in confining its nest sites to niches in the face of lofty hills.

Of other water birds, a teal which looks like a small edition of the North American black duck is widely distributed among such islands as have fresh-water ponds or marshes. A small "fly-up-the-creek" (*Butorides stagnatilis*), akin to our green heron, haunts the vales of running streams, and is therefore lacking on the atolls, while the reef heron, notable for its puzzling color phases—white, dark blue, and mottled—is characteristic of lagoon shores. On broad coral rings of the Tuamotus this bird sometimes temporarily forsakes its salt-water fishing for a banquet of lizards from the palm boles.

Without dwelling further on the Pacific water fowl, we must say something of the all but unknown native sandpipers and rails, before turning to

Frigate, or man-o'-war, birds (*Fregata minor palmerstoni*) nesting at Hatutu Island of the Marquesas

The red-footed booby (*Sula piscator*), a long-tailed, perching species and the only Pacific booby which constructs a nest in trees or bushes. Coast of Hatutu Island, Marquesas Group

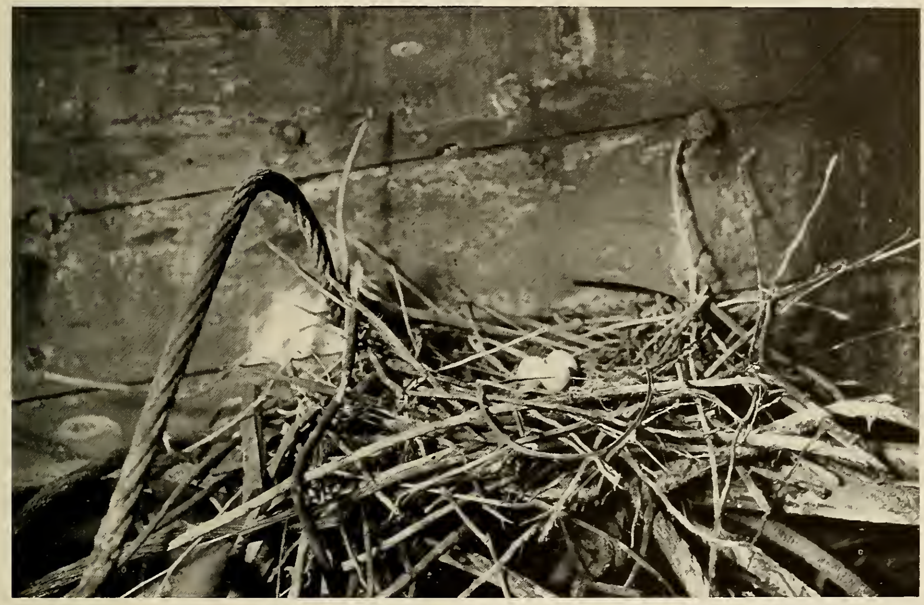
strictly terrestrial birds. Two or more forms of diminutive shore birds belonging to genera called *Prosobonia* and *Æchmorhynchus*—and related, it is alleged, to a rare snipe of the southern Andes!—were found by the early voyagers at many South Pacific localities. In some of the less sophisticated writings they are referred to as "quails." Although too small to be worth shooting in a region where edible pigeons and ducks abounded, the sandpipers in one way or another became generally exterminated. *Prosobonia* has never been rediscovered, and the only existing specimen is treasured in the Leyden Museum. Previous to the Whitney Expedition not more than five or six examples of the other genus were scattered through ornithological collections of the world, but at certain remote atolls of the multitudinous Tuamotus Mr. Beck encountered Peale's species, *Æchmorhynchus parvirostris*, as a yet common bird. To read in Beck's notes of how these sandpipers, which remind one of tiny upland plovers (*Bartramia*), scurried in flocks before him along the breezy strands, or perched within arm's reach on the mangrove branches while he was eating his lunch, is thrilling to an ornithologist who previously had known only vague bookish descriptions of the bird's appearance.

Several kinds of rails and gallinules were native to Polynesia. At least two of these are now extinct, and still more have never been represented in the museums of America. One small secretive, red-legged, black rail has been given an assortment of scientific names, according to the place of origin of the respective specimens; but a study of skins obtained during the Whitney Expedition at seventeen different islands between Oeno and Samoa indicates that a single unvarying form, which should be called *Porzanoidea tabuensis*, ranges throughout numerous archipelagoes. The stability or fixity of certain supposedly ancient types of birds, when contrasted with the remarkable geographic variability of others, is hard to interpret; the fact merely stands as one of the unsolved problems of evolution. However,

An incubating blue-faced booby (*Sula dactylatra*), largest of the Pacific species and a ground-nesting bird. Photographed at Maria Island, Tuamotu Group at Henderson Island, which is partly surrounded by the insular range of *Porzanoidea tabuensis*, there exists a larger, quite distinct black rail which has completely lost the power of flight through a reduction in the size, number, and stiffness of its wing and tail quills. This strange bird, known only since 1908, is sufficiently different from its small cousin to be placed in a new genus, and it has been described by the writer as *Nesophylax*, the "island guardian."

had become established on all the larger wooded islands.

Indigenous species belong to the families of the fruit pigeons, tooth-billed pigeons, quail doves, lories or brush-tongued parrots, true parrots, barn owls, swifts, kingfishers, cuckoos, swallows, Old World flycatchers, starlings, Old World warblers, and several others; but not all of these occur in any single cluster of islands. Thus the remarkable tooth-billed or dodo pigeon (*Didunculus strigirostris*)—not to be confused with the extinct dodo—inhabits only the main islands of Samoa. It was at one time greatly reduced through hunting by the newly armed natives and the ravages of their half-wild domestic cats, but is now, perhaps, increasing.



A quaint home of the widely distributed reef heron (*Demiegretta sacra*), built in the hold of a wrecked hulk at Tahiti

LAND BIRDS OF POLYNESIA

The land birds of the South Seas are obviously of Asiatic origin, but, quite aside from the unique avifauna of Hawaii, many peculiar species and genera have had time and impetus to develop in different island groups. The invading white man, furthermore, is responsible for the recent introduction of hawks, weavers, the so-called mina, rock pigeons, Indian bulbuls, and others. The ancestors of still another interloper, the jungle fowl, were brought by the savage Polynesian navigators on their early migrations, and, long before the advent of Europeans, feral poultry

Most exquisite of all Pacific birds are the fruit pigeons, clad in soft feathers of gray, blue, yellow, metallic green, and pastel hues, with caps of white, or lilac, or mauve, or blazing violet-rose. Some of these, such as the purple-crowned pigeon (*Ptilopus coralensis*) of the Tuamotus, and the white-crowned pigeon of the Marquesas (formidably named *Ptilopus dupetithouarsi* in commemoration of the naval officer who took possession of the islands for France), have relatively wide ranges. Others, like the Tahitian species (*Ptilopus purpuratus*), are confined to two or three islands. In still other instances, magnificent forms are restricted to a single dot of land in the wide sea; their destruction throughout a few square miles would mean the blotting out of a wonderful unit of creation. One of this category, *Ptilopus chalcurus*, found only on the uplifted coral isle of Makatea in the Tuamotu group, leads a naturalist to suspect

Purple-crowned fruit pigeons (*Ptilopus coralensis*) of the Tuamotu Archipelago, accepting berries from the captain of the "France"

that the topographic and consequent floral change resulting from geological disturbance was in some way responsible for the evolution of this bird from the stock of *Ptilopus coralensis*, for the latter lives on all the lower islands round about.

A long-tailed, raspberry-breasted fruit pigeon of Rapa, the southernmost islet of eastern Polynesia, was known previously from only one specimen in the museum at Turin, Italy. It represents the type of a new genus which has been described from Whitney Expedition material as *Thyliphaps*, the "pigeon of Uttermost Thule." The beauty of all of these birds in life passes description; even their dried skins, in the words of a visitor to the Museum, remind one of blood oranges, of peacock's tails, of precious stones!

The quail doves are no less fascinating than the fruit pigeons, and are even more rare because their ground-living habits have rendered their young easy victims of cats and hogs. Five or more kinds have thus far been taken by the staff of the "France," of which the Marquesan species (*Gallicolumba rubescens*) is for historical reasons the most important. This bird was discovered by the Russian explorer, Krusenstern, in 1813. He brought back no specimens in his ship, but published a crude drawing of the bird in the Atlas of the voyage. From that date until October, 1922, the Marquesan quail dove was not seen by a naturalist. Its appearance, relationships, its very existence, indeed, were all doubtful until Mr. Beck found it still frequenting the brushy hillsides of Hatutu and Fatuhuku.

THE KINGFISHER, BIRD OF AUGURY

The small, blue and green Polynesian kingfishers, the colors of which change astonishingly according to the angle of light, seldom if ever wet their wings by diving into streams. They prefer to forage for insects and for the lively lizards which scuttle through the vegetation. No species has an extensive range; the kingfisher of Tahiti is even different from that of neighboring Moorea. In the Society Islands the kingfishers were regarded as sacred birds, "givers of good and bad fortune," according to Sir Joseph Banks, who accompanied Cook on the latter's first voyage of circumnavigation, a tradition perpetuated in the technical name of the Tahitian species —*Todirhamphus veneratus*. The immortal Cook himself, in recounting a human sacrifice which he witnessed, states that the officiating priests awaited the voice of a god, which was finally expressed through the rattling call of a kingfisher.

Hitherto all the known South Pacific kingfishers have come from more or less mountainous islands, but the Whitney

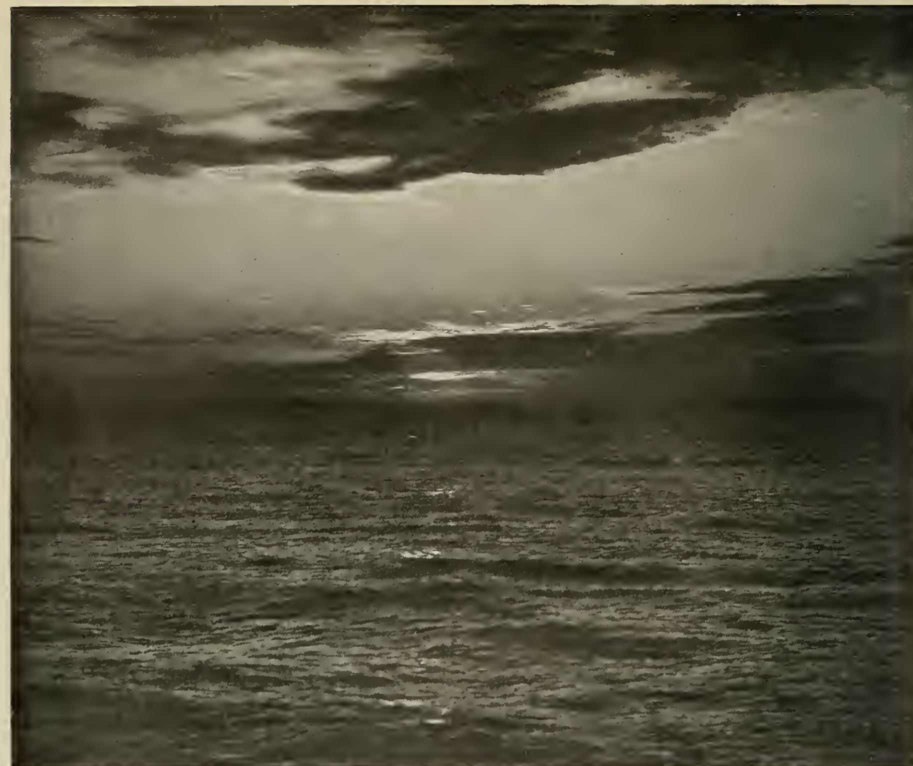
Expedition has obtained at Niau, of the Tuamotus, the new species portrayed in the frontispiece, which has been dedicated to Mrs. Whitney.

Of other land birds we can speak here but briefly. Merchants of Papeete, the metropolis of French Oceania, tell of their boyhood sport of trying to knock down with switches the low-flying *opeias,* or edible-nest swifts (*Collocalia thespesia*), which were formerly common in the streets of the town. This bird, one of a group famous as the source of Chinese bird's-nest soup, has now disappeared from Tahiti, although it still holds out elsewhere. The parrots of eastern Polynesia apparently vanished long ago, but lories the size of sparrows, and bizarre in red, blue, and emerald plumage, still inhabit the less-settled islands. Some of the lories are favorite pets of the Polynesians, who have transported them hither and thither until little clue remains as to their natural distribution. A speckled, pale-blue species (*Coriphilus smaragdinus*) is still peculiar to the Marquesas. A dark blue, white-throated lory of the Society and Tuamotu Islands was evidently first brought to Europe without a label, for in 1776 the zoölogist Müller described it as *Psittacus peruvianus!* Despite the anachronism, the specific name has priority over others more appropriate, and the libel on this paroquet's nationality must stand forever.

A similar error accounts for the name of the sweet-voiced Tahitian warbler (*Conopoderas caffra*), which the eighteenth century naturalist, Sparrman, evidently jumbled with birds obtained in the land of the Kaffirs (i.e. South Africa). The bird is related to the reed warblers of Eurasia, and its genus has run riot in Polynesia, for a distinct race, differing in size, proportions, or color from all relatives, seems to occur at each small assemblage of islands or, sometimes, upon a single islet. Large, yellowish types, represented by certain subspecies of the Society and Marquesas, are at one end of the series, and the very small, gray warbler of Christmas Island is at the other end. Even more diverse in size and pattern are the insular flycatchers of the genus *Pomarea,* named for the old kings of Tahiti. The Tahitian flycatcher (*Pomarea nigra*) is one of many South Sea species included in Lord Rothschild's monograph on *Extinct Birds* (1907); but Mr. Beck has shown that it still thrives in the mountain fastness of the queen of isles.

WHAT THE FUTURE HOLDS IN STORE

With reference to opportunities still before the Whitney Expedition, Doctor Richmond, of the United States National Museum, has reminded the writer that for many years the belief prevailed that the bird life of Hawaii was well known—that the ornithology of the group was, indeed, a "finished product." Then, about 1887, one or more naturalists began to investigate these islands in the modern, intensive manner, and *ten new genera* were discovered. We may hope for a similar prospect in the South Seas. Hundreds of islets have not yet been searched by trained men. In the secluded mountains of even the largest and "best known" islands there may well be unknown secretive birds which have not yet withered away before man and the pests he brings with him. The Whitney Expedition has demonstrated its effectiveness; its results will arouse a public sentiment which may become the only means of saving certain birds from extinction; it is assuredly paving the way for a fuller understanding of biological and zoögeographical problems in a long-neglected quarter of the globe.



Photograph by Julian A. Dimmock

SUNSET AT SEA

The Oceans

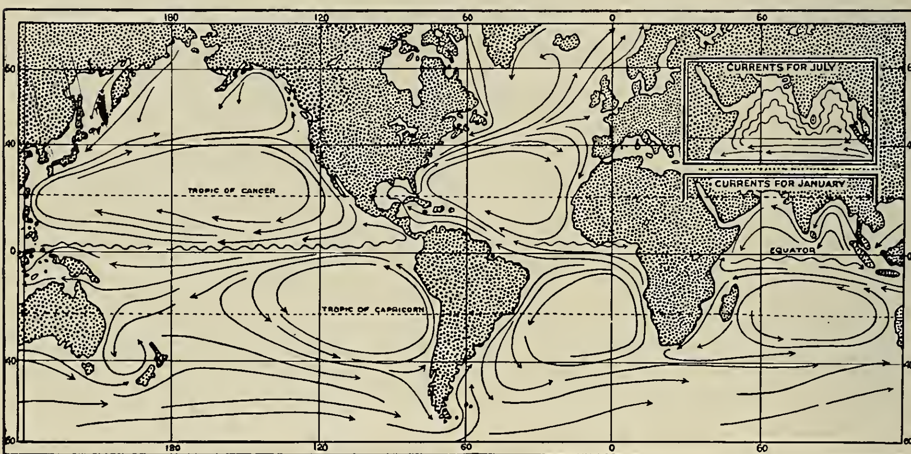
By WILLIAM MORRIS DAVIS
Sturgis-Hooper Professor of Geology, Emeritus, Harvard University

WHEN primitive man, wandering over the solid lands that supported his tread so well, came upon the "great waters" which would not support him and which could not be drunk because of their saltiness, he must have regarded them as very mysterious if the human mind had at that early time acquired the capacity of conceiving anything so abstract as a mystery. The unseen extent of the waters beyond the smooth horizon line must have seemed utterly unknowable; if other lands lay on the farther side of the waters, they could not be reached.

Those early mysteries are now solved. The extent of all the oceans has been measured, their shores have been charted, and few, if any, oceanic islands remain to be discovered; the depths of the oceans have been sounded at many points, and samples of bottom deposits have been brought up to the surface for study; the movements of the oceans in waves, currents, and tides have come to be fairly well understood. But new mysteries now confront us; and of these, the most fundamental is: what is the origin of the vast sheet of water that so evenly covers three-fourths of the earth's surface to an average depth of about two miles? Older and newer hypotheses have been framed to answer this question, but no certain knowledge has been reached. A generation ago, when most geologists confidently believed the earth to be a cooled-down aggregation of hot matter slowly gathered from an ardent chaos, the ocean was supposed to have been first formed, after the temperature of the earth's crust had been reduced enough to allow water to remain upon it, by the gradual condensation of rainfall from the heavy, steamy atmosphere which had long shrouded the globe while it was still glowing with heat. But today the confident acceptance of that earlier view is shaken by the introduction of a very different concept, according to which the earth has been built up slowly of scraps of cold matter—planetesimals—loosely at first, when its mass was small and its gravity was therefore weak, more compactly as it grew to greater and greater size and the cold exterior weighed down more heavily on the cold interior; more compactly still when the increasing outer parts crushed the inert inner parts and thereby generated a growing store of interior heat, thus providing for a beginning of the various processes of vulcanism. Eventually, as the present size of the earth was approached and reached, volcanic eruptions became powerful and frequent enough—as they still are—to expel great volumes of gases from the interior and to pour out vast floods of lava; and in so far as these gases included water vapor, a large part of it cooled and condensed in clouds and fell as rain; then—as was also supposed in the earlier hypothesis—the rain water gathered into streams and, even with greater fluidity than the molten lava, ran down the slopes of the lands and spread out with a level surface in the primitive depressions. Thus explained, the oceans began to form from a supply of interior or telluric water, not of exterior or atmospheric water; and thus they have continued to grow to greater and greater volumes through the geologic ages; thus they may, according to the later hypothesis, be growing still. It is impossible to say which one, if either, of these explanations is true; but in this sort of long-range archery, it is well to have two strings to one's bow.

The present relation of the unevennesses of our planet's surface to the volume of the ocean waters is such that the oceans are deep enough to cover the greater part of that surface in a continuous sheet, and that the lands emerge in only one quarter of the whole. The continents have generally been built in large patterns—who can say why?—and most of them are contiguous in one hemisphere. The other,

The globe may be divided into a land hemisphere (left) and a water hemisphere (right). London is close to the pole of the former; the pole of the latter is in the ocean near New Zealand. Drawn by W. E. Belanske or water hemisphere, in which New Zealand lies near the pole, is almost wholly oceanic; it includes all the Pacific as well as the adjoining waters known as the Antarctic Ocean, and a good part of the Indian Ocean; of larger land areas it includes only the outlying masses of Australia and Antarctica, and the narrowing part of farther South America. The land hemisphere, in which, curiously enough, the capital of the greatest colonizing nation of the world lies near the pole, has for its oceanic area only the winding, canal-like Atlantic with its gulflike Arctic termination and its mediterranean attachments, east and west, along with an oblique northwestern slice of the Indian Ocean.



Map of the world, showing the ocean currents.—In the monsoon region of India, the winds reverse their direction every six months, and therefore two sets of ocean currents are shown for this region. After Davis

Although the salt waters of the world—barring certain inland lakes—are thus continuous, they are naturally divided by a system of ocean currents, and also artificially for purposes of naval administration, into seven oceans, the North and South Atlantic, the North and South Pacific, the Indian, the Arctic, and the Antarctic. The first five are all characterized by wind-driven, slow-moving, clockwise-turning[1] currents of small depth, which eddy around their central and relatively stagnant sargasso seas. The small circum-Arctic eddy, rimmed in by the continents, is in gear with and therefore turns opposite to the North Atlantic eddy. The much greater Antarctic eddy, which rims an ice-covered continent, is in gear with and turns opposite to the three southern eddies.

The two Atlantic eddies are peculiarly related: they become confluent in the torrid zone, but by reason of the different relations of western Africa and eastern South America to the equator, a large branch of the southern eddy is diverted obliquely across the equator to the northern eddy; evidently, therefore, an equivalent branch must be diverted from the northern side of the northern eddy, west of Ireland, and directed past Scandinavia

[1]It is often stated that these eddies turn clockwise in the Northern Hemisphere and counter-clockwise in the Southern; but it may be truly said that they both turn clockwise if we only remember in the case of the Southern Hemisphere to look at the other side of the clock, just as we there look at the other side of the plane of the equator.

to form the Arctic eddy. This diverted branch, improperly called the Gulf Stream—a name that should be restricted to the hurried and relatively deep current that issues from the Gulf of Mexico between Florida and the Bahamas—and properly called the northeastern branch of the North Atlantic Drift, is of moderate depth and of loitering movement, but still retains an exceptionally high temperature because of the long passage of its supply current through latitudes of strong sunshine; and as a result the surface water of the Atlantic off Norway and the air lying on it have a greater excess of temperature over the mean of their latitude than is the case in any other part of the world—all because of the asymmetry of Africa and South America.

The existing distribution of land and water on the globe has not always obtained; for the continents include many stratified rocks which, as their fossils indicate, have been laid down in the oceans of different geological ages; but these strata are relatively shallow-water deposits and therefore indicate only moderate changes of level. None of the lands, with the possible exception of certain Australasian islands, has been uplifted from oceanic depths so great as to exhibit true deep-sea deposits. On the other hand, certain continents have lost part of their former extent, for their border structures are clearly truncated by the shore line, just as the end of a board is cut across its grain; they must have originally continued into what is now the ocean, and in some regions into what is now the deep ocean; hence their lost portions have been strongly warped downward. The deep oceans thus seem to have been enlarged during the geologically recorded ages, and this perhaps gives confirmation to the second hypothesis, above stated, of the ocean's origin. Let no one, however, place too great confidence in this very tentative conclusion; for if what is now unknown about the greater part of the ocean bed ever comes to be known, our present views about it may be greatly modified if not altogether overthrown.

Although the volume of the ocean, however formed, is very small relative to that of the whole earth, and although the ocean depth is, therefore, comparable only to the thickness of the paper cover on a good-sized terrestrial globe, such is the extraordinary mobility of water that the ocean smooths itself out to a perfectly level surface, which is taken as the standard surface of reference for all calculations of the generalized shape of the earth as a somewhat irregular spheroid, or "geoid," as geodesists call it, and for all measures of the altitudes of the land. The tides periodically sway the ocean margins a little out of the level; and storm winds may locally brush up the surface into waves that rise for a time "mountain high"—for so indeed they seem when their rapidly advancing crests are viewed from their deep-sunken troughs, although their actual height is hardly fifty feet at the highest—but these tide and wind waves are minute wrinkles compared to the huge undulations of mountain ranges that are excited by slow-working geological storms of deformational forces in the earth's crust; and, moreover, the ocean waves soon quiet down again after the exciting storm has passed by, while the huge inequalities of the earth's crust on the lands, even though much degraded by erosional processes during their slow production, long remain as eminences before they are very slowly worn down to lowlands; and by that time, new inequalities are produced elsewhere.

Not only has the ocean a uniformly level surface, but the greater part of its volume is uniform in various other respects also. The lands are made of many kinds of minerals and rocks, mostly of complicated chemical composition, and varying from place to place; but the ocean is made of one substance, water, of very simple chemical composition, the same everywhere. True, the ocean contains in solution a small quantity of a great variety of substances—of which the most abundant is the very soluble mineral salt, and among which even gold is minutely included—found in the continental parts of the earth's crust during ages of the most assiduous search by percolating ground waters and brought by rivers to the ocean, where they have very slowly accumulated to their present quantity, as is further told below. As a result, ocean water is about 2.6% denser than fresh water; but these many dissolved substances give no variety to the great volume of the ocean, because they are everywhere distributed in almost exactly the same proportions, partly by the circulation of the ocean currents, which in time mixes and remixes the whole content of the ocean, partly by the spontaneous diffusion of the dissolved substances themselves, in virtue of that extraordinary physical process according to which a solid dissolved in a liquid behaves like a gas.

Water is, moreover, so little compressible that the ocean is of almost uniform density from surface to bottom; in this respect it contrasts strongly with the gaseous atmosphere, which is so easily compressible that, while its lower layers are dense enough to permit seeds and sailing vessels to be propelled by the winds and to support birds and airplanes if they move rapidly enough through it, its upper layers are like a vacuum in their extreme tenuity. On the other hand, in spite of the pressures of two, three, or four tons to the square inch that are exerted at the greater oceanic depths, the bottom water is only about as much denser than the surface water as the surface salt water of the ocean is denser than the fresh water of lakes. Hence any object that is heavy enough to sink at the ocean surface will pretty surely reach the bottom; the old idea that even an anchor would cease sinking when it had descended to a depth where the water is compressed to the density of iron is a fable, with only about three per cent of trustworthy basis.

The ocean surface shares everywhere with the surface of the lands the changes of solar illumination from day to night and the irregular fluctuations of the weather. With the changes of the sky from clear to cloudy, the color of the ocean surface also changes wonderfully. Even the surface salinity varies, for drinkable water has been dipped up by ships at sea directly after a heavy equatorial rain. But the great undervolume of the ocean, below depths of two hundred or three hundred fathoms, knows little or nothing of these superficial changes. It is not only everywhere one substance and uniformly salt, as already stated; it is also persistently dark, for sunlight rapidly weakens with increasing depth of penetration. Some illumination of the deep ocean, it is believed, comes from the pale light of luminous organisms; and that the deep ocean is not so dark as terrestrial caverns may be inferred from the fact that many deep-sea organisms have eyes and colors, while various species of land animals which have taken caverns as their abode, lose their colors and all but vestiges of their eyes and become gray-white, sightless creatures. The deep ocean, however, probably has no experience of day and night, and is, therefore, without the convenient measure of the passage of time that is based on the period of the earth's rotation, which the inhabitants of the land everywhere recognize.

The deep ocean is also a very quiet region; for the movement of surface waves and currents, like the penetration of sunshine, rapidly diminishes downward. The bottom waters would be absolutely still but for the slow and steady creeping of deep polar water toward the equator, of which more is told below, and but for the slight tidal oscillations. The latter must be extremely faint, but they are of interest as being, in the presumable absence of diurnal changes of illumination, the only periodic phenomena there experienced, and hence the only phenomena by which the passage of time is marked. Deep-sea organisms must, therefore, as far as they take cognizance of their tides, work on half-moon time; and in this they bear a resemblance to myriads of Crustacea and Mollusca on tidal shores, where in spite of the sun's determination of day and night, the moon regulates the order of animal life by its control of high and low water; and the same set of conditions governs mariners on coasts of strong tidal range, like the Bay of Fundy and the Channel Islands.

Rare and small departures from ocean-bottom stillness may be caused by earthquake waves, but in the watery depths they, like the tides, can show nothing resembling the activity with which they withdraw from and sweep in upon the shores of the lands. Exceptional disturbances are also caused by submarine volcanic eruptions, but these are so infrequent that quietness may still be considered a prevalent condition.

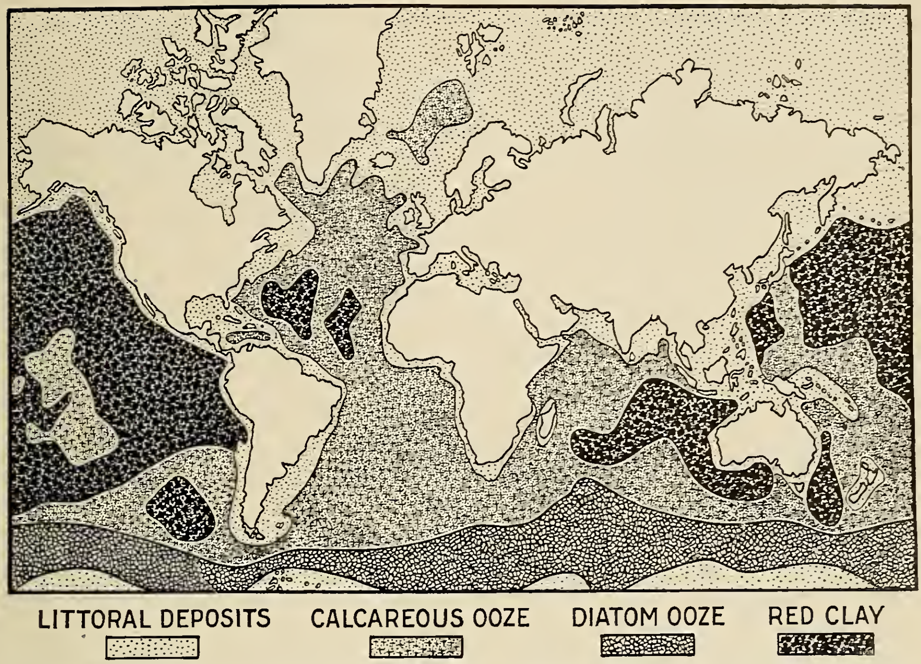
The deep ocean is not only dark and still, it is persistently cold; for by means of the vertical convectional circulation above mentioned the surface water that is chilled in the frigid oceans sinks and creeps very slowly to the torrid zone, where it must slowly rise. Be it remembered in this connection that unlike fresh water, which has its maximum density at 39° F. or 4° C., salt water is densest at its freezing point, about 28° F. or -2° C. Hence the great under-volume of the ocean in all latitudes has a temperature of between 30° F. and 40° F. or -1° C. and 5° C. The only significant exceptions to this rule are found in the basins of the enclosed mediterraneans, like the classic Mediterranean between Europe and Africa, the American mediterraneans known as the Caribbean Sea and the Gulf of Mexico, and several others in the Australasian region; the deep water of these basins, instead of being frigid, is only as cold as the open ocean at the level of their deepest entrance.

Moreover, the greater part of the ocean bottom is smooth and nearly level. Its levelness is locally interrupted here and there by volcanic cones, which have been slowly built up by countless eruptions, and which may or may not rise above the ocean surface as islands; and in a larger way by occasional flexures of large-curved cross-profiles, one of the greatest of which stretches northeastward from New Zealand, in a long swell adjoined by a deep trough, to the Tonga Islands in the South Pacific. Near certain continental shores, soundings discover the occurrence of valleys and other erosional features, as if the continental border had been depressed in recent geological time, one of the best-certified of such features being the submerged valley of the Hudson, which trenches the continental shelf southeast of the river mouth of today.

Apart from these inequalities, however, the ocean bottom, as now known, is monotonously flat over large areas. But it is well not to generalize too confidently on this topic at present; for oceanic soundings are for the most part few and far between. Areas as large as Australia still remain in the Pacific without a single sounding to the bottom. He must be a bold man who ventures to draw a generalized chart of ocean depths! It is to be hoped that much more will soon be learned of oceanic depths by means of the "sonic depth finder," an instrument recently perfected in the research laboratory of our Navy and now in use on a number of our naval vessels in different parts of the world. This instrument measures depths in terms of the time interval between the emission of a surface sound and the return of its echo from the bottom. A vessel equipped with it does not have to stop a few hours to make a sounding, as is the case when piano wire and a detachable sinker are used, but may take successive measurements every few minutes while under full headway, even in rough weather.

Not only are the deep oceans persistently dark, still, and cold, and their deep floors prevailingly flat, but their bottom deposits, as brought up in sounding tubes and dredges, have small variety of composition. They consist chiefly of calcareous ooze over vast areas of lesser depth, down to about two thousand fathoms, and of a reddish clay in the greater depths. The ooze is composed of the delicate framework of minute organisms which live everywhere near the surface and which, on dying, sink slowly through the water, very much as a fine misty rain sinks through the atmosphere; but while such a rain is only of occasional, local, and short-lived occurrence, the fine organic rain in the oceans is perpetual and universal, and thus constitutes another of the many oceanic uniformities. The analogy goes a step further: for just as a fine rain, fed from lofty clouds, reaches a mountainous highland and yet may be evaporated before it descends a mile farther to the neighboring lowlands, so the fine organic rain of the oceans reaches the lesser depths as calcareous ooze, but is dissolved before reaching greater depths, probably because of increasing pressure, and only an insoluble reddish residue, the so-called red clay, sinks to greater depths; its accumulation there must be extremely slow.

In but one respect is the ocean less uniform than the rest of the earth: it is made of the only substance with which we have familiar experience in the three states that matter can assume. The surface water may freeze into ice of slight thickness in the frigid oceans; and then, as solid water, it holds its shape as well as its volume. As a whole, the ocean is liquid water, which maintains its own volume but accepts any shape and surface that external forces impel it to take; thus, under the force of terrestrial gravity, it is given the convex spheroidal surface which we call level. From its liquid surface, largely by the aid of the winds which bring drier air to replace damper air on its ruffled surface, a small amount of ocean substance passes off as invisible gaseous water,



Map showing the distribution of the oceanic oozes and clays.—Reprinted by permission, from *Textbook of Geology*, Part II, by Pirsson and Schuchert, published by John Wiley & Sons, Inc. Redrafted, with substitution of new symbols, by W. E. Belanske

which has neither definite shape nor volume, but which diffuses itself through the enveloping atmosphere, only to be sooner or later condensed into clouds and to fall here or there as rain or snow; and this leads us to examine the great scheme of terrestrial economics in which the waters of the vast oceanic reservoir play a leading part.

It is as if the ocean, proud of its own level uniformity, wished to see the continents also laid low and smooth, and with this object sent forth its vapors so that those which descend on the lands should bear back, when they return to the ocean, all the land waste they can carry; but the continents, resenting such reduction to low equality with the level ocean, slowly writhe and rise in new highlands as older highlands are worn down, and thus strive to maintain their superior diversity of form, as well as of nearly every other quality, over the uniformity of the ocean.

The atmosphere, dampened by the addition of water vapor from the ocean, is an effective collaborator in this scheme of things; first, in that it gives forth its store of vapor as rain or snow in great abundance and frequency wherever the continents venture to raise their mountain ranges highest; second, in that the dampened air occasions the superficial disintegration or weathering of the continental rock masses, for it is the rock waste thus loosened that the streams of the land sweep down to the sea; third, in that, quite apart from the work of running streams, the weathered rock waste is superficially washed downhill by rainstorm rills, and also that weather changes from wet to dry and from warm to cold cause the rock waste to a depth of several feet to creep slowly down every slope toward and eventually to reach the stream below: hence in this long-range view of the earth's affairs, all the rock waste of the lands should be envisaged as in slow motion on its way to the sea.

The streams of the land are the most active agents in the great task of smoothing down the continental highlands to ocean level; and admirable engineers the streams are, for they grade their valley floors to a nicety with regard to the work that they have to do. The largest rivers reduce their courses to a gentle declivity; indeed, to just such a declivity as will give them a velocity sufficient to sweep along the rock waste, mostly fine-grained, that is delivered to them by their headwater brooks; and the headwater brooks retain a greater declivity, so that, in spite of their small volume, they shall have a velocity sufficient to wash down the rock waste, often of coarse texture, that is delivered to them from the valley-side slopes.

Be it noted that in this scheme of things, which presumably began its operation long ago in the history of the earth, all the life of the lands depends directly or indirectly, in its struggle for existence, on that part of the weathered rock waste which, in its relation to plant roots, is called soil. The rock waste would undoubtedly be impelled to continue its slow motion from the lands to the sea even if there were no plants to live on it; but plants could not live on the lands if there were no weathered soil to grow in. The plants of the land may, therefore, be regarded as taking advantage, for their own purposes, of the weathering device by which the atmosphere, in its coöperation with the ocean, crumbles the rocks preparatory to their being swept seaward by ocean-fed rivers. Even the trees of mountain-side forests, slowly as their successive generations follow one another, may be conceived as floating on the extremely slow soil current which, as the earth itself looks at these superficial changes, is continually flowing off the lands.

The ocean has plenty of space in which to deposit the waste of the land swept in by the rivers, as well as that worn from the shores by the waves; but the land waste that is delivered in solution is treated very differently from that delivered in suspension. The suspended waste, chiefly gravel, sand, and clay, is spread out in successive layers or strata near the shore, where its accumulation forms the so-called continental shelves, of very gradual slope to depths of forty or fifty fathoms and of somewhat steeper pitch to greater depths. It is these shallow-water strata, in which siliceous, argillaceous, and calcareous deposits are found, that are often restored to the continents, as when an upheaval reveals them in coastal plains, or as when deformational forces crumple them in new mountain ranges. On the other hand, the dissolved substances are, as already stated, uniformly spread through the entire ocean, and there they would remain indefinitely, slowly increasing, if it were not for two very unlike processes by which some of them are withdrawn.

It occasionally happens that an arm of the sea is cut off by an upwarping of the ocean bottom; and if the lands by which the sea arm is enclosed have a dry climate, the enclosed sea water may be evaporated away slowly and its dissolved salts will then be precipitated. Thus, it is supposed, beds of rock salt have been formed; but this process is so exceptional that salt is still the most abundant dissolved substance in ocean water. On the other hand, it happens that another dissolved substance, limestone, continually brought in solution from the lands to the oceans, has been adopted by many marine organisms as the chief component of their solid framework, and it is therefore continually withdrawn to satisfy their needs. Thus mollusks and other creatures, living mostly on the continental shelves but also at greater depths, secrete the dissolved limestone to make their shells. Their remains constitute the calcareous strata of continental shelves above alluded to, particularly near low coasts, where the supply of sandy and muddy detritus from the lands is small. More important are the minute Foraminifera—*Globigerina* being one of the commonest genera—which float near the surface, and the delicate shells of which, sinking after the occupant's death, constitute the greater part of the wide-spread calcareous ooze, or yield a small undissolved residue to form the red clay of the greater depths, as already described. Remarkable also, but less widespread, are the reef-building corals which, together with limestone-secreting algæ and other organisms, thrive in the shallow waters of the torrid zone, either near continents, as along northeastern Australia, or around oceanic islands, mostly volcanic, as in Fiji, or in the open ocean, as through to the Central Pacific. They construct fringing reefs of gray limestone, attached to the land, or barrier reefs rising offshore and enclosing a lagoon, or most extraordinary of all, atoll reefs, in which the lagoon has no central island remaining. The wonderful nature of these structures and the various explanations that have been suggested for them would require a special article for the telling.

The red clays and the calcareous ooze deserve a further paragraph in explanation of their contrasts with the littoral deposits on continental shelves, and of their geologic relations. In the first place, the continental shelves are the depositaries of nearly all of the silica and most of the clay that is washed from the lands, but of only the smaller part of the dissolved limestone; the deep oceans are the depositaries of the greater part of the limestone and of a smaller part of the clay; the little silica that reaches them is chiefly withdrawn from solution by the microscopic plants known as diatoms, the remains of which are found chiefly in the far southern oceans. In the second place, the limestone that is deposited on the shelves may be returned to the continents by upheaval and then may be carried back to the oceans in solution, thus being available for organic use over and over again; but the deep-sea calcareous ooze is a relatively permanent acquisition of the ocean floor; hence the supply of limestone in solution in the ocean would in time be depleted if it were not renewed from calcareous minerals in the older fundamental rocks of the earth's crust and in the lavas outpoured from volcanic vents, which thus for the first time experience superficial analysis. Whether the processes of renewal are now gaining on the processes of depletion, who shall say!

In the third place, the deposits of the continental shelves are of relatively rapid accumulation in varying composition and great thickness and with well-defined stratification under the active processes and fluctuating conditions that prevail near the coasts. Here the successive thinner and thicker layers record every tick of a second and every striking hour in the passage of geological time; but the deep-sea deposits are accumulated in slow and uniform continuity, with hardly perceptible changes of composition from millenium to millenium and presumably without stratification. They record, therefore, only the patient passage of pelagic eternity, in which there is no ticking of the seconds, no striking of the hours, and in which time simply goes evenly and endlessly on. And yet these monotonous, deep-ocean deposits, accumulating in everlasting uniformity, must as they approach the coasts merge into the much heavier and more variable contemporaneous deposits of the continental shelves, which vary from place to place, and from time to time. What a boon it would be to geological science if the on-shore deposits, in which every different stretch of a coast records the passage of its own chapter of time in its own particular fashion and in which unlike strata and fossils are laid down on different coasts at the same time, could be correlated with and dated by the corresponding portion of the steady-going, deep-ocean deposits, and thus given their proper place in a standard chronology of earth history!

The activity of marine organisms in connection with the formation of pelagic deposits brings us to the great chapter of oceanic life which properly belongs in another article by another writer, but which may be here briefly touched upon in its physical relations and in their contrasts with the physical relations of life on land. Let it be recalled, therefore, first, that all the animal life of lands depends for its sustenance, directly or indirectly, upon plant life; second, that all terrestrial plants derive their sustenance chiefly from the carbon dioxide of the atmosphere, which they take in through their leaves and decompose with the aid of sunlight; also that in their competition for this sustenance many land plants have developed self-supporting stems or trunks, which hold them up a little way in the air; third, that all terrestrial animals and plants derive the energy needed for their life work by combining a part of their organic substance with atmospheric oxygen in the continuous process of respiration, a slow process in plants, more active in animals; fourth, that land plants are prevailingly rooted in weathered rock or soil, partly because their chief sustenance comes to them in the ever-moving air, partly because a minute mineral constituent dissolved in ground water, must be brought up from the soil; but land animals are rarely rooted; they must move about in search of food, and in doing so most of them must support their weight while walking, running, or flying; when they are fatigued, they lie down or perch to rest.

So again in the oceans, all animal life depends directly or indirectly on plant life. Second, marine plants, commonly known as seaweeds, derive the carbon dioxide for their sustenance, and both sea plants and sea animals derive the free oxygen for their respiration, from a supply of those atmospheric gases that is dissolved in the ocean water; and the occurrence of animal life in the deep ocean as well as the low temperature prevailing there prove the vertical circulation of the ocean waters, for without such a circulation the supply of free oxygen would have been exhausted long ago and the deep oceans would be dead. This free oxygen must not be confounded, however, with the oxygen that is chemically combined with hydrogen to form ocean water, and the marine animals here mentioned must not be understood to include those air-breathing aquatic mammals, like seals and whales, which appear to be derived from land quadrupeds, modified for marine existence. Third, as the assimilation of carbon from carbon dioxide demands the aid of sunlight, marine plants live only in shallow water and at the surface of the ocean: the deep ocean has no flora; but as if partly to make up for this lack, the frigid oceans have littoral thickets of seaweeds at latitudes higher than those in which land plants can flourish on the continents. Fourth, unlike land plants which support themselves in the non-supporting air, seaweeds are supported by the water in which they grow; hence those that live in very shallow waters rise to their full height at high tide, and lie down, as if to rest, when the tide is "out." Finally, nearly all marine plants—but not the microscopic diatoms—and also a vast number of marine animals are "rooted," in the sense of being attached to the sea bottom, not because they gain nutriment from their attachment, but because all the nutriment they need is brought to them, often in microscopic doses, in the moving water; they do not have to go in search of it, but they have to search through a great deal of water to obtain as much food as they need. But another large number of marine animals, large, small, and minute, chiefly living at small depths in the open ocean, are free swimmers, and as they have the same average density as seawater, they float at ease: hence they do not know the fatigue of supporting their own weight, nor do they need to lie down to rest.

As to the deep sea, modern exploration has shown that it is not lifeless, as was formerly supposed, but that it has a varied and fairly abundant fauna, in spite of the monotony of existence where there is no variety to give life its spice. Perhaps the most marked physical characteristic of the deep-sea creatures is their ability to withstand the enormous pressure exerted by the overlying water; but they do this in much the same way as we land-dwellers withstand the pressure of the atmosphere; that is, by admitting the surrounding fluid within their bodies and through and through their tissues. Great as the pressure is at the ocean bottom, the mobility of the compressed water is so perfect that a delicate fin or slender tentacle can move through it. Finally, it remains to be said that the great volume of the ocean, between the well populated surface waters and the more scantily populated bottom, is almost lifeless; thus another element, that of dead monotony, is added to its darkness, its cold, and its quietness: it is a vast desert.

Gigantactis vanhoeffeni, one of the inhabitants of the deep sea, dwelling at depths of from 1 to $1\frac{1}{2}$ miles.—The light at the end of the long rod extending from its snout serves, it is believed, as a lure to attract prey. (Approximately life size)

THE NORTHERN ELEPHANT SEAL GROUP, AMERICAN MUSEUM

This photograph shows the dominant elements in the group made possible through the generosity of Mr. Arthur Curtiss James. The bull with head raised was mounted by Mr. Frederick Blaschke; the other specimens by Mr. Clyde L. Patch. The background was painted by Mr. Albert Operti from the photograph of the seal rookery shown on page 572. The "Albatross" may be seen faintly just to the left of the rocky promontory

The Northern Elephant Seal and the Guadalupe Fur Seal

By CHARLES HASKINS TOWNSEND

Director of the New York Aquarium

THERE are two species of seals native to the west coast of North America that in the past were harassed with reckless disregard of their possible extinction: the northern elephant seal (*Mirounga angustirostris*) and the Guadalupe fur seal (*Arctocephalus townsendi*). The former, as the result of freedom from molestation during recent years, is at present slowly increasing in numbers; the latter may be extinct, as it has not been seen since 1894, when several seals were killed for their pelts.

The fur seal is known to science only from the weatherworn skulls obtained by the writer at Guadalupe Island in May, 1892.[1] Of the few fur seals seen afloat at that time not one was secured, and none was seen on land during a prolonged examination of their former haunts, although a search was made of all the beach caves around the island.

There is a possibility, however, that stragglers of this species still exist, as the habit of this seal of lying in caves serves to keep it out of sight. Our hunt through the numerous caves of Guadalupe Island in May was futile, doubtless because it was made in advance of the breeding season, which occurs in June and July. We looked for the animal again in March, 1911, during the expedition of the "Albatross,"[2] but did not examine the caves, believing it useless to do so at that time of year. Any further search should be made late in July, before the young take to the water, and should include all the caves along the water line. The hope that, if still surviving, it may reëstablish itself, is reënforced by the fact that Guadalupe Island is now a guarded reservation. This valuable seal formerly inhabited the islands of Lower California and those of California northward as far as the latitude of San Francisco. In 1892 the writer secured from men who had participated in sealing at Guadalupe and the San Benito islands certain records which, supplemented by researches he made subsequently at San Diego, indicate that 5575 fur seals were taken between 1876 and 1894.

To the records of fur seals known to have been killed by sealers at Guadalupe, San Benito, and Cedros (Cerros) islands, may be added figures which the writer found recently in the third edition of William Mariner's account of the Tonga Islands, published in London in 1827.[3] Mr. Mariner was on board the British whaler "Port-au-Prince," which took 8338 fur-seal skins at Cedros, San Benito, and Guadalupe islands, between August 1 and September 19, 1806. Another record is that of the ship "Dromio" of Boston in 1807, which at "Shelvock's Island," alleged to be southwest of Cape San Lucas in latitude 21°, "in a fortnight killed 3000 fur seals." Belcher (1837)

[1]Townsend, C. H. 1899. "Pelagic Sealing." Extract from *The Fur Seals and Fur-Seal Islands of the North Pacific Ocean*, Part III, pp. 223–74.

[2]This old ship, after a long and eventful career, has recently passed into private ownership. Its record of service is commemorated in a Note contributed to this issue by Doctor Townsend (p. 619).

[3]Mariner, W. 1827. *An Account of the Natives of the Tonga Islands, in the South Pacific Ocean.*

THE "ALBATROSS" DREDGING AT SEA

The dredging boom may be seen out to [starbord; the port boom is rigged for surface towing. The "Albatross," after nearly four decades in the service of the government, in the course of which she participated in a number of important scientific expeditions, recently passed into private ownership. (See Note on p. 619 of this issue)

and others failed to find "Shelvock's Island" in the position described. It may have been Guadalupe Island, farther to the north, but whatever its identity, in this region the species taken must have been the Guadalupe fur seal. While the scattered records of the long-continued hunting of the Guadalupe seal account for large numbers, Mariner's statement and the record of the "Dromio," so long overlooked, seem to indicate that the species may have been much more abundant than has hitherto been supposed. There is further reason for this inference in the fact that the islands where the species—of the same genus as the Antarctic species—developed, remained unexploited until whaling in North Pacific waters began late in the eighteenth century. Dr. E. C. Starks[1] has shown conclusively that the great numbers of fur seals killed on the Farallon Islands, off the coast of California, during the earlier years of the nineteenth century were of this species.

While the very existence of the Guadalupe fur seal is in doubt, the preservation of the elephant seal seems assured. As a result of representations made to the Mexican government after the re-discovery of this seal in March, 1911, by the "Albatross" Expedition and again by the joint American and Mexican party of biologists[2] that visited the island in the Mexican patrol boat "Tecate" in July, 1922, Guadalupe Island was made a reservation and provided with a resident guard.

The expedition of the "Tecate" found 264 elephant seals at Guadalupe—more than twice the number counted by the writer in 1911—and from a study of the old and young estimated the size of the herd, present and absent, at about 1000 animals.[3]

The casual reappearance of the elephant seal at other islands, from Cedros northward to the Santa Barbara Islands, may reasonably be expected. As the protection now afforded by the Mexican government is limited to Guadalupe Island, the animal may not find very safe quarters when it extends its present range. It is, therefore, desirable that precautions be taken to insure the safety of such stragglers as may appear among islands of the Santa Barbara group, where in the absence of restrictions it is liable to molestation by fishermen. The elephant seal should be given the fullest opportunity to return to its ancient haunts north of the boundary. It is not only commercially valuable but also inoffensive and of great scientific interest.

The ancestors of the northern elephant seal, like those of its associate in habitat, the Guadalupe fur seal, wandered from Antarctic waters and successfully ventured across the equatorial barrier in times sufficiently remote to have enabled their descendants to acquire new characters in a strange environment. The account of the northern elephant seal, published by Scammon[4] in 1874, continued for many years to be the main source of information respecting the creature. Only a few immature specimens were to be found in museums, and naturalists assumed that t had become extinct. Much more is known about the Antarctic species.

[1]Starks, E. C. 1922. "Records of the Capture of Fur Seals on Land in California," *California Fish and Game*, Vol. VIII, pp. 15 –60.

[2]Hanna, G. Dallas, and Anthony, A. W. 1923. "A Cruise Among Desert Islands," *National Geographic Magazine*, Vol. XLIV, No. 1, pp. 71–99.

[3]For an account of the status of the herd in 1923 the reader is referred to the article by Mr. Huey in this issue.

[4]Scammon, Charles M. 1874. "The Sea Elephant," *The Marine Mammals of the North-Western Coast of North America*, pp. 115–23.

The discovery of a small herd at San Cristobal Bay, Lower California, in 1880, created an immediate revival of sealing, which resulted in the killing of more than three hundred animals during the next four years. These facts were reported to the National Museum in 1884 by the writer, who thereupon was sent at once in a chartered vessel, the schooner "Laura," in search of specimens. Sixteen seals—all that were found during a cruise of two months—were taken for scientific purposes, as the only alternative to their slaughter by sealers.[1]

The elephant seal was then lost sight of for nearly a decade. In 1892 a small band was found at Guadalupe Island by the writer while in search of fur seals under the direction of the Department of State. Some of these elephant seals were secured and the identity of the fur seal—the object of the expedition—was established.

From 1892 information respecting the elephant seal was lacking, so far as biologists were aware, until 1907, when Guadalupe Island, long uninhabited, was visited by Charles Harris in the interest of the Rothschild Museum.[2] There about forty of the animals were found.

The next important event in this history of the northern elephant seal was the visit of the "Albatross" to Guadalupe Island in 1911. Thanks to the generosity of Mr. Arthur Curtiss James, of New York, the American Museum of Natural History had the privilege of coöperating in this expedition, as a result of which the Museum obtained its splendid habitat group of these huge animals. Much descriptive and pictorial material, previously lacking, was also secured. The numerous photographs were, indeed, the only ones of the elephant seal that had until then been taken, with the exception of a few made by Harris in 1907 at the same island. Six young elephant seals captured by this expedition were exhibited at the New York Aquarium, where some of them lived nearly two years. These are now preserved as specimens in the American Museum, the United States National Museum, and the Brooklyn Museum.

In 1922 the expedition of the "Tecate" to Guadalupe took place, to be followed a year later by a second visit of this ship to the island.

Having given this brief summary of recent expeditions concerned with the elephant seal, let us cast our eye back over some of the earlier narratives. In Mariner's account referred to above, it is stated that the "Port-au-Prince" was proceeding to "the island of Ceros" (Cedros) for the purpose of "laying in a cargo of elephant oil and seal-skins" but the account contains no further reference to the elephant seal which, it is known, was abundant there at that time (1806).

Scammon,[3] in writing of the animal life at Cedros Island, says, "Seals and sea-elephants once basked upon the shores of this isolated spot in vast numbers, and in years past its surrounding shores teemed with sealers, seal elephant, and sea-otter hunters. . . . But those innumerable herds of sea-elephants have long since been nearly exterminated, and here seals likewise are found only in comparatively small numbers."

Scammon states that the elephant

[1]Townsend, C. H. 1885. "An Account of Recent Captures of the California Sea Elephant and Statistics Relating to the Present Abundance of the Species." *Proc. U. S. N. M.*, pp. 90–4.

[2]Rothschild, Hon. Walter, Ph.D. 1908. "Mirounga angustirostris (Gill)," *Novitates Zoologicæ*, Vol. XV, p. 393.

[3]Scammon, C. M. 1869. "Report of Captain C. M. Scammon, of the U. S. Revenue Service, on the West Coast of Lower California." Appendix, pp. 123–31, of *Resources of the Pacific Slope*, by J. Ross Browne.

seals come to shore at certain seasons of the year to shed their coats and to give birth to their young. He tells of the method of hunting: how the seals ashore were driven farther landward by men advancing from the water to slaughter them. Their number in the days of which he speaks was great enough to give "full cargoes to the oil-ships." The smaller animals were killed by clubbing, the large males by shooting. There is considerable evidence that the former abundance of the elephant seal in the Lower California region has not been overestimated.

Many whalers and sealers frequented the shores and islands of Lower California between 1808 and 1840 under American, British, French, and Russian flags, and it is known that the elephant seal was much hunted for a few years after the discovery of gold in California and that, as a consequence, it became scarce.

Except for some recent observations by members of the "Tecate" expeditions,[1] the natural history of the northern elephant seal apparently is recorded only in the writings of Scammon[2] and the reports of the "Albatross"[3] expedition. Rothschild's remarks on the specimens collected by Harris are limited to a single page. Scammon's descriptions deal largely with the Antarctic elephant-seal fishery.

The northern elephant seal is the largest of all seals, with the possible exception of the Antarctic species, an extremely large specimen of the former measuring, according to Scammon, twenty-four feet in length. The same author refers to one twenty-two feet long which yielded 210 gallons of oil. The three large males taken by the "Albatross" Expedition at Guadalupe Island in 1911 were each sixteen feet in length. During the past half-century the northern species has had little chance of attaining large size. Under the protection now afforded, it is possible that *monsters* twenty feet or more in length may reappear at Guadalupe Island. The writer found the blubber of the three males mentioned to be four inches thick about the fore part of the body. Cleveland says that the fat of the Antarctic species, taken by him at Kerguelen Island, was seven inches thick and that the largest specimen might yield as much as 245 gallons of oil, while Murphy[4] indicates a maximum of about eight inches for the blubber. As the oil is superior to whale oil for lubricating purposes, there can be no doubt about the great value of the elephant seal as an oil producer.

Few large animals are so indifferent to the presence of man as these great seals. They showed little inclination to move as members of the "Albatross" Expedition walked among them. When intentionally disturbed, they soon quieted down, often throwing sand on their backs with their flippers and completely ignoring our presence. Even when roughly prodded and forced into the sea, they usually returned promptly. While in the water, they were equally unconcerned about the coming and going of the ship's boats. A common attitude in the water, especially with those of smaller size, is to float with only the nose and hind flippers above the surface.

Getting out of the water is difficult

[1]Hanna, G. Dallas, and Anthony, A. W. 1923. "A Cruise Among Desert Islands." *National Geographic Magazine*, Vol. XLIV, No. 1, pp. 71–99. Also Anthony, A. W. 1924. "Notes on the Present Status of the Northern Elephant Seal, Mirounga Angustirostris," *Journal of Mammalogy*, Vol. V, No. 3, pp. 145–52.

[2]Scammon, Charles M. 1874. "The Sea Elephant," *The Marine Mammals of the North-Western Coast of North America*, pp. 115–23.

[3]Townsend, C. H. 1912. "The Northern Elephant Seal." *Zoologica*, Vol. I, No. 8, pp. 159–73.

[4]Murphy, R. C. 1918. "The Status of Sealing in the Sub-Antarctic Atlantic." *The Scientific Monthly*, August, 1918.

View of the northern end of the elephant seal rookery on Guadalupe Island.—Males, females, two-year-olds, and yearlings are lying about on the beach. The two males in the middle distance with heads erected are in fighting attitude, the proboscis being retracted and the mouth wide open. In the distance is seen the "Albatross." This photograph suggested the background for the Elephant Seal Group shown on p. 566

The old males are usually sleepy and disinclined to move unless forcibly disturbed

Adult male and female elephant seals.—The male assumes a threatening attitude only when deliberately aroused

The calloused surface in front is the result of fighting.—This part of the body is often deeply scarred and unsightly for such heavy-bodied and short-limbed animals. In passing through the shallow water the hind flippers are raised and spread to take advantage of the pushing effect of the low waves.

When the creatures are on the dry beach, progress is still slower, but under crowded conditions individuals have actually crawled inland several hundred yards. In moving up the beach the animal arches its back and, rising on the fore flippers, draws the hind quarters forward. Its progress is interrupted by frequent pauses.

During the mating season the large males engage in considerable fighting, especially those accompanying females. When within striking distance of each other, they rise as high as possible on the fore limbs, draw the flabby proboscis into folds on top of the head, which is held aloft, and strike quick blows at each other's necks and shoulders with their large canines. The attacks are accompanied by considerable nasal and vocal noise. The animals of fighting age and size bear the marks of many previous encounters, the skin of the neck and breast being rough, calloused, and hairless as a result of the punishment received from adversaries.

The fighter makes little attempt to protect his fore quarters, which seem to serve as a shield for receiving blows; but he is careful to strike quickly and withdraw his precious nose out of harm's way. There is apparently no actual seizing and tearing of the skin, the offensive blow being a quick bite with the large canines. The combatants soon separate; there is none of the prolonged tussling and fierce scrimmaging indulged in by male fur seals, which often leave them with gaping wounds. A fur-seal fight is of the dog-fight sort.

The proboscis of the elephant seal, relaxed and pendent when the animal is crawling, or lying in a flabby mass when the animal is at rest, is capable of many muscular expressions when the seal is awake and moving about. It may be withdrawn and wrinkled up in various positions on the head, or if the head be thrown back completely, may hang relaxed toward the rear.

The proboscis is only slightly developed in the half-grown males, suggesting that it does not become fully developed until sexual maturity is reached. In the females the proboscis is lacking. Anatomical study of the proboscis is desirable, as there is uncertainty whether it really can be "inflated." During the skinning operations of the "Albatross" Expedition no inflatable air sacs, or chambers, were noted, but it is possible that such may have been overlooked.

The very young elephant seal is black and is so excessively fat as to be almost helpless. The yearling is grayish brown in color, and is about four feet in length. None of the six yearlings brought to the New York Aquarium was more than five feet long. In weight they varied from 167 to 301 pounds, the males being heavier than the females. Their capture was effected by simply rolling them separately in nets and lifting them into the boats. They showed no inclination to bite when on the beach, on the deck of the "Albatross," or during their life at the Aquarium, although when approached, they would assume a threatening attitude by opening the mouth very widely.

Nothing very definite is known regarding the feeding habits of this seal. In the stomachs of those killed at various times the writer found nothing but a little sand. It is stated in some of

The bulky object on the beach in front of the boat is a young seal rolled up in a net to render it helpless. Thus secured, it was rowed to the "Albatross" and with five of its fellows started on the long journey to New York

Yearling elephant seals in the pen especially constructed for them on the deck of the "Albatross"

SIX YEARLING ELEPHANT SEALS IN THE NEW YORK AQUARIUM
The greater number of them lived for nearly two years after taking up their abode in the institution at Battery Park

the accounts of the Antarctic species that seaweed and the remains of squid have been noted in the stomachs of these seals. Murphy found, in addition to squid, the remains of small fish in the stomachs of animals killed as soon as they had come to shore.[1] Harris observed "tiny sardines not more than two inches long" in his Guadalupe specimens. Anthony[2] alludes to the capture of a young male, three-quarters grown, "which had recently bolted a bass of about two pounds weight." He adds that "a few fragments of kelp, taken perhaps at the same time as the fish, and a few pebbles were the only stomach contents." The yearlings brought to the Aquarium ate nothing but fresh fish. Usually this food was given them cut into pieces, but they preferred the live fish that were occasionally supplied. The daily ration for each of the seals was six or seven pounds of smelt, tomcods, roach, and cod. They ignored absolutely squid, live crabs, and seaweed. Unlike most seals, they crushed their food before swallowing it, often turning on their backs in the water during the process of mastication. They would take the food from the hands of their keeper with no signs of fear.

In swimming about the large pool the fore flippers seldom came into action, the hind flippers being employed much as a fish uses its tail. These young elephant seals often slept under water, stretched out on the floor of the pool.

[1]Murphy, R. C. 1914. "Notes on the Sea Elephant, *Mirounga leonina* (Linné)." *Bulletin, Amer. Mus. Nat. Hist.*, Vol. XXXIII, pp. 63–79.

[2]Anthony, A. W. 1924. "Notes on the Present Status of the Northern Elephant Seal." *Journal of Mammalogy*, Vol. V, No. 3, pp. 145–52.

It is possible that the elephant seal is more active at night than by day. It may be that it feeds only at night, which would account for the lack of evidence as to the food of those killed in the daytime. Its eyes are suggestive of those of nocturnal animals, being remarkably large, dark, and lustrous.

Although the elephant seal apparently does not wander far from shore, like the fur seal and some other species, it has at least one enemy in the shark. A specimen secured by the writer at San Cristobal Bay was disfigured by a gash on the rump in which were the marks of a shark's teeth. Sealers told the writer that fully one fourth of the smaller animals captured there bore such marks.

The total number of elephant seals killed during the past forty years at San Cristobal Bay and Guadalupe Island—the only places they were known to frequent during that period —appears to have been 454. Since 1884 none has been found at San Cristobal.

Comparison of the large skulls secured in 1911 at Guadalupe with those of the Antarctic species has shown the distinctness of the northern species. This is also apparent when the excellent photographs now available of living animals of both species are compared.

Naturalists have not seen enough of the northern elephant seal to determine whether it is polygamous to the extent of the southern species. It is evident that much remains to be ascertained in regard to this interesting mammal before its complete life history can be written.

A WARD OF GUADALUPE ISLAND

In 1922 the island of Guadalupe was declared a government reservation by the authorities of Mexico City, and it is to be hoped its elephant seal population will escape in the future the persecution to which it was subjected in the past

A Trip to Guadalupe, the Isle of My Boyhood Dreams[1]

By LAURENCE M. HUEY

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NOTE.—The preceding paper, recording the visit of the "Albatross" to Guadalupe in 1911, will have whetted the reader's interest for an article dealing with the later history of the herd of sea elephants. The main purpose of the expedition of 1923 in which Mr. Huey participated was to take a census of these animals. They had then been enjoying government protection for about a year and their number had increased from 264—the total counted by members of the coöperative expedition in July, 1922,—to 366.

Since preparing the present article, Mr. Huey has again visited Guadalupe and spent the day of August 30, 1924, on the elephant seal beach. He writes that, at that time, the count showed but 124 animals, of which only 9 were large adults. The majority were of intermediate size and there were 6 yearlings. Whether the fluctuations in the beach census of the past three summers reflect with any accuracy the relative abundance of the total living elephant seals cannot, in the judgment of Mr. Huey, yet be determined. He feels that these facts depend upon a much greater knowledge of the movements, breeding habits, and food of the elephant seal than has as yet been secured.

IT had been a restless night despite the quiet sea and the even roll of the boat, for the long-hoped-for trip to Guadalupe, the island of my boyhood dreams, was really taking place. In the early gray of dawn, I was on the bridge peering into the west with the hope of seeing the dim outline of the enchanted isle. During my early boyhood, while wandering about the water front of San Diego, I had heard many tales of this out-of-the-way island, which lies off the Mexican coast about 180 miles southwest of San Diego, and that I was now actually on my way to it was due to the courtesy of the Mexican government. I had been invited to join a party in charge of Prof. J. M. Gallegos, of the National Museum of Natural History, Mexico City, that was planning to visit the island. The voyage was made aboard the Mexican Fisheries Patrol Boat "Tecate," which started from San Diego on July 10, 1923, and, after touching at Ensenada, Lower California, set her course on the open Pacific.

After I had been watching for hours, far to the southwest a dim outline commenced to take shape about eight o'clock in the morning. Finally landmarks began to appear and these were pointed out to me by different members of the party who were familiar with the place. As I scanned the rocky slopes, I noticed that moving things were in evidence everywhere—for the island was swarming with goats! It appears that in the old whaling days goats were introduced on Guadalupe as a source of meat and have increased to such an extent that they now completely overrun it. At this season, when everything was dry, they were invading the sheer faces of the cliffs in search of some stray bit of lichen or moss on which to feed. We marveled at their agility and their ability to cling to the precipices—almost as tenaciously as a fly ascending a windowpane. However, their adventures were not without peril, for, while we were steaming slowly near the shore, searching for a suit-

[1]Photographs by the author.

able anchorage, we saw several carcasses of goats floating in the water,—an evidence that the animals had fallen from the bluffs which overhang the sea.

Our anchorage was made within fifty yards of the east shore of the island, near the site of the old penal colony that is today occupied by a garrison of soldiers, placed there to guard the surviving elephant seals (*Mirounga angustirostris*), which inhabit a small beach on the opposite side of the island. These animals were brought to the very brink of extermination by the old whalers, who sought them for their oil, which before the days of petroleum was used extensively by the gold hunters of California for lighting. The small herd which exists on Guadalupe Island comprises the only representatives of this species now upon the earth. As a result of a coöperative expedition made in the summer of 1922, this rugged island, which is only 20 miles long and 6 miles wide, was created a federal reserve by proclamation of the Mexican government.

It was with no little interest that we landed in the late afternoon. With another member of the party, I set out and explored a cañon for half a mile inland. A rocky, rugged waste it proved to be, with reeking carcasses of goats scattered about in various stages of decomposition. The narrow cañon was at times nearly stifling due to the heat of the reflected rocks, and there was no breeze to stir the air. We saw but two species of birds, the Guadalupe rock wren (*Salpinctes guadeloupensis*) and the Guadalupe house finch (*Carpodacus amplus*). Both these birds proved fairly abundant. They might be seen

The houses of the old penal colony, with a sign posted on the officers' quarters proclaiming in both Spanish and English that, by presidential decree, the killing or capturing of elephant seals is prohibited in a small flock or family searching for maggots in the carcass of some dead goat.

The eastern sky was cloudless next morning, and the sun rose in almost tropical splendor. Professor Gallegos and I were landed through the surf with our lunch, guns, and cameras, for this day had been designated as the one on which the top of the island was to be explored. A boy and pack burro were placed at our disposal by the commander of the garrison. As we gained altitude on the steep and rocky trail, a grand view of the northern end of the island was spread before us, while banks of fog were swept over the northern head by the incessant western winds.

On reaching the floor of a small valley, I was much impressed by its desolation. Not even a spear of dry grass was to be found among the rocks, and only one or two green bushes could be seen hanging by their strong roots from crevices in precipitous cliffs—out of the reach of the ravenous goats. Though safe from destruction, these bushes were not unobserved, for well-traveled goat trails led to the cliffs both above and below them, where the shaggy beasts had evidently been feasting with their eyes if not with their teeth. About half a mile from the spring, which is situated on the eastern slope of the island near the summit, was found what had been part of Guadalupe's beautiful cypress forest, but which consisted now only of dried, naked tree trunks. This was another result of the ravages of the ubiquitous goats; for when the season of the annual grasses has passed each year, the beasts resort to the bark on the trees, and are fast devastating the small forests which crown the island.

Arriving at the spring, we quenched our thirst at a pool that had been safely fenced from pollution and were pleasantly surprised at the quality of the water. A question that naturally occurred was why the spring should be located so near the crest of the high slopes. Investigation of the rock strata told the story. The water came from the forests above, on the westward slope of the island, which were continually drenched in fog. The moisture, condensing and dripping to the ground from the leaves of the trees, is concentrated by strata of hard rock which slope gently through to this point on the eastern side of the island. These strata are impervious to water, and thus carry the moisture to the outcropping where the spring occurs. Through this agency alone is life able to exist on this desolate island. Eventually the goats themselves will be their own undoing, for with the passing of the forests—which is inevitable—the water supply will also cease to be, and with it will disappear the terrestrial life on the island.

Of ten species of birds and mammals which have been recorded as endemic on this island,—namely the Guadalupe fur seal (*Arctocephalus townsendi*), the Guadalupe wren (*Thryomanes brevicauda*), the Guadalupe towhee (*Pipilo consobrinus*), the Guadalupe caracara (*Polyborus lutosus*), the Guadalupe flicker (*Colaptes rufipileus*), the Guadalupe petrel (*Oceanodroma macrodactyla*), the Guadalupe rock wren (*Salpinctes guadeloupensis*), the Guadalupe house finch (*Carpodacus amplus*), the Guadalupe junco (*Junco insularis*), and the dusky kinglet (*Regulus calendula obscurus*),—the five first named are now gone forever. The goats are responsible for the passing of three of these—the Guadalupe towhee, Guadalupe wren, and Guadalupe caracara. The

If many dry years reduce the annual growth on the island to a minimum, there will be little left of the forests, for the goats gnaw the very bark from the trees, and even climb to the more accessible limbs

towhee and wren were exterminated by the complete destruction of the underbrush by the goats. The caracaras preyed upon the new-born kids and were destroyed by the men who had been granted the concession of exploiting these animals for their hides and tallow, for they thought the birds were limiting the increase of the goats. Thus, indirectly, the goats caused the extermination of the caracara. The flicker was brought to its doom by the introduction of house cats by the early Russian sealers, who also introduced the common house mouse (*Mus musculus musculus*). Both of these animals, in addition to the goats, have run feral over the island, causing untold destruction to the birds and plants. A glance at the barren landscape and bleak, leafless skeletons of the cypress trees through which we passed was sufficient to impress upon us the fact that the end is near for what Dr. Edward Palmer in the seventies described as a naturalist's paradise.

After lunch Professor Gallegos and the pack boy went on to the top of the island to collect specimens of the cypress and take photographs, while I stayed about the spring to observe the birds. I later joined them near the summit and had opportunity for a hasty glance through the forest and for the making of a few pictures. I was much impressed by the appearance presented by the cypresses, for dead, leafless limbs hung to the ground in a thick, inter-locking mass and the goats had tunneled through these masses, much as meadow mice tunnel in a grassy swamp. In places I saw evidence that the goats had adopted even arboreal tactics, and had climbed well into the trees to gnaw away the bark. Dripping with cypress pitch, the trees presented a sad sight, for their very life blood was oozing away. Nothing but old trees were found in this forest, for the hungry goats do not allow the seeds to sprout. It remains only for the now-existing trees to live out their lives, when this species also will pass away on Guadalupe.

As we made our journey downward in the cool of the late afternoon, goats were seen everywhere journeying toward the spring—from the north, the south, and all directions. I fired my gun toward one large flock to frighten the animals, and they scurried off across the precipitous gullies and were soon out of sight.

At daybreak the next morning we set sail for the beach on the northwest part of the island, where the elephant seals are to be found. As we were approaching toward the north head in the lee of the island, the wind ripped through gaps in the crest and descended in what is known to the mariner as "woolies." Several of these were so violent that the awning on the after-deck of the boat had to be furled, and at times I thought the very rigging would be torn from the masts. After we had passed from the shelter of the island, we were met by a veritable gale and a frothing, heaving sea, which dashed over the ship, causing all of us to seek a seat of safety with a convenient handhold. We were sailing close to the rocky coast, and the towering cliffs, rising like spires into the sky, made an impressive scene. The fog had risen and, as we passed along, we were able to see the summit of the island in its entirety. Now, for the first time, though at a distance, I beheld the rugged pines in their stronghold, struggling for existence on the brink of the precipitous cliffs. Their wind-swept limbs were all stretching to the eastward, for the prevailing western winds would scarcely permit a leaf to face them. The small endemic palms were also noted, fighting for life against the elements and the goats, on the sheltered slopes wherever their existence was possible. Goats were seen everywhere and occasionally a sudden cloud of dust would rise from the faces of the cliffs where, frightened at our approach, the animals had, in the haste of their departure, started an avalance of stones toward the sea.

After we had passed well around to the western side of the island, the sea became reasonably quiet and we all began peering at the shoreline in search of elephant seals. Those of the party who were acquainted with the place called my attention to a loud snorting, which sounded plainly from the shore though we were fully half a mile away. This noise, I was told, was made by the elephant seals.

The long-awaited cove was soon reached and its short, sandy beach seemed covered with the huge beasts. I could hardly wait while the anchor was dropped and the skiff got ready. It required a bit of skilled seamanship to make a safe landing, for the breakers on the west side of the island were swept shoreward violently by the western wind. Once on the beach, I found myself face to face with the huge creatures of the sea. It was with a great deal of timidity at first that I walked in their midst, but I finally ventured to pat one enormous fellow as he lay dozing in the mellow heat of the sun. It amazed me to find that

AN ELEPHANT SEAL THROWING COOLING SAND OVER HIS BACK the beasts were not only not vicious but allowed us to walk freely among them and to talk to each other without taking alarm. Their sense of hearing seemed to be only slightly developed, but a very few grains of sand kicked over their slumbering faces was sure to arouse them.

The majority of the animals were adult or nearly adult, and there were only five seen that could be classed as yearlings. The whereabouts of the breeding females and "pups" was a mystery.

The difference in the ages of the seals was easily discernible, for the younger individuals were bluish gray while the old ones were of a yellowish cast. The older animals were in a state of moult with the hide peeling, hair and all, from their backs, much as a sunburned bather peels on our pleasure beaches at home. All showed evidences of having fought and their necks, shoulders, and faces were seared by deep scars, made either by the rocks against which they bumped or by their opponents' great canine teeth. However, they seemed placid now as they rested in the sunshine on the beach. It did not apparently matter in their case which side was up—for as many were lying up-side-down as right-side-up—nor whether the left side or the right side was toward the sun, for any part of their round body seemed to flatten enough in the sand for comfort.

After our party had viewed the herd, we made a census of the seals, which totalled 366 individuals. We then walked boldly in their midst, purposely frightening many of them into the water. With no little interest we watched the actions of the beasts, for they ambled to the water almost agilely by the use of their front and rear flippers, making remarkable speed for such heavy animals. Others that were not disturbed flipped sand onto their backs with their front flippers to free their peeling skin from the irritating flies and to protect it against the warm sunshine. One beast that I had under observation for some time, while I was making photographs, used his front flippers much as a person would use his hand, to scratch his side or his nose or any part of his body that was within reach. The action of the digits of the flipper reminded me very much of fingers, especially when the animal was rubbing the more sensitive parts of his nose.

On the second day of our stay at the seal beach, I witnessed a combat from start to finish and was much amused and impressed by the way the animals fight. The combat was provoked by the attempt of one huge beast to get to sea by crawling over the back of his neighbor, who much resented the extra two tons of weight bearing down upon his back. The animals began to grunt and snort, and rose threateningly on their front flippers with their heads erect and their huge cavernous mouths opened menacingly. Near-by seals, realizing what was about to take place, gave room and the battle commenced. The two combatants struggled, neck and neck together, each attempting to bite the other or working for an advantageous position on the sloping beach. These aggressive tactics carried them ever nearer to the surf, and finally they reached the wash of the waves. Here each would endeavor to take advantage of an on-rushing wave as an aid in hurling his bulky body against his antagonist. For fully five minutes they sparred in the surf, until one of them, apparently thinking that discretion was the better part of valor, went into deeper water, where he rolled lazily in the swelling waves, while the other ambled back to his place on the beach.

Our work on the seal beach being finished, we again returned to our anchorage on the eastern shore and the following morning set sail to the southward, steaming as close to the island as possible in the hope that a last remaining Guadalupe fur seal (*Arctocephalus townsendi*) might be discovered. How bleak and barren the landscape appeared as we moved slowly along just beyond the reach of the breakers! Hardly any bird or animal life, excepting goats, was seen, though an occasional dark-mantled western gull (*Larus occidentalis livens*) or Farallon cormorant (*Phalacrocorax auritus albociliatus*) was observed, and a single California sea lion (*Zalophus californianus*) was seen basking in the sunshine on the top of a rock near the water. The tide was low at this morning hour and many flocks of goats were observed at the water's edge nibbling at the kelp. So scarce is food for them on the island that they descend during low tides to feast upon the kelp and they no doubt quench their thirst with salt water. From our vantage point on board ship we were able to study the geological formation of the island. In many places could be seen large craters surrounded by black streams of cold lava that had once been belched forth red-hot from the earth. One area was of cinder red color, as though still aglow with the fiery heat which marked the birth of this island.

Upon rounding the southern end of the island, we saw to our surprise a United States Eagle Boat lying at anchor with the Stars and Stripes floating above the taffrail. As we passed almost within hailing distance, each national emblem was dipped in honor of the other. We proceeded to an anchorage in the quiet waters of South Bay, on the shores of which we found a party of bluejackets with the commanding officer of the Eagle Boat hunting goats to stock their larder. On our cruise around the island we had planned to spend the night at this anchorage, going up the western coast in the morning. There we intended to capture a couple of the smaller elephant seals and to bring them back alive—one for the Zoological Garden in San Diego and the other for Mexico City. Our visit to the seal beach had sadly shaken our hopes of being able to cope with or carry even the smallest of the seals we had observed in the herd. However, when we talked with the commander of the Eagle Boat and found that it was possible to obtain the help of twenty or thirty energetic sailor boys and a vessel of good displacement to bring back the captive seals, our expectations were again revived.

Two fair-sized islets mark the southern end of Guadalupe Island, and as soon as we had rounded these, we were again buffeted by the west winds. How the boat pitched and rocked in this turbulent sea! At times the sweeping spray passed clear over our ship, wetting the decks and everyone on them. During the four-hour journey up the western shore of the island, the Eagle Boat and our craft went bow to bow, and the only event of natural history interest on our journey was the flushing of a few pairs of Xantus' murrelets (*Endomychura hypoleuca*).

We landed at the seal beach and were soon followed by a dozen or more lusty bluejackets in their whaleboat. Theirs was the fiery enthusiasm of

When teased, the seals would open their cavernous mouths and act as though they would like to devour the aggressor with one gulp

It takes more than a single elephant seal to beat a detail of young naval reservists provided they have tackle enough youth, and action was what they wanted. Accordingly the seals were quickly scattered and driven into the sea when once these boys started to work in their midst. Selecting one of the smallest seals, they tangled him in a large rope cargo net, which was then lashed to a broken oar and carried to the whaleboat. As there was not enough tackle to cope with the second animal, the bluejackets departed from the beach with only one captive.

After all hands were again safely on board, each ship blew three blasts of the whistle as a farewell. The Eagle Boat put out to sea for San Diego and our ship went back to its anchorage near the garrison. Here we spent the night, and departed the next day at noon for Ensenada on our way home. Thus ended the trip of my boyhood dreams to the isle of Guadalupe, and, though there were disappointments, my pleasures were many.

The queer proboscis from which the elephant seal derives its name is here seen to good advantage

The Seal Collection

A FEATURE OF THE HALL OF OCEAN LIFE, AMERICAN MUSEUM

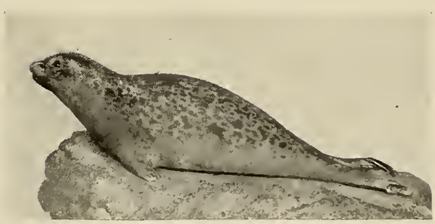
By FREDERIC A. LUCAS

Honorary Director, American Museum

A PROMINENT feature of the Hall of Ocean Life, the construction of which is drawing to completion, will naturally be the seals and their relatives and, while there are gaps that we should like to see filled, yet, when the doors are opened, a goodly portion of the seal population of the world will be represented. Chief among them are—or will be—the groups of sea elephants, Steller's sea lion, and the Alaskan fur seal. The story of the sea elephants is told elsewhere in this issue, the sea lion will be described and figured at some future time, while a picture of the Fur Seal Group must suffice for this account, which is restricted to the general collection of seals.

In poetical parlance it might be said that the series of seals reaches from pole to pole; in plain prose it contains examples from the Arctic to the Antarctic—but they are scattered along at intervals with numerous gaps between. This is partly because seals as a rule occur at widely separated localities, partly because they dwell in places difficult of access, and largely because there have been no definite attempts to collect them. Also there is little attraction in the chase of the seal: where seals are abundant, it is mere slaughter; where they are rare and wary, it is a trial of one's patience. Moreover, seals have this advantage over most animals, they can slip into the water and elude pursuit. Nevertheless, it is to be hoped that friends of the American Museum, seeing this lack in the collection, may provide means to supply the deficiency.

Aside from the fur-bearing species the majority of seals, both as to number and species, are found in northern waters and, as these lie near at hand or are easily reached, it is not surprising that seals from the Northern Hemisphere form the bulk of the collection. Our northernmost representative is the ringed seal, small in size but once of prime importance to the Eskimo as an article of food—in fact, in days gone by it might almost have been termed the Eskimo's "staff of life." Stefánsson, too, relied largely on this seal for *his* food supply. The ice may force the bulky walrus south to dig his clams, but the little ringed seal bores through the ice floes for air, while beneath them he manages to gain a scanty livelihood. Associated



The ringed seal (*Phoca fœtida*) has been the "staff of life" of the Eskimo during many a winter of the past

with him, but far less common and much more difficult to capture, is the big bearded seal, or square flipper, which reaches a weight of five hundred pounds. Neither of these seals is found in sufficient numbers to be important

FUR SEALS AT KITOVI ROOKERY, ST. PAUL ISLAND, BEHRING SEA

These specimens of *Callorhinus alascanus*, mounted by Frederick Blaschke, are the center of interest in the large Fur Seal Group prepared for the Hall of Ocean Life. Only a part of the group is here shown commercially, which is doubtless fortunate for the Eskimo as well as the seal.

Found with the ringed seal in the southern part of its range is the Greenland, or harp seal, commercially the most important of the true, or earless, seals. This is the species that at breeding time assembles in thousands on the ice floes and drifts southward to be slaughtered by the hardy Newfoundland fishermen. And while the killing of the seals is mere butchery, yet such are the attendant conditions of wind and weather that it is a most hazardous occupation and many a ship and many a man have been lost in its prosecution. This hazard is to the advantage of the seal herd, a bad season for the sealers meaning a good season for the seals, and it is the writer's belief that but for these "bad seasons," the seals could not for so long have withstood the yearly drain upon their numbers—even though there are wise laws restricting the length of the killing season and forbidding vessels to leave St. Johns, the headquarters of the sealing fleet, before a given date. What this drain is may be gathered from Levi G. Chafe's *Report of the Newfoundland Seal Fishery*, from which it appears that on an average about 125,000 seals are taken yearly, the smallest catch on record being just under 34,000 and the largest over 350,000.

The harp seals taken fall into various categories—white coats (those under two weeks old), gray coats (from three weeks to a year), bedlamers (from one to three years), and old harps (the adults). The newly born seals are clad in a white coat of thick woolly fur—hence their name. At the end of about two weeks this peels off—as does the down from many sea birds—leaving the young clad for a year in a suit of shiny steel gray. Those from one to three years old wear a more or less mottled coat of short hair, like that of the ordinary hair seal, the conspicuous black saddle of the adult not being assumed for several years. But why call the young seals bedlamers? Judge Prowse suggested that it was because, when attacked, they were so frightened that they acted like Bedlamites—a plausible suggestion but, like many a similar explanation, not the right one. The correct etymology was furnished by some one better versed in the queer twists that have befallen many Newfoundland names—such, for example, as that which transformed the Bay of Hope, Bai d'Espoir, into Bay Despair—and we learn that "bedlamer" is only a corruption of the French *bête de la mer*, really very simple. Scattered among the harps—though less numerous—are the big hoods, so called because the males have the power of blowing up a sack on the end of the nose. These form but a small portion of the catch.

What becomes of all these seals? The majority of them are converted into leather, and the finer grades of our sealskin belts and pocketbooks come from the hides of the young. A few are transformed into wolf- and bearskin furs, but the fur is too woolly to make a really good imitation. The fat, or blubber, is reduced to a very clear, tasteless oil—some of which, it is whispered, passes as cod liver oil.

The big gray, or horsehead seal, though shy and scarce, is present in the American Museum collection but there is little to be said about him. Rarest of northern seals, though also included in the collection, is the strangely marked ribbon seal, a straggler from the Siberian coast. His boldly marked coat is, or was, in demand to supply the well dressed Eskimo with holiday apparel.

Finally, among our northern seals we have the harbor seal, the one most familiar to residents and summer visitors on our Atlantic coast. Once

A male ribbon seal (*Phoca fasciata*).—The female is somewhat larger and her markings are much fainter

it was common in New York Harbor, where its name still survives in Robbins Reef, a corruption of the Dutch *robben* (seals) denoting a place where seals "haul out" to bask in the sun, and even in recent years an occasional seal has found its way into the Hudson. Formerly plentiful along our eastern coast, the seal has become comparatively rare, owing to the fact that seals and fishermen do not agree on the fish question. The fishermen consider that they have the exclusive right to take fish and, after they have depleted the shore fisheries by their wasteful and destructive methods, discover that it is really the seal which is to blame and forthwith put a price upon his head, or rather upon his tail, that being the end that must be presented by claimants for bounty. For several seasons some Penobscot Indians did a flourishing business right in Boston Harbor but, since the seal became an outlaw, he has been rare not only there but elsewhere. Not that seals do not eat fish—for they do—but the damage they inflict is slight compared with that done by the fishermen, and they do not waste the fish and it is a fairly easy matter to keep the seals within bounds.

The Caribbean seal is noteworthy for various reasons: first, because he and his immediate relatives are exceptional among hair seals in that they dwell in tropical waters instead of icy seas, and secondly because he has the distinction of being the first animal to be described from the New World, having been noted on the second voyage of Columbus in 1494. Of course Columbus must have seen other new animals but apparently they were not described.

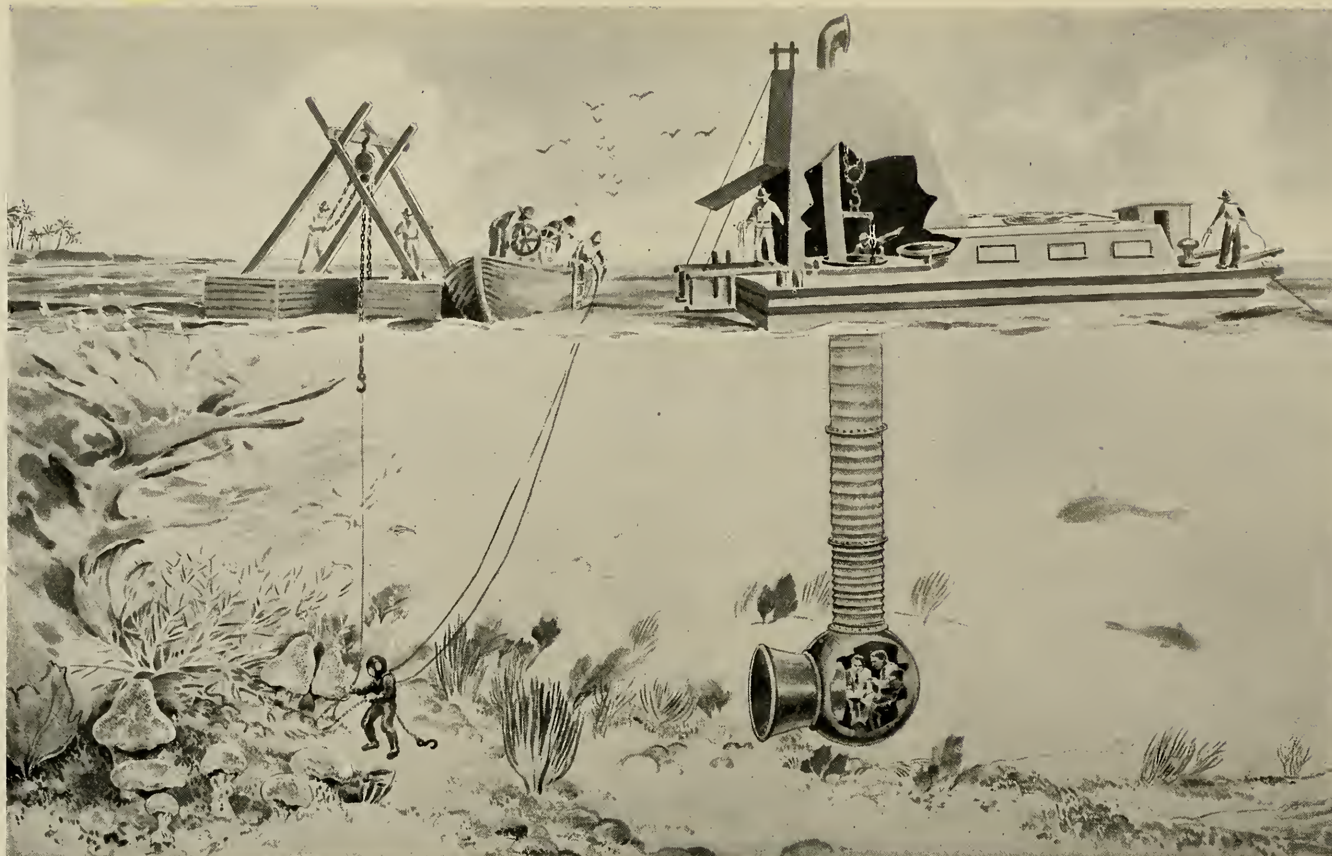
A male Caribbean seal (*Monachus tropicalis*) obtained at the Triangles by Henry L. Ward in 1886.—The blotches are not the result of any skin disease but are patches of old hair that has not yet been shed

As for the seal, it is recorded in the log book that on the islet of Alta Vela, off the coast of Haiti, the sailors came upon a band of "sea wolves," eight of which they killed: thus was the Caribbean seal made aware, in the usual manner, of the coming of the white man.

Still another point of interest lies in the fact that while one relative of the Caribbean seal is found in the Mediterranean—provided he has not been recently exterminated—another is found on Laysan Island in the Mid-Pacific. How did his ancestors get so far from home? Did they come through the strait that for a time connected the Gulf of Mexico with the Pacific? If so, why did none of them tarry by the wayside and populate the Hawaiian Islands? Once abundant not only on many of the West Indian Islands but also on the Bahamas, the Caribbean seal, unused to man and easily killed, was soon reduced in numbers, thanks to the demand for oil and hides, and for many years past has led a precarious existence at one or two places in the Gulf of Mexico, especially at some rocky islets known as the Triangles. Even here it is in danger and recently the Mexican government has called upon our own for aid in preventing its extermination.

So much for the northern seals; those of the Southern Hemisphere, aside from skulls and skeletons, are but scantily represented in the Museum collections, a single example of Weddell's seal being the sole representative of those found on the ice that fringes the shores of the Antarctic Continent. The Museum needs examples of the big, active sea leopard—one of the largest of the earless seals, quick enough to escape the killer whale and quick enough to catch and devour the amphibious penguin. Especially does the Museum need specimens of the various southern fur seals that were so ruthlessly and wastefully killed by the hardy sealers of New London, who made their way into the Antarctic long before it was charted. The killing is termed wasteful because no attempt was made to preserve the race—males, females, and young being killed indiscriminately—and because thousands of skins were lost through improper treatment. This is doubly unfortunate because the southern seals do not seem to have the recuperative power of their northern relatives, and their former breeding grounds still remain the barren wastes they were left by the sealers nearly a century ago, the only protected colony being found on an island in the La Plata River belonging to the Argentine Republic, which yields several thousand skins yearly. The only eared seal of the south that the Museum has is the southern sea lion, obtained by the Harrison Williams Expedition to the Galápagos.

So here we stop for want of material, hoping in time to add another chapter to the story of our seals.



COLLECTING CORALS ON THE ANDROS REEF

The diver fastens a chain sling about the base of a desired specimen while the crew of the pontoon prepare to raise it with a chain hoist. Meanwhile members of the Museum staff photograph and sketch the living corals through the window of the tube's submarine chamber, and direct the diver's operations by means of signals. Drawn by Malcolm Jamieson after sketches by J. E. Williamson and members of the Museum staff

Hunting Corals in the Bahamas

By ROY WALDO MINER
Curator of Lower Invertebrates, American Museum

Note.—The expedition, the achievements of which are recorded in this article, was made possible through the Angelo Heilprin Exploration Fund and through the general funds of the American Museum. The success of the expedition was assured through the generous coöperation of The Submarine Film Corporation and its parent company, the Williamson Submarine Tube Corporation, as well as through A. Schrader's Sons, Inc., which donated a complete diving outfit.

HUNTING corals with a submarine tube, diving apparatus, and pontoons fitted with chain hoists is doubtless a unique experience, though many collections have been made in the past by means of more primitive apparatus and native divers. The writer has just had the privilege of leading an expedition of the former kind to Andros Island in the Bahamas, where, through the efficient coöperation of Mr. J. E. Williamson, manager of The Submarine Film Corporation, a large collection of corals was obtained, together with photographs, sketches, motion pictures, and other data, to be utilized in constructing a reproduction of a typical Bahaman coral reef as an exhibit in the American Museum's new Hall of Ocean Life.

The expedition, which included in addition to Mr. Williamson and the writer the following Museum artists, Mr. Herman Mueller, glass modeler, Mr. Chris. E. Olsen, modeler and artist, and Dr. George H. Childs, colorist, left New York on June 6, reaching Nassau in the Bahamas three days later. After eight days in this beautiful and historic West Indian port, spent in arranging for the coöperation of the Bahaman government and in outfitting and organizing for the trip, the party left for Mangrove Cay, Andros, on the evening of June 17, with a fleet consisting of a forty-five-foot gasoline yacht, the "Standard," two motor boats, the Williamson submarine tube apparatus, a pontoon with chain hoist, and two dinghys. This fleet was towed by the "Lady Cordeaux," a sea-going tug of considerable size, owned by the Bahaman government, which courteously lent it to conduct our fleet across the dangerous arm of the sea known as the Tongue of the Ocean.

There was a full moon and a calm sea, so the trip was made without incident and we arrived off the reefs at Mangrove Cay about daybreak, June 18.

Andros "Island" is really an archipelago, for it is intersected by three bights, extending completely through the land mass from east to west, and by many subsidiary channels, that cut it up into a multitude of cays of various sizes, and form a veritable labyrinth of waterways. They are so narrow, however, as to give Andros superficially the appearance of a single body of land, extending in a general north and south direction for about one hundred twenty miles, and forming the largest land area in the Bahamas.

The "island" is for the most part low-lying, with no elevations greater than one hundred feet, and is composed mostly of coral limestone of relatively recent formation. There is much low and scrubby vegetation with occasional forests of large trees of exceedingly hard wood, called by the natives "horseflesh" because of its red color. In the interior there are extensive mangrove swamps, some of them still occupied by large colonies of flamingoes, which are now protected by the Bahaman government. The western shore shelves off gradually to form the Great Bahama Bank, composed of shallow coral and sand flats,—one of the most important sponge-fishing grounds in the West Indies. The eastern shore, on the other hand, rises abruptly from the Tongue of the Ocean,—a depth of a thousand fathoms. At a distance of about one to two miles from the eastern shore is the most typical barrier reef in the West Indies, extending the entire length of Andros. This remarkable coral reef was the immediate objective of the expedition. We pitched our work tents on Little Golding Cay near a beautiful sandy beach on the sheltered side of the island, while the fleet anchored in the lagoon near by.

Little Golding Cay is an islet situated out on the reef itself near one of the entrances to the lagoon. The outer side is exposed to the trade winds, which blow almost continuously from the southeast, dashing the waves against the coral rock which forms its shore and eroding it into fantastic pinnacles. The greater part of the cay is covered with low vegetation,—mostly fragrant bastard logwood, gumbo limbo trees writhing in fantastic shapes, rose apples with their scarlet blossoms, seven-year apples, and sea grape along the shore, bordered by bay lavender and other low shrubs. Terns nest in the hollows of the rocks, and herons, called by the natives "poor Joes," perch in the trees. So tame are they that one may approach them closely. On the lagoon side of the island is the crescent-shaped beach mentioned above, composed of white coral sand, and forming an admirable landing place for the coral specimens.

A description of the submarine tube will aid in understanding our methods of work. This remarkable apparatus was invented by Mr. Williamson's father and was adapted by the son for submarine photography. It consists of a barge, the "Jules Verne," surmounted by a tower containing chain hoists. Beneath the tower is the well, through which is lowered a tube composed of flexible sections securely bolted together. These are about two feet in diameter and readily admit the body of a man. The lower end of the bottom section opens into a spherical chamber five feet in diameter, in which two or three persons can be comfortably seated. From it they gaze out through a plate glass window an inch and a half thick into the world at the bottom of the sea. A ventilator at the top of the tube draws fresh air into the chamber by means of a canvas chute, so that one breathes easily and comfortably many feet below the surface of the water. Sections added at the top permit the lowering of the chamber to any desired depth. This tube was a most important factor in the success of the expedition as used in conjunction with the subsidiary apparatus and the Schrader diving equipment.

I shall never forget my first view of the barrier reef as seen through the window of the tube. Great trees of the reef-forming coral (*Acropora palmata*) rose from the reef platform constituting a veritable stone forest with closely interlacing branches, a marble jungle which melted into the pearly blue haze of the watery atmosphere, the wide branches often breaking the surface of the water at low tide, especially on the side toward the lagoon. Multitudinous schools of reef fishes were swimming in and out through the forest aisles in stately procession, each species keeping much to itself in exclusive fashion. Jacks, yellowtails, black angels, blue angels, blue parrot fishes, groupers, red snappers, and countless smaller brilliantly colored species were visible in great numbers. Once an enormous jewfish came slowly into view around a coral tree trunk, its huge mouth gaping as it swam slowly toward the tube and gazed at us with bleary eyes. As the tube was moved slowly back and forth by the men above, an ever-changing panorama revealed itself to our view. At times the forest opened to disclose submarine glades dotted with coral growths of fantastic shape. Posts of coral rock topped by dome-shaped heads of *Orbicella* reminded one of huge mushrooms, while beautiful fronds of the fan coral (*Acropora prolifera*) crowned mounds adorned by sulphur yellow *Porites* and waving sea fans of magenta and gold. The great staghorn coral (*Acropora cervicornis*) covered extensive areas of the reef platform, especially in front of the coral groves, its sharp, branching spikes forming intertangled masses menacing in every direction, like a complicated and confused *chevaux de frise*. Immense domes of the star coral (*Siderastræa*) and the brain coral (*Meandra*) showed here and there, diversified by brown, white-tipped fronds of stinging coral growths (*Millepora alcicornis*).

Suddenly into the midst of the strange beauty of the submarine jungle Williamson came floating down equipped with diving helmet. Now he advanced like some strange monster with slow half-gliding strides, grotesquely peering at us through the goggle-eye windows of the helmet. A long crowbar had been lowered to him and, placing it like a lance in rest, he assailed a large branching coral. The bar was not needed, for the coral fell at a touch from the point and, fastened to a lowered rope, was quickly hauled to the surface. A bucket was now let down and filled with smaller pieces while we signaled directions from the window of the submarine chamber.

On other occasions the pontoon was towed out and the chain hoist lowered. The diving equipment would be utilized to fasten a chain sling around the base of a heavy coral. The chain would be pulled taut from above and we would wait for the next wave to lift the pontoon and jerk the coral loose. The coral would then be hauled to the surface and towed ashore on the pontoon. Our largest specimens were secured in this way. The record specimen measures twelve feet and, it is estimated, weighs about two tons.

Raising a coral specimen to the deck of the pontoon by means of steel tongs and a ten-ton chain hoist. Though very heavy specimens were successfully lifted in this way, the tough steel of the tongs was finally bent in an endeavor to secure an unusually large example

Bleaching and packing corals on the shore of Little Golding Cay.—In the right foreground a box is being built around the twelve-foot specimen. In the distance may be seen, from left to right, the Williamson Submarine Tube, the yacht, the pontoon, and other vessels of the Museum fleet

As soon as the corals were collected, they were towed to the sandy beach on Little Golding Cay and stranded at high tide. Here they were put through the bleaching process by Mr. Herman Mueller, the glass modeler of the Museum staff, who is also an expert in the preparation of coral specimens. As the bleaching proceeded, the specimens were gradually moved up the beach, until finally they rested, snowy white, above the high-tide limit. One of the coral heads, a *Siderastræa*, was so heavy that it required twelve men to roll it up the beach, which soon assumed the appearance of a coral reef as it bristled with our accumulated specimens. Long festoons of drying sea fans and sea plumes, stretched between the tents, added a gay touch of color to the scene.

Then came the problem of packing, which was no small undertaking in this out-of-the-way corner of the world. We were sixty-five miles from Nassau, the nearest port from which supplies could be obtained, and our forest of corals looked formidable. But we arranged with native sloops to bring us lumber from Nassau. Sponge clippings from a sponge establishment at Mangrove Cay five miles away furnished us with an admirable packing material, showing that even in the outer islands natural resources of the environment will occasionally quite unexpectedly solve the problems that arise.[1] Sponge clippings are the waste pieces of sponge resulting from the process of trimming which commercial sponges go through in being prepared for the market. First the corals were swaddled in burlap. Then cases were built from rough lumber to fit the specimens, which were anchored securely in position and packed tightly in the sponge clippings, smaller corals being fitted in the spaces about the larger ones as the work proceeded. Thirty-one cases of corals were prepared in this way, requiring three thousand feet of lumber and ten boatloads of sponge clippings. The total

[1]Reference may be made in this connection to the way in which the Third Asiatic Expedition solved its packing problem in Mongolia, by using the camel's wool gathered from the animals of the caravan to protect the fragile fossils.

weight was estimated at more than forty tons.

The submarine tube was also utilized for the important work of photographing the coral reefs from beneath the sea. More than a thousand photographs were taken during the trip, including under-sea pictures as well as miscellaneous photographs of the surrounding region and those illustrating the methods employed. About two thousand feet of motion pictures were also secured. The tube was employed for the first time on record for making water-color sketches of living corals and associated forms beneath the sea. Mr. Chris E. Olsen and Dr. George H. Childs, artists on the Museum staff, were charged with this work and painted more than sixty water-color sketches, which will be invaluable in constructing the proposed group.

Photographing and sketching in the tube could be carried on only in calm weather outside the reef. Unfortunately we were considerably hindered in this part of the work by the almost continuous trade winds, which prevented us from anchoring the barge outside. On one occasion, however, we made the attempt and worked while the tube was swinging like a pendulum among the coral heads with the motion of the waves as they dashed against the reef. This was too risky to repeat as there was constant danger that the glass window would be forced against some projecting coral and broken. Luckily some calm days were given us when the

The Williamson Submarine Tube, viewed from the "Lady Cordeaux."—Boxes of corals cover the deck of the barge. The low-lying shore of Andros Island shows in the distance wind blew off shore, and in one instance we were able to work for hours at a stretch in the tube, photographing almost continuously under perfect conditions. Not a little work was done among the coral clusters in the more quiet waters of Hog Cay Channel, at the northern side of Middle Bight Entrance.

As may be inferred from the number of fish seen about the coral reef, fishing in the lagoon brought quick returns. Our table was always plentifully supplied. On one occasion I told a little native boy who was helping us, to get us some fish for next morning's breakfast. He asked me what kind I wanted. I said, "Red snappers." Within an hour he brought me thirty-four of these fish! At times we feasted on green turtle. Sharks were abundant and we had an adventure with one of them. Some of our men were sent ashore in the small motor boat to obtain a supply of water. A shark apparently mistook the fishlike bottom of the boat for legitimate prey and darted for the moving propeller. He was thrown completely out of the water, revealing a deep gash under the jaw. He turned over two or three times as he fell back, and then disappeared. The motor stopped completely as the men felt the shock of the impact, and it was found afterward that the propeller shaft was sprung and that the stuffing box leaked. The boat was put out of commission as a motor boat for the remainder of our stay.

We found the Andros natives of considerable help to us. Three of them came to us every morning a distance of five miles in a little sailboat hardly large enough to contain them, and looked much like the three wise men of Gotham as they strove to keep their balance in their tiny craft. At one time there were nineteen men in our party busily engaged in preparing the collections for shipment. Finally, the morning of July 15, the "Lady Cordeaux" arrived to take us back to Nassau and found us all prepared. We lightered our sixty-two cases of corals and equipment out to her at the reef entrance, by means of the barge and the pontoon, and the next morning we were all safe in Nassau Harbor.

During our stay at Andros we received much assistance and many courtesies from Commissioner Elgin W. Forsyth, whose knowledge and experience of the reefs were invaluable to us, as well as his services in securing native helpers and fresh provisions. The Bahaman government, through Administrator Burns and other officials, gave us every facility, and the people of Nassau generally took much interest in our enterprise. The capable work of Captain Lewis Isaacs of the "Jules Verne" and Captain Joseph Bethell of the "Standard" was most important to our success in acquiring the collection. The final ten days of our trip were spent first in visiting the remarkable coral formations known as "boilers" at Harbor Island, and secondly in organizing our collections and equipment for the homeward trip on the "Munargo" on July 27. Three days later we arrived in New York.

A CORAL FAIRY LAND IN THE ANDROS LAGOON

A brilliantly colored reef fish (*Thalassoma bifasciatum*) swims into a beam of sunlight between purple and brown sea bushes (*Gorgonia*) and a towering bank of *Porites* coral. From a photograph by Roy Waldo Miner, colored, under the supervision of Doctor Miner, by William E. Belanske

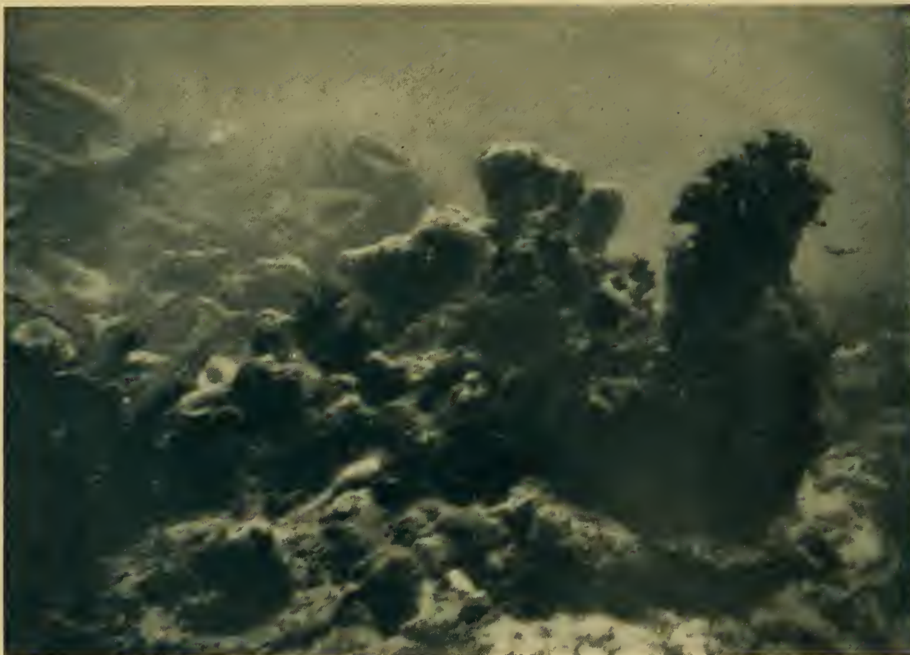
The Coral Gardens of Andros

PHOTOGRAPHED THROUGH THE WILLIAMSON SUBMARINE TUBE

By ROY WALDO MINER AND J. E. WILLIAMSON

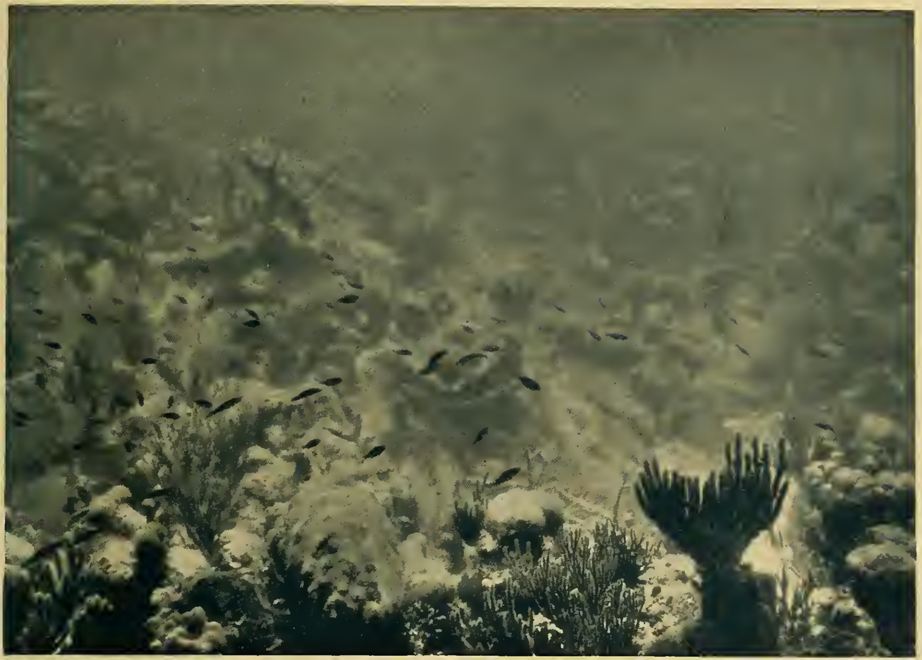
A bank of branched *Porites* corals.—Thousands of close-set individual specimens make up these formations

Mr. Williamson, of The Submarine Film Corporation, collecting corals in a Schrader diving suit.—He is looping a rope about a fine specimen of fan coral (*Acropora prolifera*) so that it may be hauled to the surface of the sea



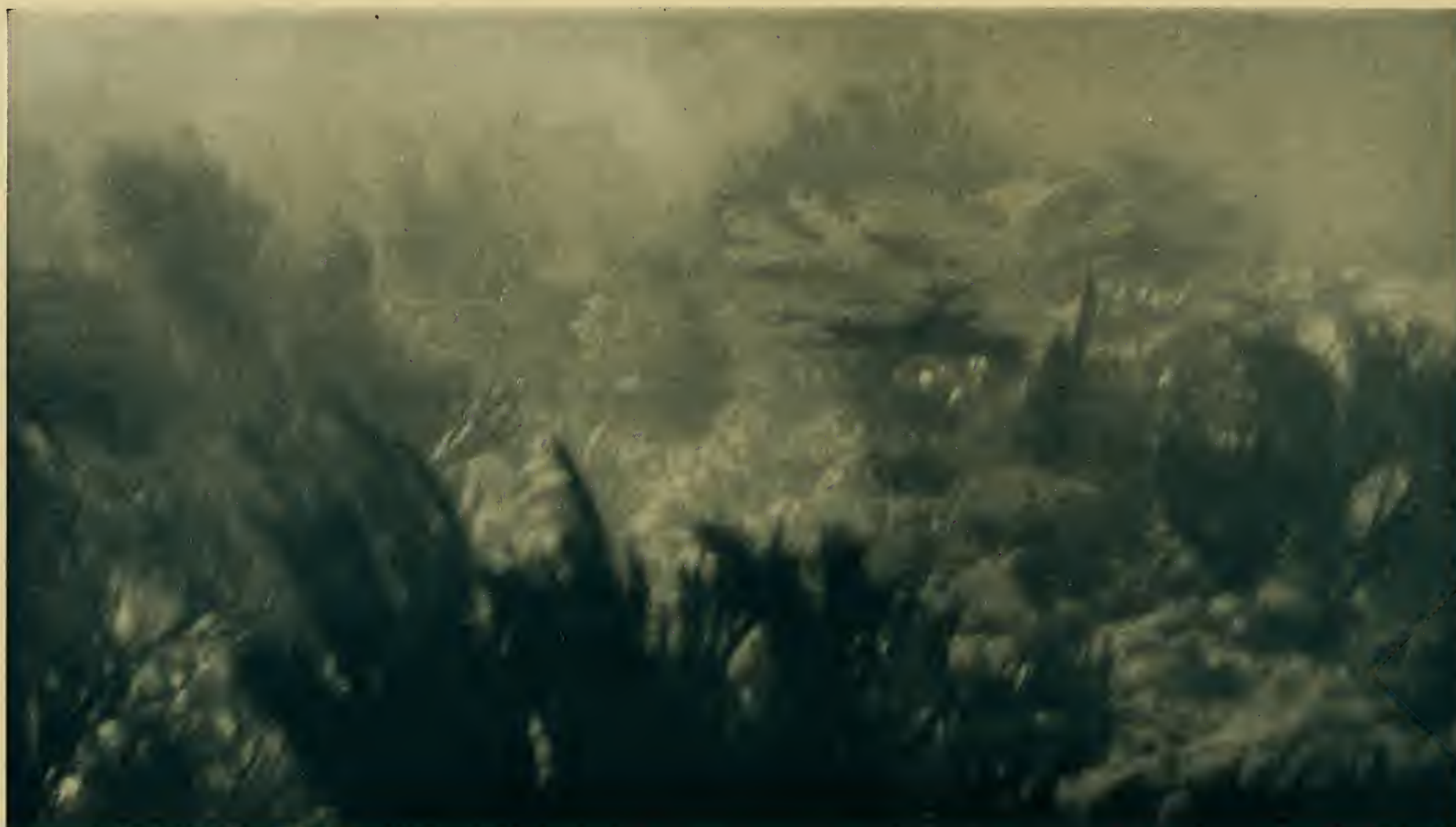
Coral posts crowned with dome-shaped living colonies of *Orbicella* rise beside the more foliate expansions of the stinging coral, *Millepora*

Glimpse through the branches of a submerged coral forest, composed of the palmate coral, *Acropora palmata*



Sunlit aisles of the sea-forest floor with reef fishes swimming about the fronds of the treelike gorgonians, or sea bushes

Waving masses of many-fingered gorgonians grow luxuriantly among the corals, adding color and grace to the scene



AN ANDROS SEA GARDEN ALIGHT WITH SUNSHINE

In the foreground is a luxuriant growth of richly tinted gorgonians. In the background to the right the beautiful palmate coral, *Acropora palmata*, spreads broad branches

SEA PLUMES AND CORAL POSTS

A vista through a submarine fairyland of magenta and gold. Such views appear in every direction through the clearings of the ocean forests

STAGHORNS AND FAN CORALS

Here and there beautiful clusters of fan coral (*Acropora prolifera*) of wondrous symmetry and almost unbelievable delicacy border beds bristling with interlacing masses of staghorns (*Acropora cervicornis*), shown in the right of the picture

A TYPICAL PALMATE CORAL GROWTH

These palmate corals rise, with broad handlike branches, sometimes fifteen or twenty feet in height, their uppermost tips breaking the surface of the water at low tide. They form the most characteristic growth of the West Indian barrier reef

A VISTA ALONG THE EDGE OF A CORAL BANK

Club-fingered *Gorgonia* and tube sponges (*Spinosella*) melt into the opalescent, watery haze. Brilliantly colored reef fishes, gleaming like jewels, dart in and out among the submarine growths

A Submarine Cable Among the Corals

By CHARLES HASKINS TOWNSEND
Director of the New York Aquarium

WHEN the "Albatross" reached Tahiti in 1899 during the Tropical Pacific Expedition in charge of Alexander Agassiz, Mr. Agassiz's first move was, in his own words, "to determine, if possible, the rate of growth of the corals on Dolphin Bank from the marks which had been placed on Point Venus by Wilkes in 1839."

We had finished a month's work among the atolls of the Low Archipelago, during which corals and the formation of coral islands had been the principal subjects of conversation.

The stones and marks set up by Wilkes at Tahiti were readily located but proved a disappointment. There were only a few scattered heads of coral growing on Dolphin Bank. Its choice as a standard by which to measure coral growth was unfortunate. As Mr. Agassiz reported the findings: "An excellent opportunity had been lost to determine the growth of corals during a period of sixty years."

Among those who attacked the problem of the growth rate of corals by setting up marks, was the late Dr. A. G. Mayor, who accompanied Mr. Agassiz on the "Albatross." Dr. T. W. Vaughan's experiments with several species of shallow-water corals at Mayor's laboratory at Tortugas and also in the Bahamas soon showed annual growths of as much as 95 mm. in diameter. Doctor Mayor's studies on the reefs at Samoa served to confirm those of observers in other parts of the Pacific, that Pacific corals grow at about twice the rate of corresponding genera in the Atlantic.

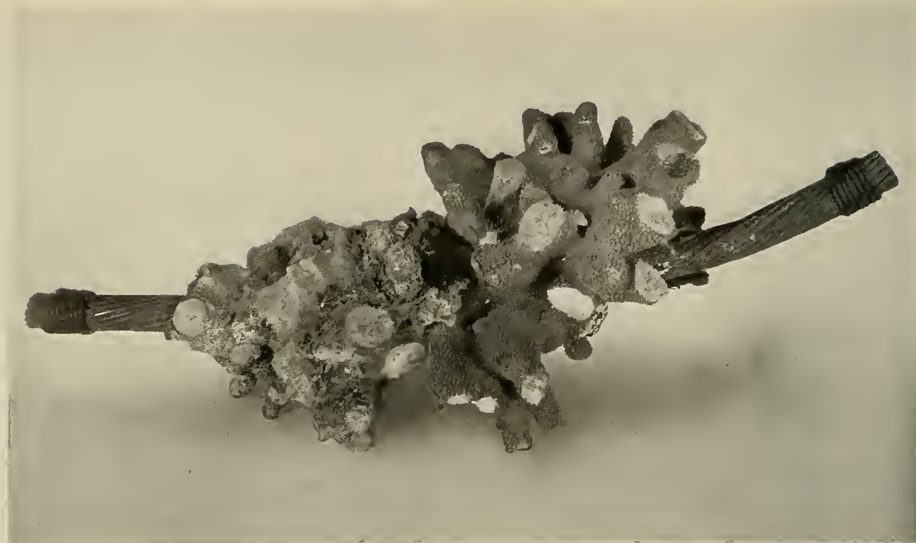
The preceding remarks are made merely by way of introducing some comments on the photograph, illustrative of coral growth, which appears on the following page. When passing the office of the Commercial Cable Company at Fifth Avenue and 46th Street, New York City, I noticed in the window a section of cable bearing a mass of coral with the following label:

> Section of cable overgrown with coral, picked up by the Cableship "Restorer" in the Pacific Ocean, Feb. 8, 1923. The Commercial Pacific Cable extending from San Francisco to the Philippines was completed July 4, 1903. This section was part of the original cable, and was picked up in shallow water just off Honolulu in the course of a repair. Thus the coral grew around the cable in the course of twenty years.

With the kind permission of Manager Thornburg the specimen—a species of *Pocillopora*—was photographed. The mass of coral measures 24 inches in length by 16 inches in greatest width, the diameter of the cable being 2½ inches.

There is no information at present available as to the depth at which the cable lay on the reef, nor do we know when coral growth upon it commenced, for the cable was not examined for twenty years. According to Mr. Thornburg there is a marked irregularity in the growth of coral; at times it appears to proceed very fast and at other times and in other places there is no growth at all. He also states that coral growth on cables placed in shallow water around the Hawaiian group has occasioned trouble but that cables located in deep water have not been affected.

The Commercial Cable Company



Courtesy of the Commercial Cable Company

A section of cable laid in 1903.—The age of its growth of coral (*Pocillopora*) falls, therefore, within the two decades that have since elapsed and, according to an eminent authority, may be less than ten years. The coral mass measures 24 inches in length by 16 inches in greatest width,—an indication of the rapidity of growth

has no other specimen of this kind and no photographs of corals attached to cables, but such growths are often found when submarine cables are lifted. The Halifax-Bermuda Cable, which lay on the Bermuda reef for twenty years at a depth of twenty feet, was raised in 1923. It came up heavily loaded with both stony and gorgonian corals, some of the latter being the common "sea fans" that are often sold to tourists. Doctor Vaughan tells me there is nothing very conclusive in the finding of coral growths on cables which have been long under water, as the date of fixation of the larvæ is unknown, and suggests that the growth pictured here might be less than ten years old. It is probable that the galvanized outer strands of the cable would not offer an attractive surface for the attachment of coral larvæ until they had "weathered" for a time in sea water.

It would seem that sections of old submarine cable, long enough to be easily recovered, would be ideal material for the gathering of evidence as to the time required for coral growth if placed in favorable locations and examined at suitable intervals.

"Pearls and Savages"

A REVIEW OF CAPTAIN FRANK HURLEY'S VOLUME ON NEW GUINEA[1]

By WILLIAM K. GREGORY

Curator of Comparative and Human Anatomy, American Museum

THE great island of New Guinea, one of the least-known quarters of the globe, forms a link between Australia on the south and the Malaysian region to the northwest and west, and is therefore of the greatest interest to the geologist, anthropologist, zoölogist, and botanist. Not very far back in geological time it was undoubtedly connected with Australia—as we may infer not only from the relative shallowness of the waters that now separate these land masses, but also from the presence in New Guinea of a number of animals and plants the nearest relatives of which live in Queensland. Perhaps about the time that the Glacial Period was coming on in Europe there were terrific disturbances in the region of New Guinea. The very foundations of the earth gave way, great blocks of rock strata were faulted downward and others were pushed upward, giving rise to the precipitous rock cliffs, many thousands of feet in height, which in some places in the existing mountains of the interior still attest the magnitude of these displacements. At the same time the land toward the south subsided beneath the sea level, the waters of the Indian and Pacific oceans rushed in from either side and, cutting off New Guinea from Australia, formed the Coral Sea and Torres Straits.

It was in these now fairly tranquil tropical waters that Captain Frank Hurley descended into the sea with the pearl divers and secured many beautiful photographs illustrating the swarming life of the coral reefs; but the greater part of his *Pearls and Savages* is devoted to his experiences with the natives of the southeastern prong of the island and of the Lake Murray region.

In the course of Shackelton's South Polar expedition Hurley had been one of a shipwrecked party that had finally won its way back to the base camp after the most intense struggles and sufferings. In these bitter Antarctic temperatures some of the men had dreamed of the steaming tropical jungles, and thus was born Hurley's determination to explore New Guinea. After his arduous and brilliant record as a photographer in the Antarctic and in the Great War, Hurley might well have been excused if he had picked an easier objective for his next bit of exploring than the interior of New Guinea, but it is fortunate for the world that he made the choice that he did and lived to bring back the superb photographs which now adorn his book.

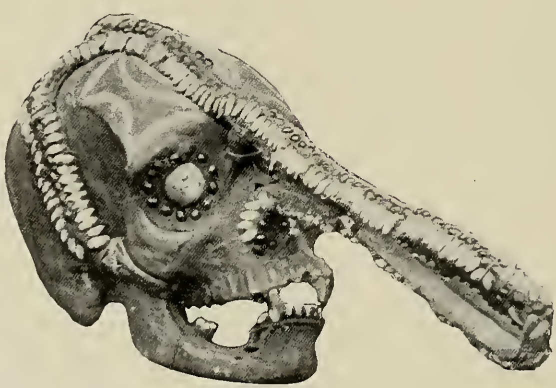
Starting from Sydney, Australia, Hurley first made a preliminary reconnaissance covering a period of ten months, during which he cruised in the Coral Sea and visited the costal villages of Papua, or southeastern New Guinea. Thus he secured the motion pictures which brought him the means of equipping his second and more extensive expedition. On this expedition he was accompanied by the naturalist Alan McCulloch, of the Australian Museum of Sydney, and the equipment included a flat-bottomed, shallow-draught vessel

[1] *Pearls and Savages* by Captain Frank Hurley. With eighty illustrations and a foreword by G. P. P. Published by G. P. Putnam's Sons.

with an auxiliary engine, and two seaplanes presented by a patron of the expedition and operating in conjunction with the vessel. Radio apparatus on board gave the Australian newspapers a daily account of the expedition, which was followed with tense interest by thousands of people in the great cities of Australia.

The seaplanes eventually had to be sent back because the steaming atmosphere was fast rotting their very fabric, but not before many notable flights had been made and some wonderful moving pictures secured, showing the vast delta of the Kikori River and the native pile dwellings and *ravis*. As for the latter, imagine a structure made of mangrove saplings bent over at the top and thatched with leaves, that stretches like a vast crocodile, in some cases 400 feet long and with a yawning entrance 70 feet in height! Into these dark communal clubhouses Hurley and his intrepid companions ventured and secured in exchange for tin cans, axes, and tobacco, much priceless booty for the anthropologists: artfully prepared human heads, "bullroarers," and other magic-making material. They also witnessed many dazzling ceremonial dances, in which the dark-skinned savages were adorned with the most elaborate feather head-dresses, each feather being carefully articulated so as to wave up and down with its owner's movements. The author describes how these people fashion pottery without a potter's wheel, and gives excellent pictures of the ingenious process of making sago out of the pulp of the "sago palm," the latter being the chief source of food, clothing, and shelter for the major portion of the Papuan population.

The author frequently comments upon the "Semitic features" of the people about Lake Murray and of many of the coastal people, but here, as elsewhere, his viewpoint is rather unscientific and the book lacks illuminating comparisons. Nevertheless, the reader who desires to compare the natives that Hurley met with those of other parts of New Guinea, and who is further interested in such larger problems as the relationship of the Papuans with the peoples of New Britain, Australia, and Tasmania, will find in Captain Hurley's book a wealth of instructive detail recorded by his camera.



Bird Banding

By MAUNSELL S. CROSBY

DO the same birds return year after year to the same place? Is the phœbe which is now raising its second brood of the season on top of the column on my piazza the same bird which built there last year, and is her mate the same? Will her children come back next year, nest as near as possible to their birthplace, and perhaps quarrel with their father for possession of the old home? In a few cases, where a bird has shown albinism in its plumage or has possessed an individual song that could be memorized by the observer, it has been recognized in a succeeding year, or at least the probability was strong that if not the same bird, it was one of the descendants of that bird which had inherited the white feathers or peculiarity of song that distinguished the progenitor. We usually assume that the robins, the wrens, and the chippies, which we find so regularly about our homes each year, are our old friends, but how often are we right?

On the other hand, where do these birds spend the winter? We have learned that these delicate creatures annually take immense flights to escape the cold and starvation of our northern winters and that they reach the warmth and plenty of southern climates, and some of us have been surprised during a winter visit to the South to discover such northern acquaintances as the ruby-crowned kinglet and white-throated sparrow perfectly at home in the apparently incongruous surroundings that are afforded by live oaks, cacti, and palmettos. The whitethroat's breeding range extends from northern Mackenzie and Ungava to southern Montana and the mountains of Connecticut, southern New York, and Pennsylvania. Its winter range is from Missouri and Massachusetts to northeastern Mexico and Florida. Do the far-northern breeders winter in New England and are the birds found on the Gulf Coast from the lower ranges of the species, or do the northern breeders make a thorough migration from the top to the bottom of the ranges, while those that nest in the Catskill Mountains of New York simply drift toward the warmer coast until the warmth of spring enables them to drift back?

Do birds always winter in the same place year after year? Do they make what to us seem unusual wanderings or migrations, not in line with the stereotyped flights we have learned to expect of them? How long do free, wild birds normally live—ducks, owls, jays, catbirds, robins? What percentage of birds annually survives natural mortality plus the toll levied by our vast army of sportsmen and gunners? How do we account for so-called accidental visitants? Are they wind-blown wanderers, or inexperienced or lost young birds, or explorers? Whence have they come and how far may their caprice or that of the elements carry them away from their proper course?

No ornithologist can as yet begin to answer most of these questions, but a means has been found whereby some answers have already been suggested, and possibly all may some day be satisfactorily cleared up. This means is bird banding.

Photograph by S. Prentiss Baldwin

The drop trap, or net trap, is propped up by a wooden peg, to which is attached a string, the loose end of which is held by the bird bander. When a bird has been lured beneath the trap by the food there spread out, a tug at the string causes the trap to fall. The gathering box, seen at the left of the photograph, is then applied to the little door in the upper left-hand corner of the trap and the bird is coaxed into this receptacle for banding This trap should be used only by an expert

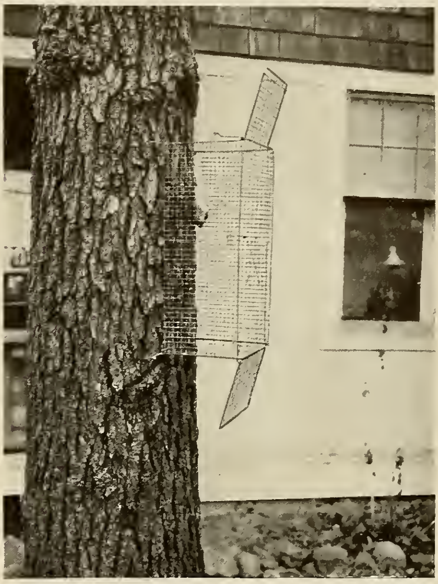
Photograph by S. Prentiss Baldwin

Mr. S. Prentiss Baldwin, widely known for his activities in bird banding, is here seen at Thomasville Station B inducing some captured birds to leave the sparrow trap and enter the gathering cage to the left of it. Sometimes such birds are reluctant to leave the banquet of bread crusts. The trap is placed within a guard fence, erected to keep out cats and dogs

More than two hundred years ago a heron was captured in Germany bearing on its legs several metal rings, one of which, according to the legend on it, had been attached some years earlier in Turkey. A hundred years later a Dutch naturalist named Brugmann marked a number of storks, hoping to find out if they would come back, but his results were negative, for no birds that returned had marks on them. Until 1899 no systematic effort was made to band and then recapture birds, but in that year Herr Mortensen, a Dane, captured birds of several species, banded them, released them, and kept a record of the banding. His success in recapturing banded birds interested a number of ornithologists, so that soon a score of individuals and organizations were drawn into the study. Many practical details had to be worked out: a suitable non-corrosive metal had to be selected for the bands, methods determined upon for numbering, marking, and recording, and also various means of trapping devised. Truly remarkable success along these lines has been obtained, and the published results are most encouraging as well as interesting.[1]

Let us now turn our attention to the United States. Aside from the sporadic experiments of a few investigators, probably the real pioneers were the members of the New Haven Bird Club, which had a number of bands made, and used them somewhat locally during the years immediately preceding 1909, at which time, through the efforts of Dr. Leon J. Cole, the American Bird Banding Association was formed. This organization came under the guidance of the Linnæan Society of New York, but supervision was officially taken over in 1920 by the Bureau of Biological Survey of the United States Department of Agriculture, so as to permit the work to become nation-wide.

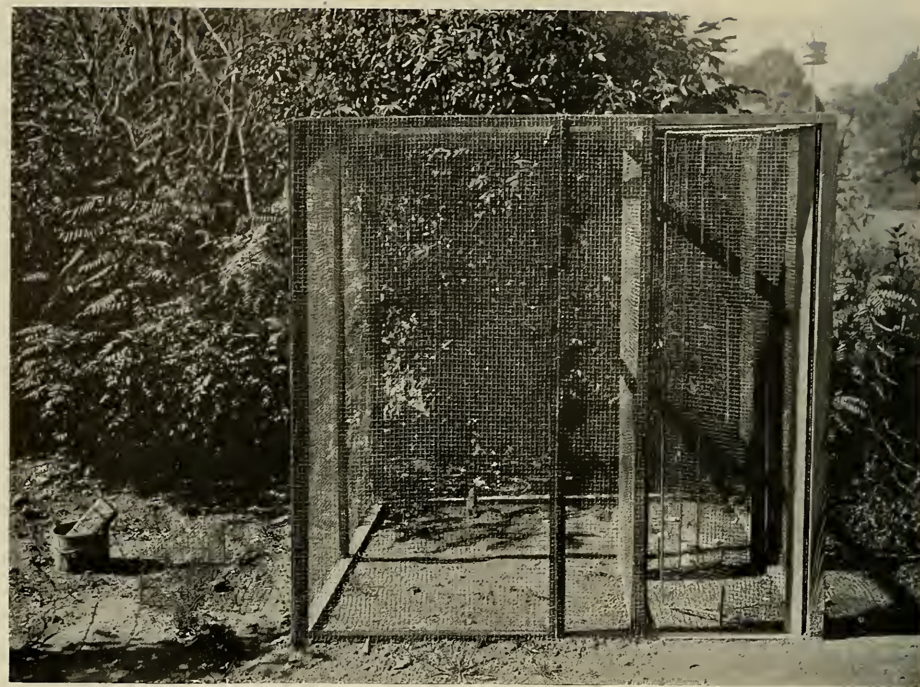
In the meantime, Mr. S. Prentiss Baldwin, of Cleveland, Ohio, one of the most ingenious and indefatigable of bird banders, had made such remarkable return records by using sparrow traps, in which birds could be recaptured again and again without injury, that a new impetus was given to the study, for hitherto most returns had been made through the finding of dead banded birds or the shooting of wild fowl by sportsmen. The old method of recording, which was dependent upon the destruction of the bird, thereby putting an end to its scientific as well as its economic and æsthetic usefulness, has been replaced, through the employment of the trap, by a system based on the return records of living birds, which may subject themselves to capture repeatedly with-



Photograph by S. Prentiss Baldwin

A tree trap, baited with suet and devised for the capture of woodpeckers, nuthatches, and creepers. A pull of an attached string closes the doors at the top and bottom

[1]Lincoln, *Auk*, XXXVIII, 1921, pp. 217–28.



Photograph by S. Prentiss Baldwin

A device of a more elaborate character than those previously shown is the house trap, in which a man can stand erect. There is an outer door at the right and there are two inner doors beyond. All of these are left ajar and the bird is induced to follow the trail of food through the several portals until he loses his way in the interior

out putting their lives in jeopardy. Through the baiting of traps with suitable food and with water for drinking and bathing, a large number of species have already been caught. Chiefly through the interest aroused by Mr. Baldwin, three associations have been formed during the past two years as convenient units, all governed by the Bureau of Biological Survey, which issues bands, permits to trap under the Migratory Bird Treaty, and up-to-date advice on banding, and also keeps the card records of all the banded birds. These smaller societies are the North Eastern, Eastern, and Inland Bird Banding Associations, while on the Pacific Coast the work is being fostered by the Cooper Ornithological Club. They are able by their character to stimulate interest, increase the number of banders, attack local problems, and perform other useful services. Already many hundreds of members have joined these associations, a great number have satisfied the government requirements and secured permits to trap, and accurate data on the movement and life of thousands of birds of many species are accumulating in the files of the Bureau of Biological Survey in Washington.

A word about the bands used. They are very light, made of aluminum, and are marked with a serial number and the words "Notify Biol. Surv., Wash., D. C." An amusing transposition of vowels in stamping an early set of bands caused them to be known as the "Boil, Serve, and Wash" series. As now made, they are sufficiently pliable to be opened and closed with the fingers or a small pair of pliers, and sufficiently rigid to prevent a bird from removing them or from tightening them by hammering with its bill, thereby restricting the circulation or causing other injury to the leg. Properly attached, they slip loosely along the tarsus, are no impediment to the bird, and are not noticeable on a freed bird except at close range.

Slowly, but surely, as return after return is made of birds recaptured after having been previously banded, a wealth of facts is being stored away. Formerly average dates of arrival and departure of migrants over a wide area gave us a general idea of how fast birds traveled. Wells W. Cooke compiled exhaustive and accurate lists contributed by scores of observers, showing dates of arrival and routes taken. But now we have an opportunity to find out how fast the individual travels—how far it actually has flown in one day. I may band a bird today and you may catch it at your station tomorrow many miles north or south. It may rest at your station and go into your trap a number of times, finally to make another long flight on its way, or it may leave you at once, covering a more moderate distance each day. A fox sparrow, one of the first March arrivals, was promptly banded. It returned several times to the trap and did not leave until the very end of April, while in the meantime large flocks of the same species arrived, stayed a day or two, and passed on. The bird was solitary when it arrived, and apparently the influence of the bounty spread before it was greater than that exercised by its relatives swiftly moving by. The more people band birds, especially along well-known highways of migration, such as the Atlantic and Pacific coasts and the Connecticut, Hudson, and Mississippi valleys, the more chance there will be to trace individual histories through the capture of banded specimens and thereby judge the whole movement.

Mr. L. R. Talbot, who operated the Thomasville station in 1922, is seen in the upper picture with a brown thrasher (*Toxostoma rufum*). This bird, No. 19247, was first banded in 1915, was captured with its mate in subsequent years, and was last taken by Mr. Talbot in 1922, being then at least eight years old

An example of this still rare trapping of another person's bird is the case of a purple finch banded at Norwalk, Connecticut, during the winter of 1922–23, and recaptured a few weeks later at Demarest, New Jersey. The purple finch is a particularly erratic bird, being abundant during some winters and nearly absent in others. Possibly food supply may affect its movements, but at all events, during

HOW TO HANDLE A BIRD

These four photographs of a captive blue jay (*Cyanocitta cristata*) may serve as a guidance to those who contemplate engaging in bird banding.

In (1) the bird is held for examination with its neck between the first and second fingers, while its feet find a perch on the little finger.

After a bird has been handled for a few moments it becomes impassive and will hang quietly, head downward, without attempting to escape (2).

If a bird is to be banded, (3) is the proper method of approach. For the purpose the little finger is placed over the neck to keep the bird quiet, and the leg is held by the thumb and forefinger until the band is put on.

When the bird is released it may not at once grasp the fact that it is free, lying in the open hand (4) for some time before bestirring itself.

Photographs by S. Prentiss Baldwin

the winter of 1922–23 it was remarkably common throughout southern New England, New York, and New Jersey. In December, 1923, and January, 1924, a banded purple finch was seen in company with an unbanded one at a feeding station four miles south of the writer's traps at Rhinebeck, New York. The presumption is that it was a bird banded by him during the previous winter, as no purple finch had been banded by him subsequently. There were practically no other purple finches about last winter. Why had this one returned and why had it moved to such a distant station? Had it overflown its mark or was the change deliberate? Did its daily foraging area cover both places, or was it originally caught while en route to the second station?

It has been definitely established by trapping that a certain percentage of birds do return, not only to their nesting sites in spring, but also to their winter quarters in autumn. Mr. Baldwin's Cleveland house wrens (the genealogies of which he is recording and the actions and relations of which are most interesting and amusing) are examples of the former, and his whitethroats at Thomasville, Georgia, are examples of the latter. On the other hand, it can be stated that the percentage of returns is rather lower than might be expected. Many factors may account for this. To begin with, there is mortality. On the whole, where the balance of nature is not interfered with, the number of a given species is likely to remain the same from year to year; that is to say, the deaths tend to offset the births. It is believed that the period of greatest mortality among most birds is the time just after they have left the nest, before they have reached full strength or learned much wisdom. Even though they successfully survive this period, sooner or later some enemy will catch them or they will perish through the effects of the elements, for in nature there is no such thing as dying a "natural" death. Even so, nature's ruthlessness is often less cruel than our lingering kindness to our doomed sick ones.

Then there is the question of overcrowding on the breeding grounds.

In the upper picture, taken by T. D. Carter, is shown a male Brewster's warbler. This bird, No. 48866, was captured at Wyanokie, New Jersey, three successive years: June 10, 1922, June 10, 1923, and June 15, 1924. On each occasion its nest was also located. Its mate was a golden-winged warbler (*Vermivora chrysoptera*) and one of their offspring is shown in the lower picture, taken by G. Clyde Fisher

Most birds that do not nest in colonies have a home area which they jealously guard from trespass by others of their kind, though often unconscious or careless of the presence of other species the habits of which do not conflict with their own. Thus a pair of kingbirds will hold their orchard against all other kingbirds, besides driving off hawks and crows, but will permit robins and bluebirds to nest there unmolested; while a single pair of kingfishers will patrol their stretch of creek to the exclusion of all others of their kind. No doubt if their young come back the next season to the same orchard or stream, there will be a battle, and the loser will have to look elsewhere for a home and a mate. Even so, a percentage of banded birds may be forced out of their home area, while unbanded birds will similarly filter in. A barred owl, one of four young banded in May, 1921, at Rhinebeck, was shot the following winter by a hunter a dozen miles away, where very likely it had taken up its abode after being invited to leave home by its parent, for it is not considered a migratory species. In this part of the country, the birds of prey seem to have fairly definite individual territory, due perhaps to the limitations of a particular food supply which must not be overtaxed. Barred owls have been present winter and summer near the writer's house for twenty-two years, but in winter there is at first only one bird, to be joined by another as the mating season approaches.

The writer's experience in bird banding has been limited by the time at his disposal chiefly to the trapping of winter birds. Chickadees and white-breasted nuthatches in abundance and a certain number of blue jays, purple finches, tree sparrows, and song sparrows have visited his traps and made interesting records. In spring he has seen banded nuthatches and chickadees entering their nests to feed their young within a few rods of the spot where they had been trapped. But the most continuous history he can relate from his own experience is that of the wintering juncos that have entered his traps since he started using them in January, 1920, after hearing Mr. Baldwin tell of his success.

The table on page 613 gives the number on the band of each junco which has returned in any season subsequent to that of its original capture, and gives every date on which it has been caught. Dates in parentheses are those occurring during the winter when the bird was "new," or first banded, and therefore do not constitute true returns. Dates not in parentheses indicate that the bird was captured during a previous winter, that it had gone away in the spring—how far? we wonder—and come back safely to the very spot where it had been fed before.

How many questions come up at this point! Why does the number of returns vary? Why have only three of the 1920–21 birds come back, and only one of those which were "new" in 1921–22? (This last one succumbed to the frenzy of a gray squirrel which got into the trap with it.) So far as trapping is concerned, the flock would appear to range in size between twenty-nine and forty-seven individuals. How much larger is it actually? How many juncos, in other words, avoid capture entirely? Is there more than one flock? Why did No. 27137 fail to register in 1920–21, seeing that in other years he has been so faithful? Was he absent, or was the winter so open that he found plenty of food outside the traps? If the latter was the case, he should have stayed away also in 1923–24.

CONDENSED RECORD OF BANDED JUNCOS

YEAR	1919–20	1920–21	1921–22	1922–23	1923–24
CHARACTER	Much snow	Very mild	Much snow and cold	Unusual amount of snow	Very mild till February
NUMBER OF JUNCOS TRAPPED	Old, 0 New, 29 — Total, 29	Old, 3 New, 32 — Total, 35 Old = 8.5%	Old, 5 New, 42 — Total, 47 Old = 10.6%	Old, 6 New, 36 — Total, 42 Old = 14.2%	Old, 7 New, 39 — Total, 46 Old = 15.2%
JUNCOS THAT RETURNED					
No. 16150	(Jan. 16, 19, 21, 22; Mar. 16)	Feb. 27			
No. 27136	(Jan. 21)			Dec. 7; Mar. 6	
No. 27137	(Jan. 21; Feb. 24; Mar. 19)		Jan. 23; Feb. 3	Nov. 6; Jan. 28	Nov. 25; Dec. 2; Jan. 28
No. 46172	(Feb. 23)		Jan. 31; Feb. 4		
No. 46185	(Feb. 28)	Feb. 12	Dec. 5; Feb. 4		
No. 46195	(Mar. 18)	Dec. 25			
No. 29140	(Mar. 19)		Jan. 22; Feb. 4	Jan. 30	
No. 29142	(Mar. 20)		Jan. 31; Feb. 2, 3	Jan. 28	
No. 48207		(Feb. 12)		Nov. 5; Jan. 28, 29	
No. 48213		(Feb. 26)			Nov. 12, 15, 18, 26; Dec. 15; Jan. 4, 5
No. 6465			(Dec. 23; Jan. 20, 22)	Dec. 17, 18 died	
No. 48829				(Dec. 5, 11, 19; Jan. 26, 27, 28, 29, 31)	Nov. 13, 15
No. 48836				(Dec. 6; Mar. 10)	Dec. 14, 15, 16; Jan. 26, 28
No. 48845				(Jan. 26, 28)	Jan. 27
No. 6505				(Jan. 27, 28, 29, 30)	Jan. 26
No. 6510				(Jan. 27, 28)	Nov. 26; Jan. 28

Where was No. 48213 in 1921–22 and 1922–23? This last winter he has been caught seven times, having at so late a date acquired the "trap habit."

Quite different has been the experience with tree sparrows, although other banders report greater success. During the winter of 1919–20, twenty were banded. The following winter only three were caught, but all three were banded birds from the previous winter. In 1921–22 one of these three birds was recaptured and one new one, while yet another unbanded bird was seen. Since then only one or two tree sparrows have been noted anywhere near the writer's place in winter and none has been in his traps. What has become of the flock? Has it been wiped out? Or is it not likely that its regular headquarters are some distance away, that the deep snows of the first winter impelled the birds to pay the traps a visit and that a few remembered the place in subsequent winters, but that now they either have sufficient food or roam in another direction when it is scarce, no longer realizing where plenty lies awaiting them?

Photograph by R. H. Howland

This juvenal sparrow hawk (*Falco sparverius*), a female, was captured at Upper Montclair, New Jersey

Although we have now seen that "returns" are to be expected of old friends both in winter and in summer quarters, transients—that is, birds which nest north of us and winter south of us—have hitherto proved much harder to recapture. Not that they avoid the traps, for they are at all times tempted by suitable bait, but the captures are nearly always new birds, a circumstance which perhaps shows that migrating birds, until they reach their destination, alight for the day's rest and food in the first attractive spot they find after the light of

Photograph by G. Clyde Fisher

An immature red-shouldered hawk (*Buteo lineatus*) with a band on its leg.—It was caught near South Waterford, Maine, in August, 1923

day makes it proper and safe to halt. So it would be mere luck if the same transient ever stopped a second time in the same place during its semi-annual trip. However, even banding new transients brings its reward, for by keeping a record of those which "repeat," the arrival and departure of waves of migrants may be noted and their relation to meteorological conditions studied. Further, as more and more people along the main migration routes join in the banding, the probability of their catching birds that others have banded approaches a certainty.

It has been known for some time that certain species of birds, notably the herons, wander during the late summer before it is time to think of going south for the winter. Young birds seem especially prone to this habit and they are likely to wander north instead of south. Young black-crowned night herons were seen in late July and August in places where, it was known, they did not breed and to the north of which, it was believed, no heronries existed. The puzzle was definitely solved when some of the birds were shot by fishermen who objected to their feeding habits, and it was found that they bore bands placed on them in a heronry situated south of the place of capture. Doctor Cole, in the *Wilson Bulletin* for June, 1922, published two letters from men who had shot night herons and they are worthy of being reproduced in this connection:

"Gentlemen dear sirs Your bird was shot here to day by me Albert Bailey for which I was more than Sorry when I found it had a ring on. I took it for a Hawk as It flew several times over my yard as I thought after chickens and Gentlemen all I can say that I am sorry If I did wrong In so doing and also beg Pardon.

Yours with Rees
Albert Bailey."

"Gentlemen: The bearer of the enclosed was found in one of our traps yesterday morning. Now will you please tell us if you are raising these pests or did you simply capture and tag it to see how far it would migrate?"

Photograph by T. D. Carter

This song sparrow (*Melospiza melodia*), No. 24702, was first taken in a government trap on March 26, 1922, at Boonton, New Jersey. Up to July 22 of that year it revisited the trap no less than thirty-two times

An astounding example of the extent to which a bird may wander was the finding of a common tern floating dead in the Niger River in western Africa. This bird had been banded in Maine! More amusing and less scientific was the report in a newspaper that "Wren Crosses Continent." Doctor Cole found that the facts in this case are as follows: Mr. Finley banded a wren in Oregon and it was later found dead in a watering trough in the same state. The band on its leg, however, read: "*The Auk*, New York, 3429," so the reporter assumed that the bird had flown nearly three thousand miles westward in its wanderings. In a recent lecture Mr. Howard Cleaves reported that robins banded in Canada and Iowa had been captured in Louisiana, and a meadowlark, banded in spring on Staten Island, New York, had been found in winter 180 miles south of its home, although the species winters in numbers on the Island. Banding should determine if the wintering birds do not come from farther north and whether all the breeding birds go south or not.

The banding of wild ducks in Ontario, Canada, and subsequent reports of birds shot during the autumn season by gunners, showed not only that sixteen per cent were shortly killed by man alone, but also that these ducks flew south by two different routes, part down the Atlantic Coast and part down the Mississippi Valley, while one bird, a blue-winged teal, was shot in Trinidad, off the coast of South America.[1] It is thought that bird banding will eventually show that there is actually a considerable east and west migration in certain species. An easy explanation is that such birds follow coast lines and rivers even when they deviate from a north and south line, and may thus stray many hundreds of miles from their original longitude, but there are other cases more obscure, which may be the result of habits formed in glacial times. Such a case is that of the woodcocks banded near St. Petersburg, Russia, which use three different routes in going south and winter in three different localities. Such also is that of the storks in Germany: those breeding west of the River Weser

[1]Lincoln, *Auk*, XXXIX, 1922, p. 329.

winter in Spain, while those nesting to the east go all the way to South Africa.[1]

A great deal more could be written of what can be learned by bird banding,—such as the progress of molts as noted in "repeating" birds, the replacement of accidentally lost tail feathers, whether birds use scent or sight in picking out food (why does a chickadee gobble up cracked peanuts which it has probably never seen before and neglect the other more familiar seeds offered to him?), the effects of parasites and bird diseases,—for instance, that malady which had attacked the feet of chipping sparrows caught by Mr. Baldwin in Thomasville. The building of suitable traps is a study in itself, so as to attract species which will not enter the ordinary "fly-trap" types and drop traps. No doubt the surface of the subject has only been scratched, and banders in future will find so much to interest them that some may have to specialize along certain lines of study to the exclusion of others. Incidentally, every new bander becomes a bird protectionist, feeds his charges, and keeps vermin and trespassers away. Ordinary care in the handling and watching of traps makes accidents to birds rare and unlikely events.

Some one has suggested the motto, "Let us band together." The writer feels sure that a trial will prove the game is not only worth while but actually absorbing and fascinating.

[1]Oberholser, *Auk*, XL, 1923, p. 438.

Photograph by Arthur A. Allen

A banded green-winged teal (*Nettion carolinense*) and canvas-backs (*Marila valisineria*) at a feeding station, Ithaca, New York

NOTES

EDMUND OTIS HOVEY

Dr. Edmund Otis Hovey, curator of the department of geology in the American Museum of Natural History, died suddenly September 27, 1924. He was sixty-two years of age and had been a member of the Museum staff for more than thirty years. The scientific staff of the Museum adopted on October 14 the following minute and resolution:

Doctor Hovey was appointed as assistant curator in the department of geology on January 1, 1894, and was second to Doctor Chapman in order of seniority among the curators of the Museum. He was appointed associate curator in 1901 and curator in 1910.

His time in his earlier years at the Museum was largely given to the cataloguing and exhibition arrangements in the department. The catalogue of types and figured specimens of fossils in the department collections, a volume of 500 pages, was completed and published in 1898–1901 in collaboration with Doctor Whitfield. Doctor Hovey's principal contribution in later years has been the series of relief maps illustrating various typical phases of physiographic geology. These maps, carefully studied and planned in advance, and executed with a high order of accuracy and scientific insight into the processes that they illustrate, are regarded as exceptionally instructive and reliable. Artistically and technically they are far above the ordinary type of relief map, constituting a permanent contribution of solid merit to the science of geology.

Editorial Service.—Doctor Hovey was editor of the American Museum Journal (now Natural History) for the first ten years of its existence from 1900 to 1910, and continued up to the time of his death a valued adviser and contributor to its pages. He was editor of the *Annals of the New York Academy of Sciences* from 1908–16, supervising the nine volumes published during those years. At the beginning of this year (1924) he undertook, with some reluctance, the editorship of the scientific publications of the division of geology, palæontology, and mineralogy in the Museum. He had organized and initiated this editorial work and was busied with it in his last days.

Studies of Volcanoes.—Doctor Hovey had for many years been especially interested in volcanic phenomena, had studied some of the volcanoes, living and extinct, of Europe, and in 1902, 1903, and 1908 spent considerable time in Martinique and St. Vincent, making a scientific study of the great outbreaks of Mont Pelée and the Soufrière. The preliminary results of this study were published in the American Museum *Bulletin* and in the *Proceedings of the Vienna International Geological Congress*. When the news arrived of the utter destruction of St. Pièrre, he took the first boat for the West Indies, leaving upon a few hours' notice and, arriving at the islands while the eruption was still in full force, was an eyewitness of many of its most impressive and remarkable phenomena, and secured an important series of photographs and observations. His later visits enabled him to record the waning activities of the volcano and subsequent changes, and he was planning to make a final visit next year to correct and check up various details and note the changes of twenty years before publishing a final memoir upon the eruptions.

Arctic Exploration.—Doctor Hovey had long been interested in Arctic exploration, was a director of the Explorers Club, and as chairman of the committee in charge of the Crocker Land Expedition of the Museum, took an active part in its organization and equipment. A succession of misfortunes and difficulties which befell this expedition made it desirable for him to go personally upon the relief expedition sent out in 1915, and this in turn met with unexpected difficulties which enforced a prolonged stay of nearly two years in the camp at Etah. Since his return he had made a series of field trips in connection with the physiographic relief maps planned and under way, and at the time of his death was about to leave for a trip to southwestern Texas to study the details of the Van Horn model.

Secretarial Service.—Doctor Hovey was for fifteen years (1907–22) the secretary of the Geological Society of America, and was very largely concerned with advancing the growth and prosperity and maintaining the high standards of that great and influential association of working geologists. The high value placed by his associates upon his services to American geology was evinced in an address and loving cup presented upon the occasion of his retirement in 1922. He was also recording secretary of the New York Academy of Sciences from 1907–16. Here also the value of his highly competent and efficient service was greatly appreciated by his fellow members. He was a regular attendant at the International Geological congresses from 1903 until their temporary cessation during the war period, taking an unostentatious but always influential part in the discussions and proceedings of the congress. As delegate from the Museum he attended in 1920 and 1923 the Pan-Pacific congresses in Hawaii and Australia respectively.

Doctor Hovey's wide personal acquaintance among geologists, and the respect entertained for his knowledge, experience, and judgment, enabled him to do much to advance the influence of the American Museum both at home and abroad. His colleagues have learned through many years of collaboration to value his straightforward honesty of mind and purpose, his unselfish devotion to the interests of the Museum and of science, his fair-mindedness and temperate expression—and his death leaves us all with a deep sense of personal loss.

Be it therefore resolved that the scientific staff of the Museum desires to record its deep appreciation of Doctor Hovey's character and services and to mourn the passing of this colleague and friend as a heavy loss to the Museum, to science, and to the large circle of his associates and steadfast friends.

THE PASSING OF THE "ALBATROSS"

After nearly forty years devoted to oceanography and fishery service in Atlantic and Pacific waters, the steamer "Albatross," a twin-screw, brigantine-rigged vessel of 1100 tons displacement, has passed out of the control of the Bureau of Fisheries.

Her career as a deep-sea exploring ship has been a notable one. With her launching in 1883, the field of marine investigations of American naturalists was extended from the shallow waters of coasts to almost the greatest known depths of the sea. During three long cruises in the tropical Pacific under the direction of Alexander Agassiz, dredging was carried on in deeper water than ever before, animal life being brought up from a depth of 4173 fathoms (more than four and a half miles). Her deepest sounding was 4813 fathoms (nearly five and a half miles). Agassiz described her as "the best deep-sea dredger in existence," and later wrote, "I can hardly express my satisfaction at having had the opportunity to carry on this deep-sea work on the 'Albatross.' While of course I knew in a general way the great facilities the ship afforded, I did not fully realize the capacity of the equipment until I came to make use of it myself. I could not but contrast the luxurious and thoroughly convenient appointments of the laboratory of the 'Albatross' for work by day and by night with my previous experience."

Never actually out of commission except for a year or more before her sale, her record of service includes, besides many winters devoted to deep-sea investigations in tropical waters, long summers spent in surveying northern fishing banks, remote Alaskan harbors, and the estuaries of valuable salmon rivers, fur-seal investigations in Bering Sea, surveys of the California-Hawaiian cable route, and gunboat service during two wars.

While dredging was done in the deeper waters adjacent to all fishing grounds investigated, there were many voyages for purely oceanographic research. The oceanic regions included in such explorations were the western Atlantic from Newfoundland and southward through the Caribbean Sea to the Strait of Magellan; the eastern Pacific off the coasts of North, Central, and South America; the tropical Pacific through Polynesia to Japan; and the western Pacific from the Japanese Archipelago to China, the Philippines, and Borneo.

If ever the American people received the fullest possible value from a government ship, they received it from this one. The benefits to science, the fisheries, and commerce springing from her almost continuous investigations —the results of which have all been published and widely distributed throughout the world

Photograph by C. H. Townsend

The beam trawl of the "Albatross" coming up from a depth of 1760 fathoms (two miles)

—are incalculable. The results of her deep-sea work—overshadowed, it is true, by those of the famous "Challenger" Expedition, which were embodied in fifty quarto volumes —would assume even larger proportions could they have been published in the same uniformly sumptuous style as those of the "Challenger." The "Challenger" was a pioneer ship in oceanographic work and must remain the leader in the literature of the science. The "Albatross" entered the field much later, but thanks to her more modern equipment and longer service, her collections were naturally much more extensive and the bulk of her published results was perhaps also greater.[1] Comparisons are not in order, but it is of interest to record that once from a depth of 1760 fathoms (two miles) the "Albatross" brought up more specimens of deep-sea fishes at a single haul of the dredge than the "Challenger" collected during her entire period of service. The writer and his assistants counted them at the time and, having the "Challenger" reports on board, looked up the record. There are in the National Museum and in the widely scattered laboratories of specialists many "Albatross" deep-sea collections awaiting examination. While serving as resident naturalist of the ship, the writer sorted, packed, and shipped to the Bureau of Fisheries and to research workers in museums and universities at home and abroad, actually carloads of *Spolia Albatrossia*.

Naturalists connected at various times with the scientific staff of the "Albatross" were Agassiz, Mayor, Kofoid, Bean, Jordan, Gilbert, Evermann, Bigelow, Sumner, and more than a score of others. The writer, after several agreeable years on board, reluctantly left the ship when assigned to duty at headquarters. Among the score of naval officers detailed to the "Albatross" during her earlier years of service were many now on the list of rear admirals, including Benson, Rodman, Eberle, Wilson, Hughes, Burrage, Anderson, and Johnston. Captain Tanner, her notably efficient and devoted first commander, contributed more than any one else toward the perfecting of the vessel's equipment.

Occasionally a beam trawl-net was torn away by the weight of its load, but I do not recall a single break in the five-mile-long wire cable. Tanner was a master at this sort of work but succeeding naval commanders learned to do the task as well. It was reserved for Captain Moser to make the deepest successful haul—more than four and one half miles—and all accomplished in ten hours. Think of reaching that far down through the darkness of the ocean for a load! Imagine an air-ship similarly equipped and miles above the earth letting down a cable in the nighttime for a haul from the surface of the earth!

In spite of its four decades of service the "Albatross" is still stanch and seaworthy. It is to be regretted that funds could not have been found for the continuance of her deep-sea investigations, for which no vessel is better fitted. The Commissioner of Fisheries told me that any qualified group of American scientific men could have had her for the asking. Her buyer says she will not be broken up.[2]—C. H. Townsend.

CONSERVATION

The Gorilla Sanctuary An Accomplished Fact.—A large area, embracing 250 square miles, has been set apart in the Lake Kivu district of Africa as a sanctuary for the gorillas and other wild animals that inhabit it. Protection will be extended even to the flora, so that for all time the natural features that lend interest to this region may have an unimpaired appeal for the visiting naturalist. The reserve is situated in the northeastern part of the Belgian Congo between Lake Kivu and Uganda and includes the three volcanoes—Mount Mikeno, Mount Kirisimbi, and Mount Visoke. It is the region described in the article "Gorillas—Real and Mythical" contributed by Mr. Carl E. Akeley to the issue of Natural History for September–October, 1923.

Impressed with the unique interest of this locality—for nowhere else in the world can the great apes, regarding which man has still so much to learn, be studied to better advantage—Mr. Akeley on his return from Lake Kivu made it his aim to secure the proper protection for the gorillas still surviving in the area. The establishment of Albert National Park (Parc National Albert) marks the consummation of his zealous effort. Accompanied by Dr. W. K. Gregory and Dr. J. H. McGregor of the American Museum, and by Prof. F. Tilney of the College of Physicians and Surgeons, Mr. Akeley went to Washington and convinced the Belgian Ambassador, Baron de Cartier de Marchienne, of the unusual opportunity within the grasp of his country to serve science through the creation of a gorilla sanctuary. His Excellency, who was then on the point of sailing for Belgium, became the enthusiastic advocate of the proposal abroad, pleading with such effectiveness that he finally succeeded in achieving his purpose. Seconding his efforts,

[1]A bibliography of the "Albatross," compiled by the writer in 1901, contained nearly three hundred titles, including documents in preparation; since then, the number has been more than doubled. Many of the publications on the results of dredgings by the "Albatross," more particularly those issued by the Museum of Comparative Zoology, are large quartos superbly illustrated.

[2]An interesting coincidence in connection with the passing of the "Albatross" was the sale of the "Hirondelle," the splendid steamer built by the late Prince of Monaco for o eanic research. In accordance with the terms of his will, the proceeds from the sale of the vessel were applied to the endowment fund of the Oceanographic Museum at Monaco, which he founded.

with unrelaxing devotion, was the Belgian Consul at Baltimore, Mr. James G. Whiteley.

Thanks to the vision and persistence of those interested in the realization of this plan, and of Mr. Akeley in particular, who first conceived it, the gorilla sanctuary awaits only the definite demarcation of its boundaries and the signature of King Albert before being formally proclaimed a national park.

New Groves Acquired by the Save the Redwoods League.—On August 24, the Franklin K. Lane Memorial Redwood Grove, a beautiful two-hundred-acre tract of giant trees on the Redwood Highway, at Kettintelbe (Phillipsville), sixty-five miles south of Eureka, in Humboldt County, California, was dedicated with suitable ceremonies. The grove was acquired through a fund contributed by a group of friends of Franklin K. Lane, headed by Mr. E. E. Ayer of Chicago. In addition to its magnificent stand of redwoods this grove has areas suitable for camping and the privilege of using these for the purpose will be extended to the public.

The Save the Redwoods League announces also that through a generous gift from Mr. G. Fred Schwarz of New York, supplemented by funds supplied by the League from dues and contributions of members, it has acquired a splendid tract, 157 acres in extent and containing more than 12,000,000 feet of redwood, located on the Redwood Highway, ten miles south of Crescent City.

A Museum for the Yosemite.—A grant of $75,000 has been made available through the Laura Spelman Rockefeller Memorial for the erection of a museum building in the Yosemite National Park, for its equipment and furnishing, and for the maintenance, during the first three years of its existence, of the personnel in charge. The plan contemplates the eventual absorption of the museum by the National Parks Service and the establishment of similar local museums in other national parks.

The maintenance of museums in our parks is not an untried experiment. In fact, last year more than 55,000 people visited the shack in the Yosemite that tentatively housed the nucleus of the collections planned for instalment in the building now made possible. In other parks, too, the foundations have been laid of what promises to be a movement of far-reaching educational importance. It is particularly fitting that museums should find place in our national parks, where thousands upon thousands of individuals annually spend their holidays. With their curiosity stimulated by the wonders of nature surrounding them on all sides, they have the chance through the exhibits of the museum to gain authoritative information regarding the local rocks and stones, the characteristic animals of the area, the flowers that grow in rock cleft or stream-bordering meadow, and the Indians who were the original discoverers of the region long before the days of the white man.

All of these phases of interest will, as the plan develops, be represented in the prospective building in the Yosemite. It is not contemplated, however, to make the museum a substitute for the park but rather a key to its features of interest. In furtherance of this purpose it is proposed to label the trees of the park and to mark geologic formations that are especially worthy of attention.

The American Museum is represented on the committee in charge by Dr. Clark Wissler, vice chairman, by Honorary Director Frederic A. Lucas, and by Mr. George D. Pratt, one of its Trustees.

The Paul J. Rainey Wild Life Sanctuary.—The name of Paul J. Rainey was certain to have an abiding place in the memory of those interested in wild life through the part he played in first making known to the stay-at-home population the interesting habits of African game animals as revealed by the motion-picture camera supplemented later by pictures no less interesting of animal life in the Arctic Circle. In yet another way his name will henceforth be linked with the preservation of the records of nature. Forty square miles of territory in Vermilion Parish, Louisiana, have been presented to the National Association of Audubon Societies by Mrs. Grace Rogers, Rainey's sister, with the stipulation that they be maintained in perpetuity as a haven for birds, to be known as the Paul J. Rainey Wild Life Sanctuary. The land is bounded on the east by the State Wild Life Refuge and on the west by the hunting marshes of Edward A. McIlhenny.

Not only will the hunter be kept out of the guarded area, but through the immediate planting of duck foods in large quantities, every allurement will be offered to birds to enter it.

The Biological Survey Solicits Aid.—Have migratory wild fowl been increasing or decreasing in number during the last few years? Drainage has deprived them of needed water and has resulted in their concentration in undrained areas, thus making for density of bird population in some places with corresponding sparsity in others. Accurate figures are needed regarding the various species not only of water fowl but of other migratory birds in order that the Migratory Bird Treaty Act and Regulations may be efficiently administered. To this end the Bureau of Biological Survey solicits detailed reports of observations, particularly of wild ducks and geese, dating from 1913, when the first migratory bird law became effective, or from any year subsequent thereto when notations were commenced by the individual observer. The reports should contain special reference to the annual increases or decreases and to the condition of the habitat of the birds. They should include a statement regarding the opportunities the individual has had to make observations and the dates when and the places where they were made. A questionnaire is furnished by the Bureau of Biological Survey covering the points of special interest and value.

BIRDS

The Extinct Cuban Macaw.—Through the generosity of Dr. Thomas Barbour the American Museum has come into the possession of a specimen of the extinct Cuban macaw (*Ara tricolor*). Only four specimens of this bird are represented in American collections, one being in the Museum of Comparative Zoology and two in the National Museum, the newly acquired specimen making the fourth. Nor have the museums of the Old World a representation noticeably better. Five is the number of specimens mentioned in Rothschild's *Extinct Birds* as the ascertained total in European collections, though the author adds that there are probably others of which he is not aware.

Ara tricolor, formerly confined to Cuba and the Isle of Pines, became extinct as long ago as 1864 when apparently the last specimen was shot at La Vega. Like all the West Indian macaws it was ruthlessly sought for food until its extermination resulted, its striking plumage failing to restrain the hand of the destroyer; but while the other West Indian forms were blotted out, not a specimen remaining to serve as a reminder of their former existence, the Cuban macaw survives at least in the form of a decimated remnant of museum specimens.

To his valued gift of the macaw Doctor Barbour has added that of another rare bird, the extinct New Zealand blue duck, associated with the mountain torrents of that country. This duck (*Hymenolaimus malacorhynchus*) is remarkable from two standpoints: its individuality of structure has earned it the status of a monotypic genus, while its bluish gray color is unique among ducks and swans.

THE NEW YORK AQUARIUM

Report of the Director for 1923.—To one unfamiliar with the difficulties of maintaining captive fishes in a healthy condition the equipment that is necessary and the care that must be exercised are in the nature of a revelation. In the tanks of the New York Aquarium there were at the close of 1923 no less than 3727 specimens representative of 116 species. Many of these came from Sandy Hook Bay and it might at first thought seem that the harbor water would answer their needs. But because of its low salinity and its increasing pollution, this water would be a menace and the Aquarium is therefore dependent on its reservoir of pure sea water to supply the needs of the marine fish entrusted to its care. Many of the fish come from the tropics and require water of a temperature higher than that obtaining in northern seas. In consequence water supplied to these fishes has to be artificially warmed. Lake and river fishes need non-saline water, and in the case of trout and other northern forms this water must be artificially cooled during about five months of the hot spell.

To meet these several requirements the New York Aquarium has four water systems, with ideal equipment for circulation, filtration, aëration, heating, and cooling. Constant vigilance is required to guard against accidents and to this end employees serve in eight-hour watches, guarding pumps and filters, taking the temperature of the water, and observing its flow.

During the past year the attendance at the Aquarium totaled 1,813,647,—greater by nearly 400,000 than the number of individuals that visited the American Museum during the corresponding period. Even so, the number of visitors to the Aquarium was nearly 300,000 less than in 1922, the explanation being the greater inconvenience occasioned by the extensive renovations of the Aquarium building. These renovations, when completed, will, however, greatly enhance the attractiveness and substantiality of the setting, in addition to making more space available for exhibition purposes, and it is safe to predict that the influx of the public through the iron-studded doors that commemorate the former use of the building as a fortress will in the future be greater than ever.

The interest of the Aquarium is not only in its fishes. At the close of the year it housed in addition 99 aquatic reptiles, representing 18 species, 58 amphibians of 8 different species, 544 invertebrates, belonging to 16 species, a marine mammal, and two water birds from the Galápagos Islands,—a penguin (*Spheniscus mendiculus*) and a flightless cormorant (*Phalacrocorax harrisi*).

The services rendered by the Aquarium are not confined to the exhibition of specimens. It has helped other communities plan aquaria, has through exchanges and gifts furnished specimens to other institutions not only in this country but abroad, has supplied during 1923 no less than 800,000 whitefish fry to Lake Champlain, 100,000 yellow perch fry to Prospect Park Lake, Brooklyn, and sundry thousands of trout fingerlings to Palisades Interstate Park, and finally through the written contributions of its scientific staff—notably the illustrated article on "Our Heritage of the Fresh Waters" prepared by Director Charles H. Townsend for the *National Geographic Magazine*,—has disseminated knowledge of many of the interesting forms represented in the institution at Battery Park.

MAMMALS

Mr. George G. Goodwin of the department of mammalogy, American Museum, has presented to the institution 162 mammals which he collected in New York State during his vacation. The first specimens were taken at Berlin, on the Massachusetts border, and included a series of smoky shrews (*Sorex fumeus*)—a species hitherto unrepresented in the Museum collection—a water shrew, and a fine series of woodland jumping mice (*Napeozapus*). From Berlin Mr. Goodwin went northward by automobile, passing the southern end of Lake George and proceeding thence up the valley of the Hudson River to Minerva. From Minerva he followed a trail for eighteen miles that led through wooded country and it was here that he secured several larger animals including beaver and raccoons.

REVIEWS

"Founders of Oceanography."—About a year before his death on July 26, 1924, Sir William Herdman wrote in the preface of his *Founders of Oceanography*[1]: "I have myself lived through the period that has seen the development of the Natural History of the Sea into the Science of Oceanography, and have known intimately most of the men who did the pioneer work."

Among the founders of the science of the sea, he speaks at length of Prof. Edward Forbes, Sir Wyville Thomson, Sir John Murray, Alexander Agassiz, and the Prince of Monaco. When the next volume on oceanography is written, the work of Sir William Herdman himself will constitute an important chapter.

We have read his admirably written book with such absorption that it is fitting, in describing it, to use as far as possible the language of the author. In his chapter on Forbes he says "the best description in brief form is that he was the pioneer of oceanography." Thomson's name, he very properly states, "will go down through the ages as the leader of the famous Challenger Deep-sea Exploring Expedition." Murray's period was continuous with that of Thomson. It fell to his lot to complete the work of Thomson, the two having guided the destiny of the greatest single undertaking of oceanographic exploration. To Murray's tremendous energy must be credited the excellence of the fifty quarto volumes constituting the incomparable "Challenger" reports. This expedition was a national undertaking.

As outstanding examples of the enterprise of private oceanographers, Sir William selects two names—those of Alexander Agassiz and the Prince of Monaco. Both of these men devoted most of their lives and much of their private fortunes to marine explorations, and their investigations and sumptuous publications carried forward without pause the development of the new science of oceanography. Agassiz' work was done with both government and private vessels, while the Prince of Monaco built three vessels for marine investigation, each larger and more perfectly equipped than its predecessor. He also founded and endowed the Oceanographic Museum at Monaco and the Oceanographic Institute at Paris.

[1]Longmans, Green & Co., New York, 1923.

The science of oceanography has gained much during the last half century from observations made at biological establishments on shore. The author naturally devotes most of the chapter regarding these stations for marine research to the celebrated Stazione Zoologica at Naples and to Anton Dohrn, "the founder, benefactor, director, the centre of all its activities, the source of its inspiration." There is no other laboratory where the study rooms are occupied by investigators of established reputation from all parts of Europe and America, attracted by the fame of the institution and its director. Its Aquarium on the ground floor is one of the sights of Naples.

All of the first seven chapters are filled with interesting details respecting the men, the ships, and the laboratories that have contributed to the creation of the modern science of the sea. The succeeding chapters—more than half of the book—are devoted to the physical characteristics of the oceans, under such headings as hydrography, ocean currents, plankton, submarine deposits, coral reefs, the sea-fisheries, etc., all discussed by a master in oceanography who has devoted a lifetime both afloat and ashore to gaining a knowledge of the sea.

To the plankton, which no one has studied more assiduously than Herdman himself, two chapters are devoted. The name is used to include all the small animal and plant organisms that drift about in the sea. The importance of the plankton in the scheme of nature can scarcely be overstated. Abundant in most seas, its innumerable and varied organisms constitute the food of young fishes of many kinds and also of great schools of migratory fishes such as the herring and mackerel. The luminescence of the sea surface is due largely to light-producing organisms composing much of the plankton. There is not space here for remarks on such important chapters as applied oceanography, the fisheries, and food matters in the sea.

The present writer had the privilege of knowing Herdman in Washington when the specimens obtained by some of the Pacific dredgings of the "Albatross" were being unpacked. Later on there were pleasant meetings in New York in company with the late Doctor Mayor.

Like his associates in oceanography, Murray, Agassiz, and "Monaco," Herdman devoted much of his private fortune to the furtherance of marine investigations. His sudden death, just as he was about to start for the meeting of the British Association for the Advancement of Science, is a matter of profound regret. In the book he has left us, we have the most recent summary of oceanographic science.—C. H. Townsend.

"Woodland Creatures" by Frances Pitt.—A book of intimate studies of some of the forest-dwelling mammals and birds of the British Isles has just been issued under this title by E. P. Dutton and Company. The author is not only a keen and independent observer of animals in the wild but at great pains she has reared at various times all of the mammals and several of the birds she describes, so that her sketches, in addition to revealing a comprehensive background of woodland knowledge, have the special interest that attaches to the biographies of individual animals. The badger, the dormouse, the fox, the rabbit, and the squirrel are each assigned a chapter or more, while alternating with the accounts of these mammals are chapters devoted to the woodpeckers, the bullfinch, the sparrow hawk, the kestrel, various owls, and the magpie and the jay. The book is attractively illustrated.

"Outwitting the Weasels" by Helen Harrington.—Two plays adapted by Helen Harrington from stories by Clara D. Pierson have recently been issued by E. P. Dutton and Company. Both of them are well suited for presentation by children and both inculcate wholesome ideas in a non-didactic, humorous, and delightful way. "Outwitting the Weasels," one of the two plays, has as its theme the protection of the birds—on the one hand, from the deliberate aggressor, represented by the boy with the sling; on the other hand, from that slipshod negligence, unfortunately not confined to childhood, which fails to replenish the empty drinking fountain or provide other necessities upon which the birds have come to depend.

THE BRITISH ASSOCIATION MEETING

For the fourth time in its history the British Association for the Advancement of Science, which was founded in 1831, held its annual session in Canada. The Toronto meeting opened on August 6, under the presidency of Major-General Sir David Bruce, K.C.B., F.R.S., the successor in office of Prof. Sir Ernest Rutherford, F.R.S., and was attended not only by many scientists from the Old

World but by Canadian savants and representatives from the institutions of learning in the United States. Through the papers read before the several sections and their subsequent discussion opportunity was given for a broad interchange of knowledge.

The American Museum was represented at the gathering by President Henry Fairfield Osborn, who took part in the sections of zoölogy and anthropology, and by Dr. W. K. Gregory, who participated in the discussion regarding "The Origin of Land-living Vertebrates" and presented before two of the sections a paper, prepared in collaboration with Dr. Milo Hellman, on "The Dentition of *Dryopithecus* and the Origin of Man." Although unable to be personally present, Dr. William Diller Matthew contributed an account of his recent find in Texas under the title of "A New Link in the Evolution of the Horse." A paper by Dr. Clark Wissler on "The Segregation of Racial Characters in a Population" was presented by title.

The Museum has had the privilege of welcoming a number of the delegates on their way to and from the British Association gathering. Among those who visited the institution and established contact with its scientific staff may be mentioned: Prof. E. S. Goodrich, of Oxford, and Mrs. Goodrich, Mr. F. A. Bather, who has recently succeeded Sir Arthur Smith Woodward as keeper of geology, British Museum (Natural History), Prof. J. T. Cunningham, Prof. W. J. Dakin, Prof. Walter M. Tattersall, of Cardiff, Doctor Pritchard, of Melbourne, Australia, Prof. George Hickling, Dr. Clarence Tiveney, Dr. C. C. Hentschel, Dr. Kenzo Iguchi, of the Imperial University, Sapporo, Japan, Lady Henderson, Dr. Cuthbert Christy, Prof. J. W. Gregory, of the University of Glasgow, and Prof. D. M. S. Watson, of University College.

COMPARATIVE ANATOMY

Dr. Heichiro Motohashi, of the Imperial College of Agriculture, Tottori, Japan, has been in attendance at the American Museum, studying the osteology of the wild asses of Asia and using for the purpose skulls and skeletal material obtained by the Third Asiatic Expedition.

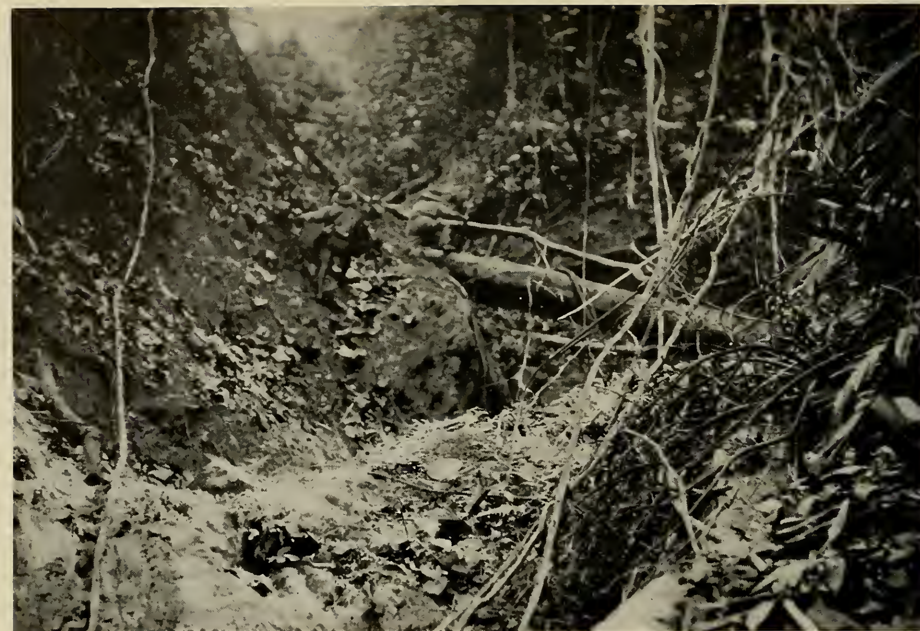
ASIA

Hunting the Sumatran Rhinoceros.—In the July-August issue of Natural History, p. 527, allusion was made to a cable sent by Mr. Arthur S. Vernay in which he announced that he had secured a female and young male of the rare Sumatran rhinoceros (*Dicerorhinus sumatrensis*). In a letter dispatched by Mr. Vernay a full report of this achievement, which he describes as the *grand coup* is given. These rhinos are very carefully protected because of their scarcity and it was only thanks to the generous interest that Sir Harcourt Butler, the governor general of Burma, has taken in the expedition that permission to secure specimens for the American Museum was accorded. The district chosen for the hunt was the Pegu Yomas, a rough, precipitous region of shale and sandstone, in the south-central part of Burma. Arrangements for the successful prosecution of the hunt were made by Mr. Hopwood, the conservator of forests, Tenasserim Circle, sixteen elephants being provided for transport and a detail of six military police mounted on ponies being ordered to accompany Mr. Vernay.

The plan of campaign was to work up each of the main streams that flow into the Pegu River, in the hope of coming upon wallows, and also to explore in similar fashion each of the feeders of these streams. For six days a careful survey of the country was made without revealing the presence of a dark form. On one occasion the party came upon a wallow that had been used twenty-four hours before. They settled down near it to await the possible return of the animal that had used it but although they lingered till the late evening, no rhino appeared to reward their vigil.

On the seventh day the party scoured country covered with creeping bamboo, a favorite food of elephant and rhino. The going was exceedingly difficult and not even a rhino track was discernible as compensation for the arduous search. Time was getting on and it was decided to make for camp. The way thither lay along a stream known as the Bahmalik Chaung. Mr. Vernay writes:

> After a mile or so we found that the water in the stream was suddenly tinged with mud. We followed the discolored water upstream for 475 yards and ascertained that a feeding stream that flowed into the Bahmalik at that point was responsible for the brown tinge. Beyond the feeder the water in the Bahmalik was clear. We discussed the matter and came to the conclusion that the muddy discharge must be due to one of three things: (1) a local rainstorm, (2) a landslide, (3) elephants wallowing—the discoloration seemed too heavy to be caused by rhinos. Although the



Photograph by Arthur S. Vernay

A rough climb along the course of a muddy mountain stream to ascertain whether the brown discoloration of the water was due to a local rainstorm, a landslide, or a wild animal wallowing

Photograph by Arthur S. Vernay

One of the rewards of the effort depicted in the upper photograph.—This little rhino (*Dicerorhinus sumatrensis*) was adopted by Mr. Vernay and the other members of his expedition. The tiny fellow came to feel quite at home in the bamboo enclosure set aside for his use hour was late, an occurrence such as this needed investigation.

We started up the little stream. The ascent was difficult, even formidable, and to us in our impatience to reach the goal the climb seemed interminable. After a time there appeared in front of us a stretch worse than any we had previously traversed. The water was now very thick. It confirmed our conclusion that there must have been a landslide and, as we were feeling very weary, we sent our two natives up to investigate. These men climb like cats and soon were lost to sight.

After ten minutes or so they reappeared gesticulating wildly. We knew that the big moment had come. Slowly we made our way up. We wanted to save our breath for the final effort, when steadiness of aim is all-essential. At length we reached our natives. They informed us they had heard a grunt. We listened, and presently we too heard a sound that meant rhino.

The way beyond was narrow and steep. We thought that over the top of the rocks about twenty yards above us there must be a flat place, for beyond was an old landslide. We wanted to have a look at this flat place without being observed ourselves. As there was room for only one individual at a time, I led the way and Percy-Smith followed close behind. I clambered to the spot and with the utmost care peeped over. Not ten yards away was a rhino in a wallow. I pulled back, fortunately found a place that offered good support for my feet, and then straightened up again. As I came into view this second time the rhino—a female—saw me. She made one plunge, when a lucky shot in the brain killed her.

As Mr. Vernay approached the wallow, a small object emerged from behind the fallen animal. It was a baby male rhino about one month old. It charged viciously but ineffectually. This little rhino was transported to camp in a bamboo basket, quickly and skillfully made by the two natives. It took milk out of a bottle and was a camp pet for several days. It was then sent to Rangoon, to be placed in the Zoo. But it did not survive and, as a consequence, it will be mounted with its mother in an American Museum group.

The Dinosaur Eggs.—The famous dinosaur eggs collected in Mongolia last summer by the Third Asiatic Expedition have recently been prepared for exhibition and are now on view. They belong to nine different groups and show considerable variation in size and surface markings. The largest and by far the most important group consists of thirteen eggs in the rock, two weathered out but still intact, and at least two more represented by broken shells lying on the surface near the nest. President Henry Fairfield Osborn is to give the general scientific description of the eggs and the microscopic study of the shells is to be undertaken by Dr. Victor Van Straelen of the University Libre of Brussels. Doctor Van Straelen has recently published a paper regarding the structure of some fragments of supposed dinosaur eggs from the Cretaceous of southern France and is well equipped for the task assigned to him.

Plaster casts of three of the Mongolian eggs have been made and sets have been sent to the following institutions: Geological Survey of China, Peking; British Museum, London; Natural History Museum, Brussels; U. S. National Museum, museums of Yale, Princeton, the University of California, and the State University of Iowa, Buffalo Society of Natural Sciences, and the Cincinnati Zoological Park Association. Also a single cast has been sent to each of the more important museums of Australia.

HISTORY OF THE EARTH

The Geology of Greenland.—A contribution by Dr. Edmund Otis Hovey, late curator of geology and invertebrate palæontology, American Museum, is printed as the leading article in *The American Journal of Science*, Fifth Series, Vol. VIII, No. 45. It is entitled "Geology of Northwest Greenland and Its Relation to the Flora, Fauna, and People of the Region" and is a timely article on an area which at the present time is attracting attention in connection with the recent return of Captain Donald B. MacMillan from its fastnesses. As the head of the party sent out to relieve the Crocker Land Expedition, Doctor Hovey gained knowledge at first hand of Greenland and its phases of interest, and this knowledge has been supplemented by extensive and painstaking reading. As a result his article gives an informing picture of this Arctic land where the conditions of life are comparable to those along the edge of the continental glacier during the Ice Age. The account closes with this significant statement:

"The recent possession of firearms by the Eskimo has exterminated caribou from the southern portion of the Smith Sound area and restricted the musk ox to the more inaccessible north coast of Greenland and the wilds of Ellesmere Land to the west, while it already threatens the numbers of seal and walrus in the sea and the polar bear on the sea ice. The possession, furthermore, of the steel trap at the same time imperils the existence of the fox and the hare. If these animals be eliminated from the country through these improved agents of destruction which the Eskimo obtains through barter with the white man, the Eskimo too must disappear unless he is supported by his civilized brother. The Danish trader has to some extent replaced caribou and musk ox hide with imported reindeer hide, but the contribution of the seal, the walrus, the hare and the fox to human life will never be made good by anything that the white man is likely to furnish in the way of food and suitable clothing. The balance of nature will be disturbed and the amelioration of existence which has led to the increase of population in the present day Polar Eskimo will result in his ultimate extermination."

Dr. Chester A. Reeds, associate curator of invertebrate palæontology, American Museum, was elected an honorary member of the Sociedad Geografica de Colombia at the session held on June 27. Doctor Reeds' proposer was the president of the society, Don José M. Rosales.

Dr. Kurt Ehrenberg of the University of Vienna, and Mrs. Ehrenberg, have been for some weeks guests of the American Museum, where Doctor Ehrenberg has been studying on the one hand the fossil invertebrates, with a view to determining their adaptations to a sessile life, and, on the other, the osteology of the bears, with special reference to the cave bear. Doctor Ehrenberg is the son-in-law of Dr. Othenio Abel, whom the Museum will have the pleasure of greeting in February, 1925.

EUROPEAN PREHISTORY

Pliocene Man.—The Osborn Library has lately been favored with several new publications by Mr. Reid Moir of Ipswich, England, describing his most recent work in the Red Crag and related deposits of East Anglia. The American Museum two years ago contributed funds to Mr. Moir's investigation at the famous Foxhall station[1] and in due time received a share of the recovered specimens, which are now on exhibit in the hall of man. The finds of 1922, figured and described in one of the present papers, consist of ordinary cores and flakes, also a number of chipped forms in the shape of hand axes, scrapers, and perforators—all apparently bearing the earmarks of human handiwork. A nearly parallel series of flints, obtained from the Bramford Pit (not far from Foxhall), are described in the same paper.

A second paper describes and figures in natural size six especially large flints found on the foreshore at Cromer. These specimens in part resemble the *coup de poing*, or hand axe type, of the Lower Paleolithic industries and are so regarded by the author. It is assumed —and doubtless properly so—that these flints were washed from the exposed Cromer Forest Bed deposits, which Moir regards as of Late Pliocene origin; while others, such as Lyell and Osborn, consider the formations as of early Pleistocene date. A third paper describes an early paleolith (a hand axe) found *in situ* in the Glacial Till bluff at Sidestrand in Norfolk. The specimen, together with its matrix, was derived, it is thought, from an older geological formation, perhaps of the same date as the Cromer Forest Bed series, which, as indicated above, contains flints of the same general character.

Pleistocene Man.—A fourth paper by Moir concerns the discovery, in a single excavation near Ipswich, of no less than five successive "occupation floors," or buried land surfaces on which ancient man camped or which he temporarily occupied. The bottommost of these "floors" contains traces of fire and of flint flakes of an indeterminate industry; the next three levels yield flints of distinctly Mousterian affinities; and the uppermost level is distinguished by specimens having Aurignacian characteristics. Above the top floor are found scattered Solutrean blades and finally, the surface soil gives implements of Neolithic type. One remarkable feature of the investigations at this site is the discovery of crude pottery (fragments) in the upper Mousterian level. The fifth and last paper describes seven flint blades of early Solutrean type, found mostly in Suffolk, at varying depths in the gravels ranging down to eighteen feet. Some of the specimens are fine examples of workmanship and, but for the depths at which they were discovered, would most naturally be regarded as of Neolithic date.

Truly, fifteen years of labor were never more amply rewarded than those of Mr. Reid Moir in his own home district! After decades of heated argument about eoliths and Tertiary man, the facts are now more or less frankly admitted by competent opinion both Continental and American. Perhaps the only embarrassing feature of the situation is the comparative indifference of English scientists.

[1]The reader is referred to the article by Prof. Henry Fairfield Osborn entitled "The Pliocene Man of Foxhall in East Anglia" that appeared in the issue of Natural History for November-December, 1921.

And yet, as if to contradict this statement, there comes to our desk, at the moment of writing, a booklet by J. W. Gregory, professor of geology at the University of Glasgow, entitled *Evolution of the Essex Rivers and of the Lower Thames.* This intensive study of local geological history contains a brief chapter on the geology of East Anglia with special reference to the advent of man. In the course of his remarks on this subject Professor Gregory accepts, at least in general terms, the validity of the conclusions of Mr. Moir and other East Anglian archæologists.

Miocene Man.—One of the first Continental authorities to accept Mr. Moir's work was Prof. Louis Capitan of the École d'Anthropologie in Paris. Characteristically his enthusiasm has not allowed him to rest satisfied with proofs of the Pliocene antiquity of man; he now champions the long-rejected evidence for Miocene man. In a recent letter to Prof. Henry Fairfield Osborn he tells of having made new excavations last October at Puy de Boudiou, Department Cantal, France, where is situated a flint-carrying deposit of recognized Miocene date; of having studied the local geology of this as well as of the contemporary neighborhood site of Puy Courney, of long-standing fame; and finally of having examined and reëxamined all the extant collections from the two sites. "All this," he writes, "results for me and my friends who have viewed the pieces objectively that not less than forty of them present all the characters of worked flints, and well worked, recalling the Mousterian types—grattoirs, racloirs, knives, perforators—of which the flaking and retouching resemble indisputably voluntary and intelligent workmanship. This is my positive opinion; but this gives an earlier date than the known species of man or his precursors and enables one to understand the hesitation of scientists. Nevertheless, the flints are there and their stratigraphy is indisputably contemporary with *Hipparion, Dinotherium,* and the mastodon."—N. C. N.

THE APPROACH TO ROOSEVELT MEMORIAL HALL

Park Commissioner Francis D. Gallatin is planning the approach from the West Side drive to the Roosevelt Memorial Hall. A spacious carriage way, with broad flanking pathways, will lead directly up to the great façade. A double row of trees will line these pathways and the landscape engineer, Mr. J. V. Burgevin, agrees with President Henry Fairfield Osborn that the tree that deserves this place of honor is the *Ginkgo,* or maidenhair tree. It is a striking fact that this ancient tree, which like the cycads and the big trees of California is reminiscent of the flora of the Mesozoic, is one of the trees best able to withstand the hostile environmental conditions of New York City. In this connection we quote from the delightful work of Dukinfield Henry Scott, recently published, entitled *Extinct Plants and Problems of Evolution*:—

> The family of the Maidenhair Tree is . . . . only represented in the living Flora by a single species, *Ginkgo biloba,* a beautiful tree with leaves like magnified leaflets of the Maidenhair Fern. There is some doubt whether this species is actually known in the wild state; to a great extent it has been preserved from extinction by the piety of the Buddhists, who grow it as a sacred tree in the precincts of their temples, in China and Japan. The Maidenhair Tree is the last survivor of a group of Gymnosperms of considerable importance in long-past geological times.
>
> Then we come to the Cycads, a family little known except to botanists or travellers in warm countries. A magnificent collection of these plants will be found at Kew, chiefly in the Palm-house. . . . The Cycads often bear a superficial resemblance to Palms, and sometimes are called by the absurd name of Sago-palms; really they have nothing to do with the true Palms, and their sago is not of much account. For the most part the Cycads bear cones; they are fine handsome plants. . . . The Mesozoic Age, however, is justly called the "Era of Gymnosperms." Besides the Cycads, there were in those days very many Conifers overspreading the world, and a considerable number of Maidenhair Trees or their relations. This last group is of much interest, from the fact, already mentioned, that it is now represented by a solitary surviving species. The zenith of the Maidenhair Trees (Ginkgophyta) was attained in the Jurassic. At that period, various species are found which cannot be distinguished from the recent genus *Ginkgo,* while there were also others, with more divided leaves and some further differences, indicating distinct genera.

EXTINCT ANIMALS

Fossil Horses from the Texas Pliocene.—The American Museum Expedition in northern Texas has secured from the Blanco formation, Upper Pliocene, a fine skeleton representing a stage in the evolution of the horse intermediate between that of *Pliohippus* of the Lower Pliocene and that of *Equus* of the Lower Pleistocene. *Pliohippus* is the earliest of the one-toed horses. In it the splints that represent the side toes of the earlier ancestors of the horse are almost as long as the cannon bone; in *Equus* they are about half as long. *Pliohippus* and representatives of all the earlier stages also retain a small splint or nodule of bone, the last remnant of the fifth digit of the fore foot, which is a complete toe in the Eocene horses; in *Equus* this has wholly vanished. *Pliohippus* is considerably smaller than *Equus*, its teeth are shorter, its feet more slender, and in various particulars it is more primitive,—that is, nearer to the earlier evolutionary stages. The size and proportions of the skeleton obtained from the Blanco formation are those of a rather small *Equus*, the pattern of the teeth is intermediate but nearer to *Pliohippus*, a tiny nodule of bone remains to represent the fifth digit of the fore foot, and it is expected that when the skeleton is prepared and studied, it will be found to be intermediate in many other details. The geological succession of the stages in the evolution of the horse is as follows:

One-toed horses	Lower Pleistocene	Sheridan and Rock Creek	*Equus*
	Upper Pliocene	Blanco formation	(New stage)
	Lower Pliocene	Oak Creek, Upper Snake Creek, etc.	*Pliohippus*
Three-toed horses	Upper Miocene	Pawnee Creek beds, etc.	*Merychippus*
	Lower Miocene	Harrison, Rosebud beds	*Parahippus*
	Upper Oligocene	John Day, Upper White River	*Miohippus*
	Lower Oligocene	White River (middle and lower)	*Mesohippus*
Four-toed horses	Upper Eocene	Uinta formation	*Epihippus*
	Middle Eocene	Bridger formation	*Orohippus*
	Lower Eocene	Wasatch formation	*Eohippus*

The latest stage, *Equus*, lasted along into the middle Pleistocene in North America and then became extinct, but in the meantime *Equus* had found its way into Asia and Africa, where the type still survives in the modern horses, asses, and zebras; and the true horse, domesticated by man, was reintroduced into the New World by the Spaniards and later colonists.

The three-toed horses of the Miocene were small animals about the size of a Shetland pony. While some of them evolved into the large one-toed true horses, others, more conservative, retained their side toes and small size, developed a somewhat different pattern of teeth, and survived in the Pliocene of Texas and Florida, also finding their way into the Old World, where they were first discovered in the Pliocene of Europe and named *Hipparion*, or "little horse." It was at first thought that these Old World examples of *Hipparion* were the ancestors of the modern horses, but it now appears that they were a side branch, and the more direct line of descent is traceable through the American *Pliohippus* and the skeleton, as yet unnamed, from the Blanco formation.

A small species of *Hipparion*, hardly larger than a sheep in size, was common in the Upper Pliocene, and skulls, limbs, and feet of several individuals were found by the Museum party in the Blanco formation. More fragmentary remains were also found in the Pliocene of Florida.

It is perhaps in order to note here that in some of the recent well advertised attacks upon evolution the statement has been made that the above succession of geological formations and of stages in the evolution of the horse is arbitrarily arranged, and that there is no proof that the formations were successive and not contemporary. Such a statement is wholly untrue, and could be made only in entire ignorance or reckless disregard of the facts. It has not, of course, been made by any geologist of standing or by anyone who has any practical knowledge of the field conditions or any experience in collecting fossil mammals. The entire sequence of formations and stages is not found in any one place, but it is correlated from several partial and overlapping sections, as shown more in detail in *The Age of Mammals* and various other publications by Professor Osborn and others. The sequence of the formations is quite beyond doubt, and the evolutionary stages characteristic of each are never found in an earlier formation, although they sometimes survive into later ones without much change. In southwestern Wyoming the Wasatch formation with *Eohippus* definitely underlies the Bridger with *Orohippus*, and in northeastern Utah it underlies the Bridger and Uinta. In south-central Wyoming the Uinta definitely underlies the White River. In western South Dakota and Nebraska the upper White River underlies the Rosebud and Harrison; these underlie the later Miocene; the latter underlies the Lower Pliocene; and the Pleistocene caps the series, Upper Pliocene here being absent (or unfossiliferous so far as known). In each of these cases the identity of the stage is proven by the presence of fossils of the appropriate stage of Equidæ, and of the various other animals the evolution of which has been traced.

The sequence in the case of the horse is merely one item out of a vast mass of evidence which proves the correctness of the geological procession as accepted by competent geologists.

A third important find made by the Museum party in the Blanco formation is a fairly complete skeleton of a fossil camel. Various fragmentary remains of larger and smaller species of horses and camels, mastodons, ground sloths, glyptodonts, peccaries, etc., will aid in the study of this interesting fauna.

The party consisted of Dr. William Diller Matthew, Mr. G. G. Simpson, and Mr. Charles Falkenbach. The friendly interest of many residents in the various localities examined aided considerably in the success of the expedition. The Museum is indebted especially to Messrs. Parke and McAdams of Clarendon, and Judge Daniels of Silverton; and the Messrs. Webb and R. B. Smith of Crosbyton, Texas, for various courtesies.—W. D. M.

Dr. George Hickling, one of the delegates to the meeting of the British Association for the Advancement of Science, stopped at the American Museum on his return journey to work on the fossil shark skulls from Texas represented in the collections of that institution. Dr. D. M. S. Watson, another delegate, spent several days in the department of vertebrate palæontology in conferences with Doctors W. D. Matthew and W. K. Gregory and with Mr. Walter Granger.

A NEW GIFT TO THE MUSEUM LIBRARY

The Library of the American Museum is again indebted to Mr. Ogden Mills for a gift of books that will be of great service to research workers visiting the institution as well as to the Museum staff. The volumes were originally part of the library of the English ornithologist, Major W. H. Mullens.

NEW MEMBERS

Since the last issue of Natural History the following persons have been elected members of the American Museum, making the total membership 7764.

Life Members: Mrs. William Belknap; Messrs. Harry Burrell, John H. Hall, Jr., Ellis Stanley Joseph, Arthur N. Milliken, and William Rennult.

Honorary Life Member: Doctor H. Schouteden.

Annual Members: Miss M. Parsons; George Clinton Andrews, M.D.; Messrs. John Burden, Alfred J. Crane, Joseph N. Early, Frank Phillips, E. C. Smith, Noel Statham, and Charles B. Williams.

Associate Members: Mesdames Preston Boyden, Richard H. Day, Emilie L. Heine, A. Howard Hinkle, Paul Jernigan, Walter Hines Page, Fry Strohl; the Misses Nellie P. Carter, G. H. Emery, Minna Frotscher Koch; Bishop Boyd Vincent; Doctors Stanley C. Ball, Samuel C. Harvey, Matthew F. Kreisle, Alfred Resch, Harris H. Vail; Henry T. Smith, D.D.S.; Prof. Alfred Rosenblatt; Messrs. J. Earle Bacon, Francis N. Balch, Thomas Alexander Barns, J. C. Basak, Edward M. Brewer, Peter Bulthouse, Clifford Coles, S. B. Gibbs, Floyd C. Hach, Rush N. Harry, Edward Murdoch James, David M. Johnson, Harper Kelley, R. T. Kellogg, Geo. K. Lehner, Thornton Lewis, James W. Lowry, William M. Matthews, Benj. L. Miller, C. O. G. Miller, Robert Watt Miller, P. M. Norton, H. Eugene Parrott, Robert Livingston Resor, Remingio Rigal, Geo. T. Ruddock, W. Kesley Schoepf, Lee W. Sexton, Wm. Short, E. B. Stanley, Jose Steinbach, George F. Sternberg, Will Sutton, W. O. Wayman, Frederick S. Webster, Robert Welles, and H. A. Worcester.

The European Number

In the successive issues of NATURAL HISTORY for 1924 the reader has been given the opportunity to make a scientific tour of the world, necessarily not exhaustive but serving to call attention nevertheless to some of the wonders of nature in Australia, Asia, South America, in the oceans and on their islands, as well as to the part that the American Museum and other institutions have had in making known the interest of our globe.

With the November-December issue a return is made to **Europe,** the birthplace of our civilization, the land of our forebears. It is the anthropological and archæological interest of that continent that will have especial emphasis in this number. Mr. J. Reid Moir, who has devoted years of conscientious study to the problem of the eoliths, will discuss the evidences of Tertiary man in England, while some supplementary remarks on the subject will be appended by Sir Ray Lankester, formerly director of the British Museum (Natural History). These essays are to be followed by a paper contributed by Dr. Louis R. Sullivan, associate curator of physical anthropology in the American Museum, devoted to the "Relationships of the Upper Palæolithic Races of Europe." The Museum has been accumulating throughout a long series of years a valuable collection of Old World archæological material, and Mr. N. C. Nelson, associate curator of archæology, who has charge of this collection, will call attention to some of its points of interest. Obermaier's recently published volume *Fossil Man in Spain*, will be reviewed by Miss Christine D. Matthew.

The papers above mentioned are actually in hand and their publication is therefore assured, but it is the hope that one or more eminent authorities, in addition to the contributors specified, may find it possible to fulfill promises tentatively made by writing articles dealing with other phases of the archæology of Europe.

The American Museum's recent expedition to Lapland, undertaken by Dr. G. Clyde Fisher and Mr. Carveth Wells, will be commemorated by a beautiful series of illustrations of Arctic flowers preceded by a brief introductory article.

Finally, the natives of the Russian Far East will be represented in a series of decorative pictures prepared under the supervision of V. K. Arsenieff.

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Vol. XXIV NOVEMBER-DECEMBER, 1924 No. 6

NATURAL HISTORY

EUROPE

TERTIARY MAN IN ENGLAND DISCUSSED BY J. REID MOIR AND SIR E. RAY LANKESTER—WHAT IS AN EOLITH? ANSWERED BY GEORGE GRANT MACCURDY—WILD FLOWERS OF THE UPLANDS OF LAPLAND PICTURED BY G. CLYDE FISHER—EUROPEAN PREHISTORY REVIEWED BY N. C. NELSON—THE JARDIN DES PLANTES REPEOPLED BY BASHFORD DEAN—RELATIONSHIPS OF THE UPPER PALÆOLITHIC RACES OF EUROPE TRACED BY LOUIS R. SULLIVAN—FOSSIL MAN FROM A NEW VIEWPOINT DISCUSSED BY CHRISTINE D. MATTHEW—NATIVES OF THE RUSSIAN FAR EAST PICTURED FROM STUDIES MADE BY V. K. ARSENIEFF

EDMUND OTIS HOVEY, 1862-1924, BY JAMES F. KEMP—THE MUSEUM OF TOMORROW BY GEORGE SARTON

To the many friends in Europe who have enriched the collections of the American Museum, stimulated its studies through their scientific contributions, and extended hospitality to members of its staff during their travels abroad, the appreciation of the Museum is hereby tendered

JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY
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NATURAL HISTORY

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NOVEMBER–DECEMBER, 1924

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The North American Number

In the issue of NATURAL HISTORY for January–February, 1925, a return will be made to our homeland. In the successive numbers of 1924 some of the wonders that lie beyond our shores were brought to the attention of the reader, but the marvels of nature that are a part of our **North American** heritage have a more intimate appeal. We return from a journey of twelve months, with our interest quickened, it is to be hoped, for the activities of nature that are going on at our very door.

We say "door," but the word is misleading. We live in a mansion with many doors. At one extreme these open upon the Arctic tundra, at the other upon a region of tropical warmth. And some of our doors even lead to the remote past, when a fauna now extinct was in possession of the land. Through one of these portals Prof. Henry Fairfield Osborn will conduct the reader to the age when the mastodon was a dominant form of life. Through another door, opened by Mr. Alfred M. Bailey of the Colorado Museum of Natural History, the reader will view the snowy owl in its northern home.

In an article contributed by Prof. Frank G. Speck, of the University of Pennsylvania, acquaintance will be made with the dogs of the Labrador Indians. Mr. Ludlow Griscom, of the Museum's department of birds, will tell of a recent visit to the coastal prairies of southern Texas, with their interesting bird life. Mrs. N. C. Nelson will describe how phœnix-like two hundred fragments of Indian pottery took shape as a beautiful bowl. An account of the celebration of the Navajo Night Chant, as depicted in the recently installed groups in the American Museum, will be contributed by Dr. P. E. Goddard, curator of ethnology. Mr. William M. Savin will offer some interesting observations on the social wasps. The story how the yellow warbler escapes the responsibilities of foster parenthood that the cowbird tries to thrust upon it, will be told by Charles Macnamara. Mr. Karl P. Schmidt, of the Field Museum of Natural History, will trace the origin and growth of the curious "hoop snake" story.

The articles above mentioned are a few of those presenting various aspects of **North America,** but others no less attractive in subject matter will also find place.

A LARGE CHOPPER OF EARLY CHELLEAN AGE
It was found upon the foreshore site at Cromer and is here reproduced natural size

NATURAL HISTORY

VOLUME XXIV NOVEMBER–DECEMBER NUMBER 6

Tertiary Man in England

BY J. REID MOIR

THE whole series of strata forming the earth's crust has been divided by geologists into four great periods—the Primary, Secondary, Tertiary, and Quaternary. Each of these divisions is made up of a number of sub-periods, ranging from the most ancient Archæan, the first sub-division of the Primary, to that of the Late Pleistocene, which is the last sub-division of the Quaternary. In geological parlance the present is termed the Recent Period, and, going back in time, we find in successive order, the Pleistocene, Pliocene, Miocene, Oligocene and the Eocene epochs. Below the Eocene is the chalk which marks the passage from the Tertiary to the Secondary Period.

In England no evidence has been found of man's presence in deposits older than those referable to the Pliocene, so that there is no need in this article to deal with any strata of pre-Pliocene date. It is now many years since man's existence in the Pleistocene, or Quaternary, became generally accepted, and a large and ever-increasing number of scientific people now believe that human beings were present on this earth during the latter part of the preceding period, the Tertiary. It is the purpose of this article to give a description of some of the flaked flints of Pliocene age that have been found in England and that have convinced many competent observers that man existed in the Tertiary Period.

The general opinion upon the question of the antiquity of man obtaining among English scientific men prior to the above-mentioned discoveries was that the well-known Palæolithic flint implements of pointed and oval form, found usually in the terrace gravels of existing river valleys, represented the earliest efforts of man to shape flints intentionally. It is, however, somewhat remarkable that this view should have ever received such widespread acceptance. The earliest Palæolithic implements exhibit evidences of considerable skill in flint-flaking, and it was unreasonable to regard such well-made artefacts as representing man's first attempts at implement-making. The results of the researches in the Pliocene deposits of England, and especially those conducted in recent years in East Anglia, have gone far to show the justice of the foregoing criticism, and appear to have provided archæologists with the long-looked-for types leading up from the most simple artefact to the earliest, though elaborately flaked, palæolith, and to demonstrate a slow but continuous improvement in the art of flint-flaking.

THE KENTIAN EOLITHS

In the year 1889 the late Sir Joseph Prestwich—one of England's greatest geologists—made known to the scientific world the nature of the flint implements found by Benjamin Harrison in and upon the highest portions of the plateau of Kent.[1] It was shown that

[1]Prestwich, Sir Joseph. *Quarterly Journal of the Geological Society of London*, Vol. XLV, May, 1889, pp. 270–97, and Vol. XLVII, May, 1891, pp. 126–63.

the place of occurrence of these implements—to which the name 'eolith' (dawn stone) was given—indicated that they were of vast geological antiquity, and it was claimed that the whole of the great valley known as the Weald of Kent, lying between the North and the South Downs, has been formed by denudation since the makers of the eoliths lived. This highly probable supposition is illustrated diagrammatically in Fig. 1, which shows the contour of the country between, and including, the North and the South Downs.[1] It will be seen that the eolithic gravel occurs upon the sloping surface of the chalk, and there seems little doubt that this gravel was laid down by water running off the high chalk dome, indicated by dotted line in Fig. 1, which at one time existed over the Weald of Kent. It is thus apparent that the makers of the eoliths lived upon a chalk surface many hundreds of feet above the present level of the Weald, and that all this vast mass of strata has been removed by denudation since Eolithic times. There is thus very striking evidence in Kent of the vast geological age of the eoliths, and this evidence finds support in Suffolk, where, in the detritus bed at the base of the Red Crag, have been found examples of the Harrisonian type of implements in a rolled and abraded state, pointing to the fact that these specimens had a long history before their arrival in this Pliocene deposit.

The eoliths themselves are of the simplest possible description, being for the most part naturally fractured pieces of tabular flint exhibiting human flaking along one or another of their edges, which were apparently used for scraping and cutting purposes of a rough and primitive nature. Nevertheless, though simple, these specimens are of great importance in that they indicate a profound antiquity for the human race, and as providing the basic forms from which all the later types of flint implements were evolved. I have dealt with this question in detail in one of my published books,[2] but it is necessary here to give a brief outline of my views upon it. To flake flint with precision, it is necessary to provide oneself with a more or less flat striking platform upon which flake-removing blows with a hammerstone may be delivered with success. If blows are directed on to the rounded surface of

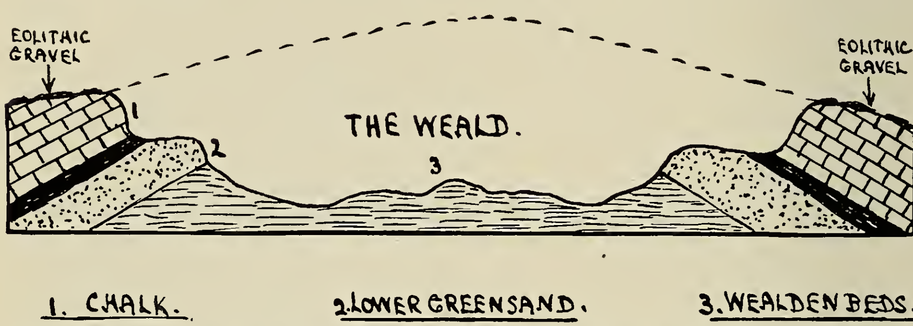


Fig. 1. Diagrammatic section, not drawn to scale, of the North and the South Downs, and and the Weald of Kent.—The makers of the eoliths lived upon the high chalk dome (indicated by a dotted line) which at one time extended over the Weald. Enormous denudation has thus taken place since these early flint-using people existed

[1]This illustration is adapted from a similar section in 'Ightham.' The Homeland Association, London.

[2]J. Reid Moir, *Pre-Palæolithic Man.* Harrison, Ancient House Press, Ipswich, England.

a nodule, it will be found that the hammerstone cannot 'get home,' and the blows glance off ineffectually. The provision of a striking platform in flint-flaking has always been and must forever remain a fundamental requirement, and the makers of the eoliths were fortunate in finding ready to their hand large quantities of natural tabular flint which provided them with two more or less flat surfaces upon which to direct their flake-removing blows.

The simplest form of eolith is illustrated in Fig. 2 and is merely a piece of tabular flint flaked along its left margin to a cutting edge. This specimen, together with a large number of others of the same type, comes from the plateau of Kent, and represents the earliest form of 'side scraper,' called by French writers a *racloir*. Another very well-known type of Eolithic implement is shown in Fig. 3. This is of pointed form, but is in reality a double *racloir* in which the two cutting edges have coalesced at the narrowest portion of the flint and have accidentally formed a pointed implement. These specimens may be regarded as the ancestral forms from which all the later Palæolithic "points" of different ages have been developed.

The Eolithic point, however, gave rise to another type of implement, named by Sir Ray Lankester 'rostro-carinate,' which in its turn developed into the Early Palæolithic hand axes that are so familiar to prehistorians. In the production of the two cutting edges of the implement illustrated in Fig. 3, the resulting flake scars inevitably met and formed a gable, or ridge, (marked KEEL in Fig. 3) and gave rise to the triangular section of the specimen through the line A B. The apex of the triangle represents the gable, or ridge, mentioned, and it appears that the stability of this keel and its usefulness as a cutting edge were soon recognized by early man, for in the rostro-carinate specimen we see

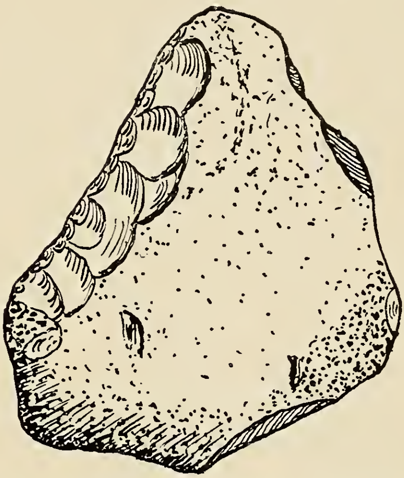


Fig. 2. The most primitive type of implement known to science—an Eolithic side scraper from the Kent plateau. (Natural size)

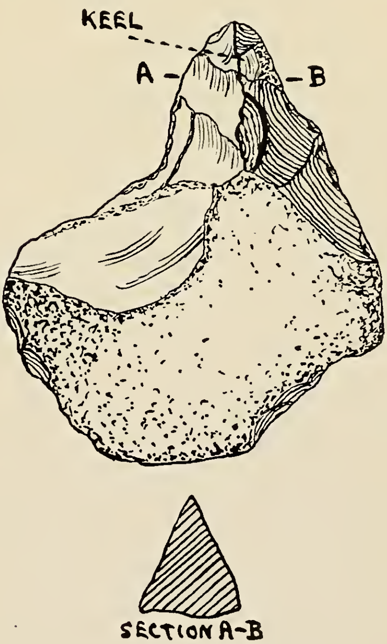


Fig. 3. An Eolithic point from the Kent plateau.—Note the keel of this implement, and its triangular section through the line A–B. (Natural size)

this feature extended and becoming in fact the functional portion of the implement. In addition to the side scraper and the point of Eolithic times definite borers, the pointed end of which was formed by blows delivered upon both the upper and the lower surfaces of the pieces of tabular flint, make their appearance. Thus in the Harrisonian eoliths we see the earliest and most primitive flint implements known to science. Their great antiquity is evidenced by the position in which they are found, and by the enormous denudation resulting in the formation of the Weald of Kent that has occurred since Eolithic times. When the specimens themselves are examined, they prove to be—as might be expected—of the simplest forms, such as would be made by a creature just emerging from a simian condition, who had sufficient intelligence to flake flints and to use them for cutting and scraping purposes of a primitive nature. Further, though the eoliths are so rough and simple in type, they nevertheless provide us with the basic forms from which all of the later flint implements were evolved, and the Harrisonian specimens became, therefore, of fundamental importance to students of prehistoric man.

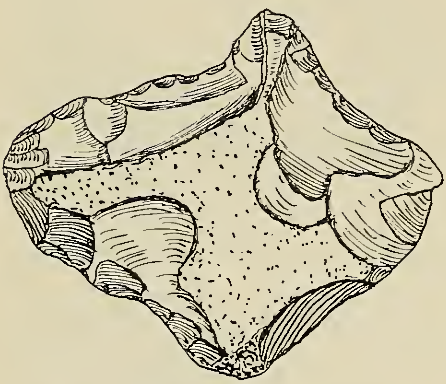


Fig. 4. A rolled Eolithic point from beneath the Red Crag at Bramford, near Ipswich. (About $\frac{7}{8}$ natural size.) Compare with Fig. 3.

There would seem little doubt that the eoliths were flaked by means of blows delivered with a hammerstone—as was the case with nearly all the implements of the Stone Age—and their forms do not suggest that they were used as weapons of offence or defence. It may be that rough unflaked flints or pieces of wood were utilized for these purposes, but, if so, the discovery of such remains has not been recorded hitherto, nor have any mammalian bones yet been found associated with the eoliths.

Though the evidence points to the great antiquity of the Kentian eoliths, yet, as these specimens have not been found there in any geologically datable deposit, it is not possible to say with certainty to what period of the past they must be referred. It is fortunate, therefore, that, as has already been mentioned, implements of the Harrisonian type occur in the detritus bed resting at the base of the Red Crag—a marine deposit of Pliocene age. One of these sub-Crag eoliths is illustrated in Fig. 4 and, if it is compared with that shown in Fig 3, the very close resemblance of the two specimens to each other will be readily recognized. There is thus, as will be seen, very good reason for assigning these first efforts of man to flake flints intentionally to at least an early portion of the Pliocene and it may be that further research will result in the relegation of the eoliths to the end of the still more ancient epoch, the Miocene.

THE SUFFOLK BONE BED

It is now necessary to turn our attention to the remarkable deposit—known as the Suffolk Bone Bed, or detritus bed—that occurs chiefly in shallow depressions in the surface of a very old Tertiary accumulation, the London Clay, at the base of the Suffolk Crags. It will be noticed that the London Clay—an Eocene deposit—is overlaid in East Anglia by the much later Pliocene Crags, and there is reason to believe that the top of this clay was a land surface over an immense period, during which the Oligocene and Miocene beds were being laid down in other parts of the world. Toward the latter part of the Pliocene this London Clay land surface was, it appears, slowly submerged beneath the sea, and the various remains (bones and teeth of both terrestrial and marine animals, conglomerate, phosphatic nodules, foreign rocks, flints, and flint implements) occurring, possibly, in superficial deposits on that surface were quietly washed into the shallow hollows where they are now found.

The sea that first overwhelmed the East Anglia land was evidently of a warm temperature, because the shells found in its deposits are those of Mollusca that can live only under non-boreal conditions. The denuded remnants of the deposits of this sea, which are known in Suffolk as Coralline Crag, a whitish deposit differing greatly in appearance from the later Red Crag, are separated from the London Clay by a detritus bed, which, however, has not yet been examined extensively for flint implements.[1]

As the sinking of the land continued, the land bridge, which cut off the area of the Coralline Sea from the cold waters of the Arctic Ocean, was broken through or submerged, and the deposition of the Red Crag began. During this period the Coralline Crag was greatly denuded, and over large areas actually replaced by the deposits of the Red Crag Sea. Occasionally, however, the former escaped complete destruction, and at Sutton, near Woodbridge, Suffolk, a section was opened by Sir Ray Lankester and myself in 1911

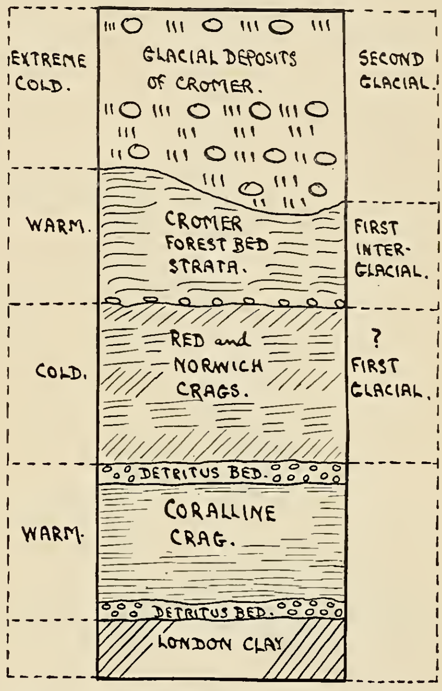


Fig. 5. Diagrammatic section, not drawn to scale, showing the succession of the Pliocene deposits of East Anglia.—The drawing also indicates the climate obtaining during the laying down of the various deposits, and their relationships to the glacial deposits of Cromer

which exposed the following beds in vertical succession: (a) London Clay, (b) detritus bed, (c) Coralline Crag, (d) detritus bed, (e) Red Crag, and (f) present land surface (see Fig. 5). It is thus clear that the Coralline Crag is definitely older than the Red, and, further, that the two detritus beds are more ancient than the respective crag deposits beneath which they occur, and must not be confused with them. During the deposition of the Red Crag the

[1]Moir, J. Reid. *Proc. Prehistoric Society of East Anglia*, Vol. II, Pt. 1, pp. 12–31.

East Anglian area was evidently sinking toward the north, and rising to the south, so that the oldest beds of the Crag occur in the southern part of Suffolk and the north of Essex, while the latest are found resting upon the chalk, the London Clay and Lower Tertiary being absent in Norfolk. It is necessary here to repeat that the Red Crag is essentially a cold-water deposit. It is true that warm-water shells are found in the oldest layers of this Crag, but considering the essentially boreal character of the bulk of the shells contained therein, it seems reasonable to suppose that the non-boreal forms were derived from the breaking up of the Coralline Crag or survived only for a short time in the Red Crag sea.[1]

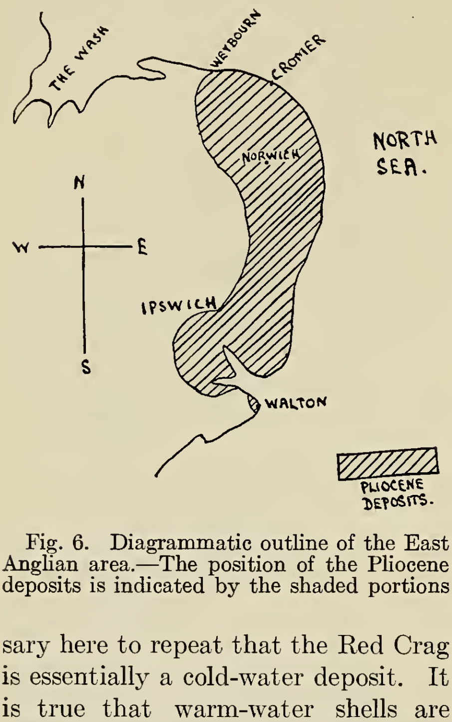


Fig. 6. Diagrammatic outline of the East Anglian area.—The position of the Pliocene deposits is indicated by the shaded portions

The approximate area now occupied by the Pliocene deposits (the Coralline and Red Crags, and the Cromer Forest Bed) of East Anglia is shown diagrammatically in Fig. 6, but it is probable that at one time the Crag accumulations extended much farther to the west. Beneath the Red Crag beds of Norfolk, the shells of which are almost exclusively boreal, there occurs a detrital deposit, known as the Norfolk Stone Bed, which contains a number of mammalian remains, together with certain humanly flaked flints, first found by Mr. W. G. Clarke of Norwich in 1905.[2] These implements, which may be said to be of the same order as those found by me in 1909 in the Suffolk Bone Bed beneath the Red Crag, are nevertheless possibly somewhat later in date.

THE SUB-CRAG IMPLEMENTS

The sub-Red Crag detritus bed, which is sometimes as much as three feet in thickness, is, as its name implies, composed of materials of different periods occurring prior to the time when the deposit was laid down. Sir Ray Lankester has shown[3] that these varying materials have been derived from the following sources:—(a) the chalk, (b) the London Clay, (c) a Miocene land surface, (d) a marine Pliocene deposit (the Diestian Sand), (e) the earlier sweepings of a land surface which submerged after the Diestian deposit, and (f) later sweepings of the same land surface. It will thus be seen that the flint implements, now to be described, that were found in the detritus bed, may be referable to any of the periods represented by c, e, or f of the above list. We have no reason to think that at the epochs when the chalk and the London Clay were being laid down, man was present upon this

[1]I should like to state in this connection that the views above expressed regarding the boreal character of the Red Crag and its marked divergence from the older Coralline deposit are those of Sir Ray Lankester (*Philosophical Transactions of the Royal Society of London*, Series B, Vol. I, 1912), whose researches in this subject are so well known and with whose opinions I am in complete agreement.

[2]Clarke, W. G. *Proc. Prehistoric Society of East Anglia*, Vol. I, Pt. 2, pp. 160–68.

[3]Lankester, Sir Ray. *Philosophical Transactions of the Royal Society of London*, Series B, Vol. CII, May, 1912, pp. 283–336.

planet nor can he well be associated with the marine accumulation (d). These deposits need not, therefore, enter into our speculations. It is, of course, not possible in the present state of our knowledge to assign the sub-Crag implements to any particular one of the periods, c, e, or f; all we can say is that they must belong to one or more of them, and that the specimens are sealed down beneath a deposit hitherto regarded as of Pliocene age.[1] It seems reasonable, however, to suppose that the implements of Harrisonian Eolithic type found in the detritus bed are referable to either c or e and that the later type of artefacts in the same deposit are referable to f.

The mammalian remains found in the detritus bed are not present in great quantity, but are of interest and importance nevertheless. Among them may be mentioned *Mastodon arvernensis*, *Rhinoceros schleiermacheri*, *Hyænarctos*, *Hipparion*, hyæna, tapir, trilophodont mastodons, and the Pliocene beaver. These animals are not, of course, referable to one and the same period, and we are not at present able to state with which of the faunas represented the sub-Crag implements are to be associated.

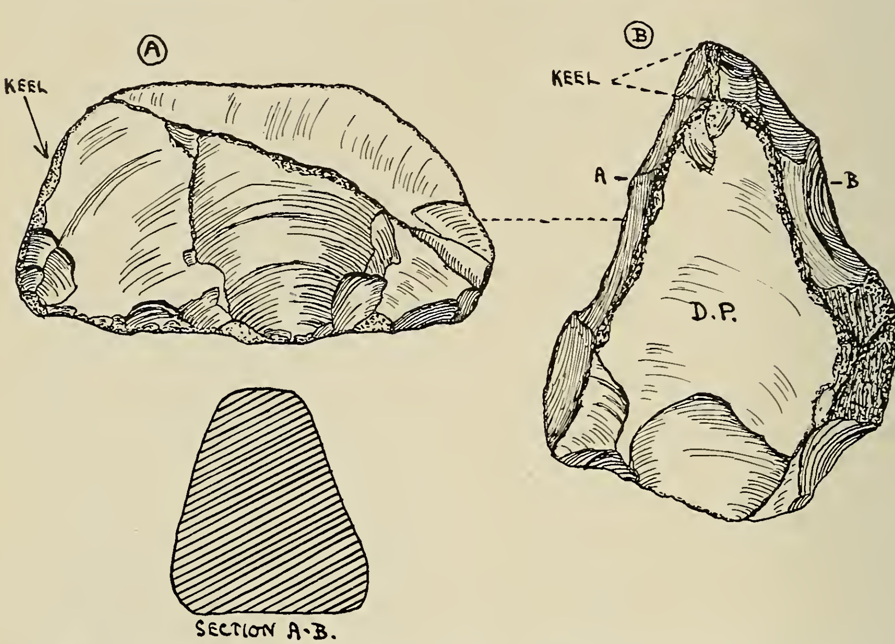
The detritus bed, which is an incoherent deposit, contains very numerous examples of striated flints and many far-traveled erratic rocks, often of large size. These facts point to glacial conditions, a conclusion supported by the evidence of the shelly sands surmounting the detritus bed, which, as has been shown, contains an ever-increasing number of cold-water molluscs, as the zones of the Crag are traced northward from Suffolk into Norfolk. I am inclined, therefore, to regard the detritus bed as a glacial accumulation, redeposited by marine action, and the Red and Norwich Crags and their underlying detritus bed as representing *the first glacial epoch of East Anglia* (See Fig. 5.).

Unlike their Eolithic predecessors, the people who made the implements found beneath the Red Crag had little or no tabular flint with which to work. The great bulk of the flint in the detritus bed is of nodular form, and it is of much interest to note how this material was broken by cleaving blows into pieces of a more or less tabular form from which the implements were made. This method of fracturing the raw material was probably 'handed down' from generation to generation, and resulted from the need to provide suitable striking-platforms upon which flake-removing blows could be delivered with precision.

A typical example of the method described is the rostro-carinate (Figs. 7a and 7b), which is the outstanding implement of the sub-Crag detritus bed and derives the "rostro" part of its name from the fact that its front portion is shaped like the beak of a bird of prey. Its lower surface represents one of the original areas of fracture produced in cleaving the flint nodule, while part of the other area is preserved as an upper or dorsal surface (D.P. in Fig. 7b). The functional portion of this type of implement was the keel, which no doubt was used for cutting and chopping purposes. It is to be noted that the rostro-carinate, though bigger and more elaborate, is of the same type as the Eolithic point of triangular section (Fig. 3) and it is equally clear that, as time went on, this keel gradually was extended farther and farther backward until it reached from one end of the imple-

[1]Some observers would place the shelly sands of the Red Crag in the Pleistocene.

ment to the other and gave rise to the earliest Palæolithic hand axes of triangular section. By a further development, as a result of which the flat under-surface of the rostro-carinate was transformed into a cutting edge, the earliest palæoliths with two cutting edges were invented.[1] The rostro-carinate, it is thus seen, is of fundamental importance in the evolution of the Palæolithic hand ax. Further, it is clear that implements with a more or less flat base, like, for instance, the well-known carinated planing tool of the Aurignacian (Upper Palæolithic stage) are closely related in type to the rostro- carinate of pre-Crag times.



Figs. 7a and 7b. The left lateral, and upper dorsal, views, and section of a rostro-carinate flint implement obtained from beneath the Red Crag at Bramford, near Ipswich. Note the keel of this implement and its triangular section through the line A–B. (About $\frac{5}{7}$ natural size).

In the sub-Crag industry we see a great advance from that of the Eolithic both in an increased proficiency in flint-flaking and in the greater variety of implements that make their appearance in the detritus bed. The specimens were evidently flaked by means of heavy, though well-directed blows, delivered with a weighty hammerstone of flint, and the resulting flake scars are generally large. It is evident that the method of flaking a block of flint, and of afterwards detaching a portion of the flaked surface, producing what is known as a flake implement, was already in vogue in pre-Crag times, and such a specimen is illustrated in Fig. 8. This specimen, though so ancient, is quite comparable with many of the rougher flake implements of the Early Mousterian (Palæolithic Period). A number of scrapers of a type similar to that existing through the greater part of the Stone Age have been found beneath the Crag, and one of these specimens is shown in Fig. 9. In Fig. 10 we see a very definite side

[1]Moir, J. Reid. *Philosophical Transactions of the Royal Society of London*, Series B, Vol. CCIX, 1920, pp. 329–50.

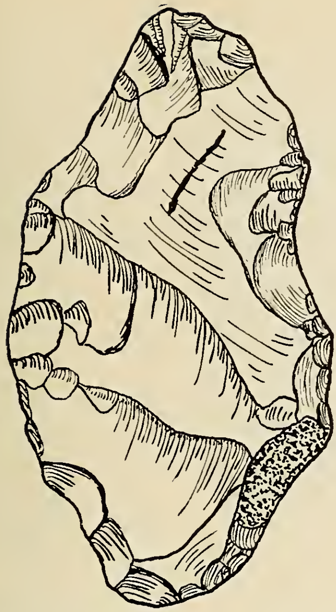


Fig. 8. A flake implement found beneath the Red Crag in the brickfield of Messrs. A. Bolton Co. Ltd., Ipswich. (Natural size)

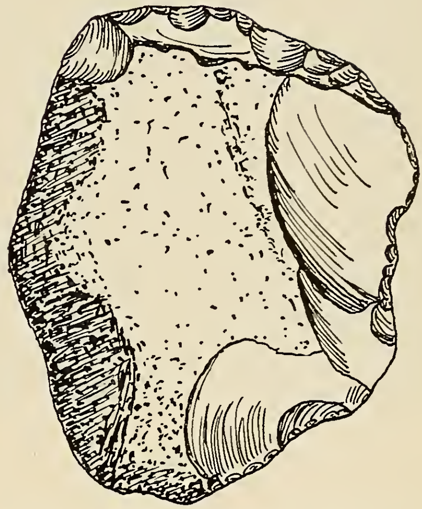


Fig. 9. A scraper with rounded cutting edge from beneath the Red Crag at Bramford, near Ipswich. (Natural size)

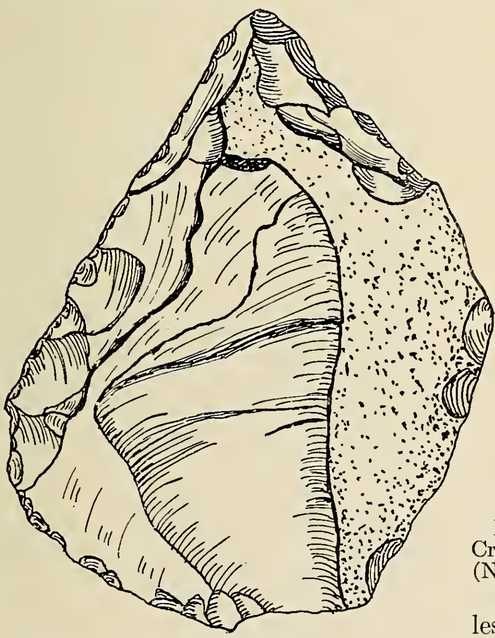


Fig. 10. A side scraper, or *racloir*, from beneath the Red Crag in the brickfield of Messrs. A. Bolton Co., Ltd., Ipswich. (Natural size)

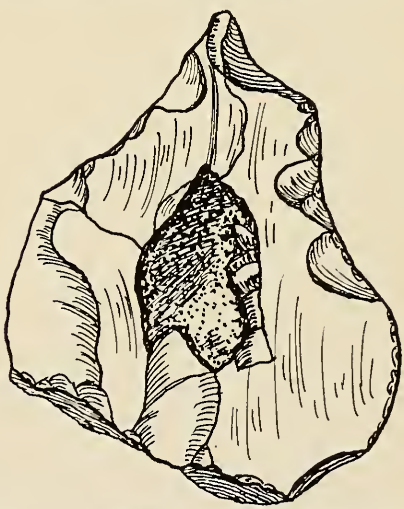


Fig. 11. A borer from beneath the Red Crag at Thorington Hall, near Ipswich. (Natural size)

scraper from the detritus bed, which is clearly developed from Eolithic specimens of similar form (Fig. 2), and is no less clearly related to the side scrapers of later Palæolithic times. A borer from beneath the Crag is illustrated in Fig. 11, and represents a type of implement used throughout the Palæolithic and the Neolithic periods. The specimens (Figs. 9, 10, and 11)

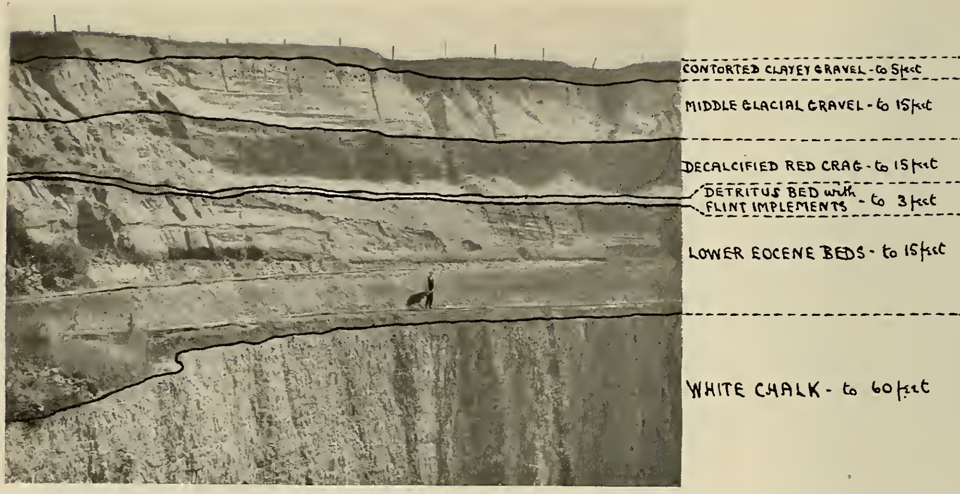


Fig. 12. View of the great pit at Bramford, near Ipswich, showing the plateau beds of East Suffolk, and the position of the implementiferous detritus bed, beneath the Red Crag

are made from flakes which exhibit the plain area of fracture produced when the flake was removed from the parent block of flint. They were no doubt used for scraping and cutting purposes —such as, perhaps, the 'preparation' of the skins of animals. The implements above described (Figs. 8 to 11) have all been found in the detritus bed beneath the Red Crag at various places in Suffolk.

One of the most famous sites is that situated at Bramford, near Ipswich, where a magnificent section of the plateau beds of East Suffolk is to be seen. A photograph giving a general view of this large excavation is shown in Fig. 12, and it will be seen that the Pliocene detritus bed rests there upon Lower Eocene beds (which in their turn lie upon the chalk) and is covered by (a) a considerable thickness of decalcified Red Crag, (b) a stratum of Middle Glacial Gravel of Pleistocene age, and (c) a deposit of contorted clayey gravel representing probably the Upper Bowlder Clay of glacial origin.

The photograph reproduced as Fig. 13 shows another portion of the

Fig. 13. Another view of the Bramford pit.—The lowermost figure is Prof. H. Breuil, the well-known French prehistorian. Immediately above him is Prof. J. E. Marr and at the extreme left is the writer of the present article

Bramford pit. The lowermost figure is the famous French prehistorian, Prof. H. Breuil, who, with the implement in his right hand, is pointing to the sub-Crag detritus bed. Immediately above him in the picture is Prof.

J. E. Marr, F.R.S., whose left hand rests upon the base of the Middle Glacial Gravel, while I am shown standing further to the left. The photograph was taken on the occasion of the last visit of Professor Breuil to Ipswich, when he definitely accepted the view that the sub-Crag implements were made by man.

THE FOXHALL INDUSTRY

In addition to the implements found in the detritus bed at the base of the Crag, I have discovered another series trated again. The Foxhall implements which were associated with a workshop débris, and burnt flints, showing that an actual occupation level is present at this spot, are generally of a yellowish-white color, and are more delicately flaked than the majority of the specimens found at the base of the Crag. It is also clear that the Foxhall pieces are later in date than the mahogany-colored implements from the detritus bed, as in several cases the former have been made out of the latter, a fact revealed by the differing patina-

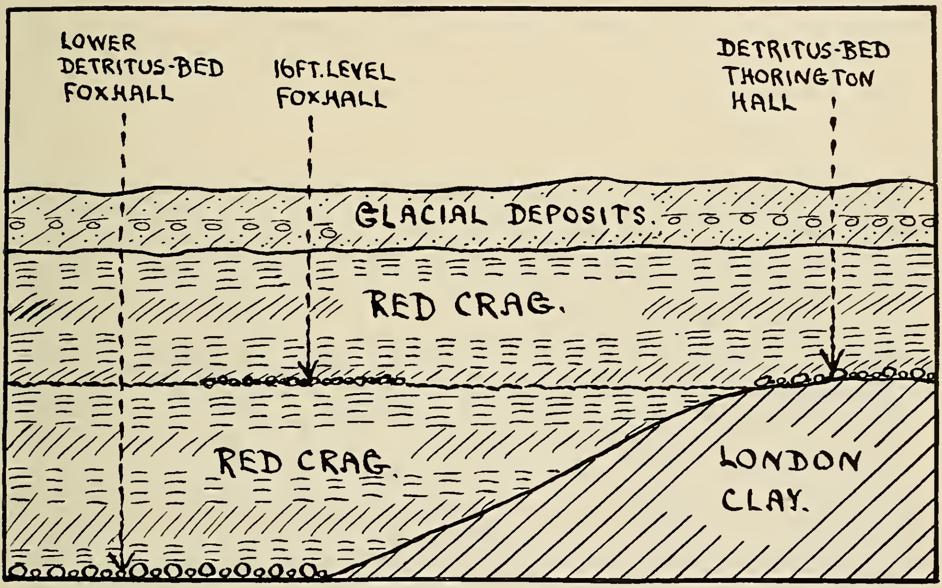


Fig. 14. Theoretical diagram, not drawn to scale, showing the probable relationship of the detritus bed beneath the Red Crag at Thorington Hall and the 16-foot level at Foxhall to the lower detritus bed at the latter place

occurring at a depth of sixteen feet from the surface, *in the Crag itself* at Foxhall, near Ipswich.[1] Some of the best of these specimens, together with photographs and drawings of the Foxhall site, have already appeared in an article in NATURAL HISTORY[2] by Professor Osborn, and need not be illus- tion of the flake scars of the two periods. But the difference between the forms of the Foxhall flints and those from beneath the Crag is not really very marked, and it is not justifiable to regard them as representing a totally distinct culture.

Further, beneath the Crag at Thorington Hall, near Ipswich, the implements and flakes, both in color and flaking, are in every way comparable

[1]Moir, J. Reid. *Proc. Prehistoric Society of East Anglia*, Vol. III, Pt. 3, pp. 389–430.
[2]Osborn, Henry Fairfield. NATURAL HISTORY, Vol. XXI, No. 6, November–December, 1921.

with the Foxhall examples, and in Fig. 14 I have given a theoretical diagram offering an explanation of the occurrence of specimens *beneath* the Crag at Thorington Hall, which are evidently of the same kind as those found at Foxhall in the Crag itself. The detritus bed at Thorington Hall rests upon the London Clay, as does the lower detritus bed at Foxhall. Unfortunately the great prevalence of water at the latter place has prevented me from examining this lower bed, but, from commercial diggings carried out years ago, it is known to rest upon the Eocene clay. If this detritus bed could be examined, the mahogany-colored implements which have already been mentioned would in all probability be found also in it. After the deposition of the lower detritus bed the land continued to sink, and the implementiferous level at Thorington Hall and the 16-foot level at Foxhall represented a land surface occupied by man,—only at the latter place he lived upon Crag, while at the former the surface was composed of London Clay.

THE CROMER FOREST BED

From the above short survey we see that in pre-Crag times a marked advance in human status had been made, and that this is shown by the appearance of several new types of flint implements, many of which in their form and flaking are clearly prophetic of Chellean (Early Palæolithic) times. After

Fig. 15. View of a portion of the flint spread at Cromer, beyond the seaward extension of the beach and exposed at low water

the deposition of the shelly Crags over the old land surfaces occupied by pre-Crag man, and the final sealing in of his relics by these marine deposits, the East Anglian area slowly rose and the Crag deposits were subjected to sub-aërial denudation as a land surface. In the northeast portion of Norfolk this denudation was so extensive as to leave only a few feet of the shelly Crag intact, while in places the whole of the Crag was removed and the underlying Stone Bed, very rich in large masses of flint of fine quality, exposed. At this period the configuration of the land of the Norfolk district was very different from what it is today. In place of the wide North Sea and the high bluffs of the Cromer coast was a broad and shallow valley—a northern-flowing extension of the present river Rhine—inhabited by herds of animals and also, as we now know, by parties of primitive men engaged in making flint implements and in hunting. These people, as they progressed up the valley of the then-existing Rhine, came upon the above-mentioned exposures of Stone Bed flint, and proceeded to flake it into various types of implements. We have seen that the outstanding implemental form of the sub-Crag detritus bed was the rostro-carinate, and also that, even in that ancient deposit, some of the specimens were beginning to assume an Early Palæolithic character. In the culture now to be described the rostro-carinate is no longer the predominant form; a roughly flaked hand ax has taken its place.

The Cromer specimens are found chiefly upon the foreshore, beyond the seaward extension of the sand and shingle beach, exposed at low water. They lie upon the chalk, and have evidently been derived from a formation at the very base of the Cromer Forest Bed series of deposits, which form the lowermost strata of the high bluffs of the Norfolk coast[1]. The shore line in this area is slowly receding owing to the combined effects of underground springs and marine action; and the hard ferruginous deposits at the base of the bluff, which offer resistance to these disintegrating agencies, are finally left upon the foreshore and are exposed when the tide is at its lowest. In some places, as at East Runton, about two miles northwestward of Cromer, large areas of the implementiferous bed can be seen *in situ* upon the chalk, and from this deposit have been recovered several very definite examples of Early Palæolithic hand axes. But in most cases this bed is not intact and is represented merely by a large quantity of flints evidently derived from the breaking-up of the deposit by modern sea action, which removes the ferruginous material holding the flints together. A portion of the great flint 'spread' at Cromer is shown in Fig. 15: the seaward extension of the shingle beach is clearly observable, and vast numbers of flints of all sizes are seen lying beyond it. The artefacts found among these flints are often of massive size, and exhibit either a very marked yellow-ocherous color or a glossy black surface, which gives the specimens an appearance of having been blackleaded.

The position of these implements upon the foreshore at Cromer, and their relationship to the cliff deposits is shown in Fig. 16. The solid rock underlying the whole section is the white chalk, and upon its surface can be seen the denuded remains of the Crag with the Stone Bed at its base. On the top of the Crag is the old land

[1]Moir, J. Reid. *The Great Flint Implements of Cromer, Norfolk.* Harrison, Ancient House Press, Ipswich, England.

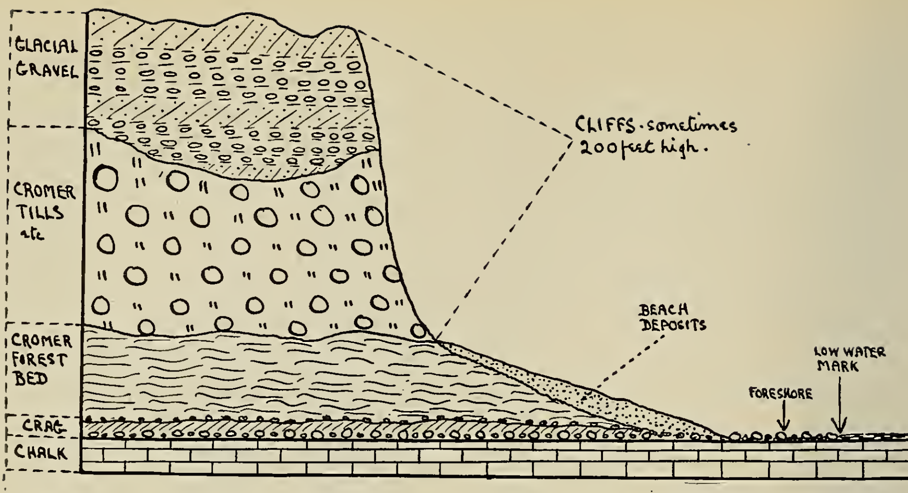
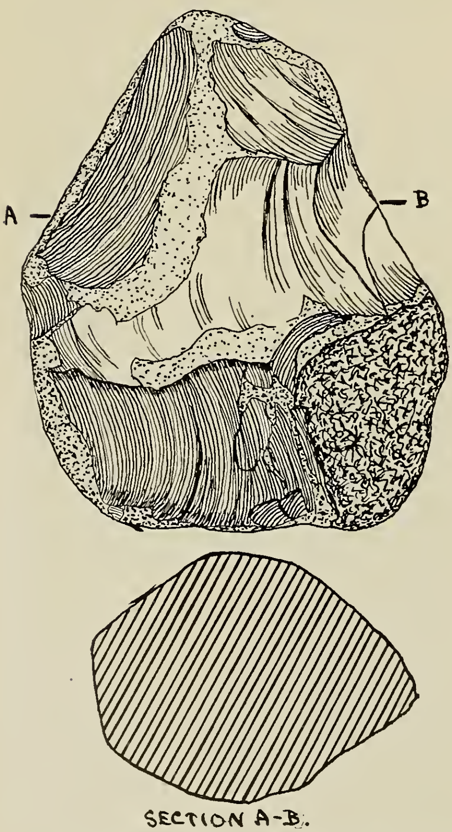


Fig. 16. Diagrammatic section, not drawn to scale, of the cliff, beach, and foreshore at Cromer, showing the relationship of the implement-bearing bed exposed at low water, to the cliff deposits. The Early Chellean land surface is located upon the top of the Crag



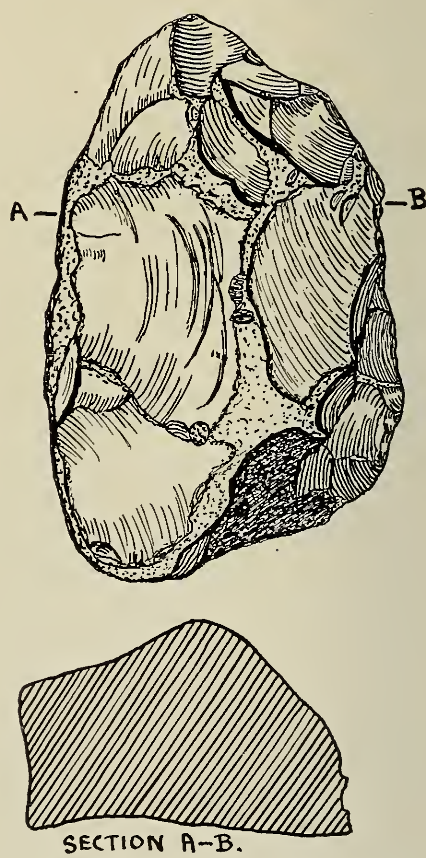


Fig. 17. (left) An Early Chellean hand ax from the foreshore site at Cromer.—The ridges and outstanding portions of the implement have been greatly worn down by modern sea action. (About $\frac{5}{8}$ natural size)

Fig. 18 (right). An Early Chellean hand ax from the foreshore site at Cromer.—The ridges and outstanding portions of this implement also have been greatly worn down by modern sea action. (About $\frac{5}{8}$ natural size) surface to which the foreshore flints are referred, and this in its turn is covered up by the Cromer Forest Bed deposits consisting of three divisions: a Lower Freshwater Bed, an Estuarine Gravel, and an Upper Freshwater Bed. These were each laid down by the ancient Rhine and the fossil contents of the deposits demonstrate that the climate was warm and temperate, thus offering a marked contrast to that obtaining when the underlying Crag, which is full of cold-water shells, was being accumulated.

Above the Forest Bed deposits occur the Glacial Tills and Bowlder Clays of Cromer, which represent the second glacial episode of East Anglia. These Bowlder Clays are often hollowed out by running water from the melting ice and the depressions filled with gravel, sand, and brick earth, showing that a more genial climate (that of the Middle Glacial Period) had set in. Such a hollow is shown in Fig. 16, and the general succession of the Pliocene beds of East Anglia, together with the position in the series of the two earliest glacial periods, is illustrated in Fig. 5. It is of interest to note that the Cromer area gives us evidence of *excessive deposition* of strata since the early Palæolithic people lived (see Fig. 5), while in Kent the evidence is equally clear that, since the much more ancient Eolithic races existed, *excessive denudation* has made itself manifest (Fig. 1).

CROMER (FOREST BED) FAUNA

The fauna represented in the Cromer Forest Bed is extensive and important. A large number of mammalian bones have been found upon the foreshore at Cromer and have been described by Owen, Falconer, and others.[1] Unfortunately, however, we do not know in many cases to which of the three divisions of the Forest Bed (so called from the quantity of remains of trees found in it) these fossils are to be referred. The following list of mammals, while not complete, will give a general idea of the land fauna.

LAND FAUNA

Southern elephant	*Elephas meridionalis*, (not common).
Straight-tusked elephant	*Elephas antiquus*, (abundant).
Mammoth	*Elephas primigenius*, (very rare).
Etruscan rhinoceros	*Rhinoceros etruscus.*
Hippopotamus	*Hippopotamus amphibius.*
Fossil horse	*Equus fossilis*
European bison	*Bison bonasus*
Red deer	*Cervus elaphus*
European beaver	*Castor veterior*
Cave bear	*Ursus savini*
Sabre-toothed tiger	*Machairodus* sp.
Monkey	*Macacus* sp.

It is possible, and in fact probable, that the southern elephant is a derived fossil older than the Cromer Forest Bed and, if this is the case, we have here an *Elephas antiquus* fauna of Early Palæolithic (Chellean) times. The Forest Bed is the only place known to me in East Anglia where such a fauna occurs, or where we have definite indications of the warm climate which we know obtained in early Palæolithic times.

CROMER (FOREST BED) IMPLEMENTS

When we examine the implements coming from the Forest Bed, we see that their forms support the evidence of the fauna; they are, in fact, of Early Chellean type,—such as occur in quantity as derivatives in certain ancient Palæolithic gravels in East Anglia. We need, however, to have the term Chellean, as applied to flint implements, such as hand axes, rigorously defined. For some the word signifies a very well-made implement

[1]Osborn, Henry Fairfield. *The Geological Magazine*, Vol. LIX, No. 10. October, 1922, pp. 433–41.

approaching the Acheulean in excellence, while for others it is more easily applied to altogether rougher and less elaborately made specimens. I am one of those who favor the latter interpretation and I propose therefore—and in this I am supported by many competent archæologists—to regard the Cromer artefacts as Early Chellean.

Figures 17 and 18 illustrate two examples of the hand axes recently found.[1] The former has flaking on both surfaces, and is of more or less rhomboidal section, while the latter is approximately flat on the under surface and has evidently been struck from a larger mass of flint previously prepared by flaking.

There is no doubt that the Cromer industry shows an advance from the sub-Crag culture, but it is nevertheless closely related to it. The ancient Cromerians, using probably large hammerstones of flint, were able to detach in some cases enormous flakes of flint, and the whole industry is on a large and massive scale. On the foreshore at Cromer the contents of a workshop site were found, comprising hand axes, choppers (see frontispiece of this article), side scrapers (Fig. 19), points, and numerous flakes. From the large size of many of the implements recovered it is reasonable to conclude that their makers were people of great strength. Their skill in flint-flaking is evidenced by the immense flake scars produced by the primary quartering blows, the well-formed striking platforms, and the regular and accurate secondary flaking.

[1]These figures are reproduced by kind permission of the editor of *Nature*, in which journal they originally appeared (August 16, 1924).

Fig. 19. An early Chellean side-scraper, or *racloir*, from the foreshore site at Cromer. (About $\frac{3}{4}$ natural size)

The only skeletal remains of man referable to the Cromer Forest Bed (First Interglacial) period is the famous Heidelberg jawbone,[2] and it is possible that this very primitive individual may represent one of the race of Ancient Cromerian flint flakers.

In Fig. 20 is reproduced a photograph of the cliff, about seventy feet high, and the foreshore at West Runton.[3] The arrow in white points to the level at which Mr. Savin found a well-made Palæolithic implement at the base of the glacial gravel. This gravel rests upon glacial clay and underneath this deposit the Upper Freshwater Bed is exposed at the foot of the cliff. The arrow in black indicates the position of the implementiferous horizon on the foreshore. Though earlier observers have not been so fortunate, perhaps, as to make such an extensive find of humanly flaked flints in the Cromer Forest Bed as has fallen to my lot since 1920, it is in order, nevertheless,

[2]Schœtensack, O. *Der Unterkiefer des Homo Heidelbergensis aus den Sanden von Mauer, bei Heidelberg.* Leipzig, 1908.

[3]Reproduced by kind permission of the editor of *M n*, from Vol. XXII, March, 1922.

Fig. 20. View of the cliff and foreshore at West Runton, near Cromer.—The white arrow indicates the level at which Mr. Savin found a well-made Palæolithic implement at the base of the glacial gravel, while the black arrow shows the position of the foreshore implements. The bluff is about seventy feet high

to record the fact that it is now many years since the first intimation of the discovery of such flints in this deposit was published. The first find of flaked flints, claimed as of human origin, in the Cromer Forest Bed, was made by Mr. W. J. Lewis Abbott, who issued his original paper in *Natural Science*[1] in 1897. Mr. Abbott has also published more recently a further account of his discovery and a description of four of the specimens.[2] In 1911 Dr. W. L. H. Duckworth[3] published an account of the Cromer Forest Bed and described a flaked flint found by him in "the Forest-Bed on the foreshore at Overstrand," of which specimen he states that "one margin bears marks precisely comparable to the finer working on an undoubted chert flake, or scraper (of the type of Le Moustier) obtained by me in a cave at Gibraltar." Finally, I described in *Man*[4] a piece of humanly shaped wood, found by the late Mr. S. A. Notcutt, who in 1916 dug it out of the Cromer Forest Bed, where this deposit was exposed at the base of the cliff southeast of Mundesley.

[1]Abbott, W. J. L. *Natural Science*, Vol. X, 1897, pp. 89–96.

[3]Abbott, W. J. L. *Proc. Prehistoric Society of East Anglia*, Vol. III, Pt. 1, pp. 110–13.

[3]Duckworth, W. ' . H. *Cam. Antq. Soc. Communications*, Vol. XV, 1911.

[4]Moir, J. Reid. *Man*, Vol. XVII, November, 1917, pp. 172–73.

This brief account of the evidence that man existed during the Pliocene in England will, I hope, enable American readers to gain an understanding of this highly important division of prehistoric archæology. It may, I think, be claimed that the presence of flint-flaking man upon this planet in the profoundly ancient Tertiary Period, is now definitely established, and it remains for further researches in East Anglia to bring to light some human bones that will enable us to see the type of man who inhabited England in the far-off days of the Pliocene.

Note on J. Reid Moir's "Tertiary Man in England"

BY SIR E. RAY LANKESTER, K.C.B., F.R.S.

The only matters in which I do not altogether agree with Mr. J. Reid Moir's statement in the preceding article, have to do with nomenclature and terminology. Serious misunderstanding is apt to arise from the want of an agreed nomenclature, accepted by those who write upon a given subject, and this is obviously the case where new discoveries and views are accumulating as the result of study in separate areas and under the influence of separate and independent investigators. An authoritative list of terms, with clear definition of their significance, is urgently needed in regard to the study of the antiquity of man. Such a list can only be established as the result of an international conference and agreement similar to that which has legislated in reference to the generic and specific names of plants and animals. I do not put forward any claim to impose the nomenclature which I think preferable or justified, but I will point out two instances in which I do not agree with Mr. J. Reid Moir.

(1) I regard the use of the term "Quaternary" to indicate a group of strata later than the Pliocene section of the Tertiary "Period" as objectionable. The later and even recent deposits are all adequately classified as "Tertiary." There is no *natural* separation of the later deposits from the Pliocene and underlying Tertiary strata, which is in any way equivalent to the separation of the Tertiary from the Secondary series of strata, or of the Secondary series from the Primary. The rejection of the convenient and familiar classification of strata into Primary, Secondary, and Tertiary is not useful. On the contrary, it leads to misconception and confusion, as when the term "Tertiary Man" is used to separate older examples of mankind from those occurring in the deposits known as Pleistocene. Why should we call Pleistocene Man "Quaternary" and not "Tertiary?" It suggests a degree of separation and distinctness which goes far beyond the actual facts.

(2) In regard to the application of the terms "Pliocene" and "Pleistocene," Mr. Reid Moir states that he is in agreement with me as to the *fact* that the marine deposit known as "the Red Crag of Suffolk" was laid down by a refrigerated sea, differing greatly from that which deposited the so-called White, or Coralline, Crag. This latter had a molluscan fauna, in many respects identical with that of the deposits distinguished by the marine "Pliocene." It should be so designated and the Red Crag should be assigned to the Pleistocene. But Mr. Moir refuses

to take this step. I think, on the contrary, that it is high time that the misapprehensions of Lyell and his followers should be discarded and the discoveries of the last fifty years given their true significance, by definitely assigning the "Red" and the "Norwich" Crag to Pleistocene, while the White, or Coralline, Crag is recognized as the sole stratified deposit, representative in East Anglia, of the Pliocene. Lyell and most of his followers erroneously considered the shells derived by the Red Crag sea from the denudation of Coralline Crag deposits, as not derived but as living members of the Red Crag fauna. Similarly they regarded the cetacean bones and teeth and the remarkable teeth of terrestrial mammals (which have been derived by the Red Crag from earlier deposits) as part of the Red Crag fauna, cotemporary with its boreal Mollusca. The importance of the Suffolk "Bone Bed" (as I called it sixty years ago[1]) was not appreciated, and the fact that it consists of the "detritus" or wreckage of a vast mass of earlier strata, together with the wash-up of a land surface persisting from Eocene times, was ignored. The Eocene contribution of clay nodules and well-known Eocene fossils to the "Bone Bed" and so to the shell banks of the Red Crag area, was recognized by Lyell. But the derivation of the cetacean bones and teeth from a destroyed Pliocene deposit, like that existing in an undisturbed condition near Antwerp, was not known until I showed that this was the fact by a careful comparison of the fossils in question. Then, too, it became apparent that the terrestrial mammals, the teeth of which are found in association with the Red Crag, *were not* (as had been supposed) cotemporary with the Mollusca of the Red Crag sea, but were of several successive ages,—Eocene, Miocene, and Pliocene. Stripped of these derivative fossils, which were accumulated in the bone bed (often called coprolite bed) at the base of the Red Crag, that deposit was clearly revealed as of later date than any of them and was entitled to association with the yet later gravels and sands of the Pleistocene. It could no longer be grouped with the Coralline Crag, which has a molluscan fauna, including forms characteristic of Pliocene and warmer seas.

The fact that neither the Coralline Crag nor the Bone Bed of Suffolk extend into Norfolk, accounts for the absence of their contents in the Norwich Crag. In fact, that deposit rests on the chalk, from which it is separated by a densely packed deposit of more or less fractured flint pebbles, called "the Stone-bed" by the Rev. John Gunn. The Norwich Crag is the true and purified Red Crag minus those deceptive contributions which it received in the Suffolk area from Coralline Crag and Bone Bed. The Norwich "Stone Bed" is approximately the equivalent of the Suffolk Bone Bed deprived of those constituents. Flint nodules are present in both and among these there are in both many fashioned by human agency.

I will only say further that an agreed and intelligible nomenclature of flint implements is urgently needed. Terms are now applied to them in a haphazard way. One set of terms is based on the shape of the implement, another on the use to which it is supposed that it was applied, a third is merely descriptive of geological age or of locality. It should be possible to draw up a nomenclature of an authoritative and intelligible character.

[1]*Proceedings of Geological Society of London*, Vol. XXVI, 1870, pp. 493–515.

What Is An Eolith?

By GEORGE GRANT MacCURDY
Director of the American School of Prehistoric Research in Europe

THERE was a time, not so very long ago, when even polished stone implements were looked upon as the work of nature. Then came Thomsen in 1836 with his triple division of prehistoric time into the Ages of Stone, Bronze, and Iron. Later it was found necessary to divide the Stone Age into two periods: the Palæolithic and the Neolithic.

Broadly speaking, the Neolithic Period is characterized by implements in which polishing was employed as a final shaping process; the Palæolithic Period is distinguished by the complete absence of polishing as a shaping process. There are also other differences, based especially on typology, associated fauna, and stratigraphy. Palæolithic implements occur in undoubted Pleistocene deposits, while Neolithic cultural remains are of later date. Stratigraphy is, therefore, the basis on which Stone Age chronology rests.

Recognition of the authenticity of palæoliths was scarcely more than achieved when a new struggle broke forth over the question of the nature of certain chipped flints found *in situ* in Tertiary deposits. This struggle has lasted for nearly sixty years and the end is not yet in sight. One of the causes of confusion and differences of opinion has been the lack of precision in the definition of terms, especially of the term "eolith."

The Stone Age of Thomsen was later found to be only the closing period of that age. A second much older and longer period—the Palæolithic—had to be created; chronologically this period is co-extensive with the Pleistocene, or Quaternary Epoch, of the geologic time scale. The possibility, or even probablity, of a Stone Age culture antedating the Pleistocene had not been anticipated. In the event that such a culture should exist, a third period of the Stone Age would have to be created; and if a consistent nomenclature were to be maintained, this period would of necessity be called the Eolithic Period.

Granted that there be an Eolithic Period, the definition of an eolith becomes a comparatively simple matter. An eolith is a flint (or other stone) that has been shaped or utilized by man or his precursor during the geologic period known as the Tertiary. Having defined the term, one can now proceed to the question as to whether eoliths actually exist and, if so, whether any have been found.

Flint played an important rôle in cultural evolution throughout the Stone Age. To primitive man it is the most utilizable of all stones because of its hardness and mode of fracture, which leaves a sharp, comparatively straight edge. Moreover, flint flakes are produced by purely natural means and thus form ready-to-hand tools inviting use. Did a human precursor, capable of taking advantage of such ready-to-hand tools, exist during the Tertiary Period? The men of Heidelberg and Piltdown were obviously not the first users, or even makers, of tools. That the first tool users existed as early as the Tertiary is not impossible, or even improbable. The finding of skeletal remains in association with cultural remains *in situ* in a Tertiary deposit would solve the problem of eoliths. Until such a discovery is made, the question is destined to remain an open one.

Assuming that a tool-using precursor did exist in Tertiary times, he would, more often than not, have made use of a flint flake only once or twice and then have cast it aside or lost it without leaving any unmistakable traces of utilization. Even if he did leave such traces or took the trouble to shape or retouch an implement, experiments and observation prove that nature, untrammeled though blind, is ever ready to take advantage of conditions, even to the chipping of flint. One should not, however, on the other hand lose sight of the fact that there is one signal difference between man and nature, namely, man can produce conditions as well as take advantage of them. Nature may fail a million times before producing one retouched and serviceable edge; whereas it is possible for man to exercise a control over conditions to such an extent as to achieve the result at the very first attempt. Obviously, the only element of control over conditions is that of intention exercised by a tool-using human precursor.

That chipped flints are to be found in certain Tertiary deposits is conceded by both sides to the controversy; that some of these are practically identical with flints admittedly of human workmanship and belonging to later periods is beyond the realm of controversy. What agency is responsible for this class of chipped flints, blind nature or a being with an object in view and capable of controlling conditions to the extent of realizing that object? The chances would seem to be very much in favor of the latter; except possibly in situations where conditions exist fortuitously favoring the play of natural forces. According to the Abbé Breuil, such conditions do exist at the base of the Parisian Eocene (Thanetian) on the estate of Belle-Assise in the suburbs of Clermont (Oise). S. Hazzledine Warren has found similar conditions in the Bullhead Bed at Grays in Essex. The Bullhead Bed is at the base of the Thanet Sand, hence of the same age as the deposit at Belle-Assise. Warren states that if the best selected flakes from the Bullhead Bed were mingled with flakes

Examples of non-human flaking produced in a natural eolith factory by the grinding of one flint against another under pressure. Both of these specimens, as well as numerous others, were dug out of the so-called Bullhead Bed, in Essex, England, by Mr. Samuel Hazzledine Warren, from whose paper, "A Natural 'Eolith' Factory Beneath the Thanet Sand," the figures are reproduced. The upper flint is a scraper comparable in workmanship to a man-made eolith. Of the lower flint, a trimmed-flake point, Mr. Warren remarks: "If considered by itself, upon its own apparent merits, and away from its associates and the circumstances of its discovery, its Mousterian affinities could scarcely be questioned."

from a prehistoric workshop floor, they could never be separated again unless it were by their mineral condition.

On the other hand, Breuil is authority for the statement that conditions favoring the play of natural forces do

This flint, obtained at le Puy Courny, in Cantal, France, is assigned to the Upper Miocene, yet the high degree of excellence shown in its workmanship would entitle it, in the opinion of Dr. Louis Capitan, who made the above sketch, to find place with honor in an Aurignacian series. (Reproduction natural size)

not exist in certain Pliocene deposits of East Anglia, where J. Reid Moir has found worked flints.[1] If these flints cannot be ascribed to nature, and apparently they cannot, they would seem to fit the foregoing definition of an eolith.

Can the same thing be said of the chipped flints from Upper Miocene deposits near Aurillac (Cantal). Sollas and Capitan have both recently answered in the affirmative. Capitan finds not only flint chips that suggest utilization but true types of instruments which would be considered as characteristic of certain Palæolithic horizons. These not only occur but recur: punches, bulbed flakes, carefully retouched to form points and scrapers of the Mousterian type, disks with borders retouched in a regular manner, scratchers of various forms, and, finally, picks. He concludes that there is a complete similitude between many of the chipped flints from Cantal and the classic specimens from the best-known Palæolithic sites.

Similar conclusions were reached by Sollas after a preliminary study of the unrivaled Westlake collection. Sollas is once more going over the whole question in the light of new evidence, gleaned from the same collection placed in his hands for purposes of study after Westlake's death. All prehistorians will await with much interest his final conclusions, which should go far toward answering the question as to whether the chipped flints from le Puy Courny, le Puy de Boudieu, and Belbex are artifacts or only freaks of nature.

It must be borne in mind, however, that a final decision in regard to the Upper Miocene flints of Cantal represents only a part of the sum total of evidence for and against eoliths. The question is one of the most difficult in the whole realm of cultural evolution. In many respects it is as confusing in its complexity as the question of the spread of culture itself. But the difficulty of drawing a hard and fast line of demarcation between the artificial and the natural, cannot be regarded as either proof or disproof of the existence of man-used eoliths. It is a case where both sides to a controversy can be right.

[1]The reader is referred to Mr. J. Reid Moir's article in this issue.

Midnight sun viewed from Mount Nuolja

Alpine Wild Flowers of Arctic Lapland

IMPRESSIONS GATHERED IN THE COURSE OF THE EXPEDITION OF THE AMERICAN MUSEUM TO THAT REGION[1]

By G. CLYDE FISHER
Curator of Visual Instruction, American Museum

THE abundance of flowers in the Arctic regions is usually a surprise to those who dwell far south of the polar circle, for we do not associate these delicate growths with ice and snow. On a recent expedition to Lapland made with Mr. Carveth Wells, I had the opportunity to observe many of these flowers under conditions that rendered them most attractive.

During our entire journey we had with us Dr. Erik Bergström, who knows the plant and animal life of the region thoroughly. His keenness as a naturalist added much to our interest and enjoyment. A special botanical excursion up Mount Nuolja, made in the company of Prof. G. Einar Du Rietz of the University of Upsala is also remembered with pleasure. Mount Nuolja is situated near Abiskojokk in the northern part of Swedish Lapland, and is almost of the same altitude as Slide Mountain, the highest peak in the Catskills. Professor Du Rietz, who is an ecologist and plant geographer, with a special interest in lichens, says it is botanically one of the richest mountains in all Lapland. On our climb we confined our attention mainly to the flowering plants.

Many plants were observed in this part of the Arctic region that I had seen on Mount Washington in our White Mountains, but this is not surprising when we recall that many boreal species grow on the peaks of the White Mountains, and that formerly there must have been quite a free interchange of plants around the pole, for every family of Arctic flowering

[1]The expedition was made possible through the generosity of the Swedish State Railways, the American-Swedish News Exchange, and the Swedish American Line. The photographs are by Doctor Fisher.

A bit of *Trollius* meadow near the timber line on Mount Nuolja. In the background are straggling white birches, and in the middle ground, on the right and on the left, may be seen a few leaves of a large plant of the parsley family, which the Lapps eat as we do celery.

The characteristic and prevailing flower (*Trollius europæus*) is more than two inches in diameter, and both by its color and its shape justifies the Swedish name, which, when translated, is butterball

The yellow mountain violet (*Viola biflora*) is the most abundant violet in Lapland. It is an alpine species, reaching an altitude far above timber line

Orchids are usually thought of as temperate or tropical plants, but there are several species in Arctic Lapland. The flowers of this one (*Gymnadenia conopsea*) are a delicate purple and have a delightful fragrance

The Swedish name of the mountain cranberry (*Vaccinium Vitis-Idæa*) is "lingon," and the fruit takes the place of our cranberry. It grows abundantly in the higher ground of Sweden, including Lapland. Considerable quantities are consumed in Sweden and large supplies are exported to other countries.

The mountain cramberry grows also in rocky places in the higher mountains of New England and in the Adirondacks.

Two species of true cranberries occur in Sweden, at least in small numbers, but apparently they are not utilized commercially

HARSPRÅNGET FALLS

At one of the sharp turns which give to Harspränget Falls their name, stand these two pines (*Pinus silvestris* var. *lapponica*), their roots penetrating the crevices in the rocks. Many species of wild flowers also cluster on the rocks and add color to the scene

VIEW ACROSS LAKE AKKAJAURE

The drooping twigs of the northern white birch (*Betula odorata*) weave a graceful pattern against the horizon. The birch is found at greater altitudes than either the spruce (*Picea excelsa*) or the pine (*Pinus silvestris* var. *lapponica*) and it is from a close European relative of this tree that the cultivated weeping birches were derived. In the background is seen Mount Akka plants is circumpolar in distribution, and there is hardly a genus that is not.

On the mountains of Lapland, as is doubtless true elsewhere, it is interesting to note how the length of time that the snow lies on a given area influences the flora of that area. Some places well below the timber line are treeless or show retarded growth because the deep snow continues there so long each season. Frequently one will see in the summer a group of dwarf birches, for example, in full leaf, while adjoining it may be a group just in bud, that got its late start due to the duration of the snow.

It is also interesting to note which flowers are first to bloom after their coverlet of snow has melted away. Upon Mount Nuolja the earliest are the snow buttercup (*Ranunculus nivalis*) and the purple mountain saxifrage (*Saxifraga oppositifolia*).

A necessary characteristic of boreal and alpine plants is the small size of the vegetative part, although the flowers are not correspondingly reduced. One who goes from the tropic or temperate zones into the Arctic regions, can hardly recover from the surprise at finding these diminutive representatives of plant groups he has known: dwarf willow (*Salix herbacea*) and net-veined willow (*Salix reticulata*) only two or three inches high, and, in bloom or in fruit, Lapland rhododendron (*Rhododendron Lapponicum*) only a very little taller, dwarf birch (*Betula nana*) scarcely a foot high, and alpine azalea (*Azalea procumbens*) lifting its pink flowers hardly more than an inch above the ground. By far the commonest heath plant in Lapland is the crowberry (*Empetrum nigrum*). This plant has almost the same range as the cloudberry (*Rubus chamæmorus*) and both occur at Montauk Point, L. I.

Another surprise is occasioned by finding the Arctic flowers blooming so close to the snow; it is almost as amazing as the discovery of a living plant right on the snow,—the so-called 'red snow,' which is a tiny alga (*Sphærella nivalis*). These minute plants are so abundant in Lapland, at least during July, that large patches of snow have a noticeable red tinge.

Lapporten—a conspicuous pass formerly traversed by the Lapps on their migrations

Wild Flowers of the Uplands of Lapland

PHOTOGRAPHED BY G. CLYDE FISHER

THE NORTHERN DWARF CORNEL

This plant (*Cornus suecica*) is similar to its more southern cousin, the dwarf cornel, or bunchberry (*Cornus canadensis*), but the petal-like bracts of the former seem to have a slightly greenish-yellow tinge, and the cluster of flowers in the center is of deeper tone. One would hardly expect to find the species of Sweden and Lapland in North America; nevertheless, it grows on this continent, where its range, from Labrador to Alaska, is more northern than that of *Cornus canadensis*

THE WILD GERANIUM

The beautiful rose-purple flowers of *Geranium silvaticum* closely resemble those of our wild or spotted cranesbill. The generic, like the popular, name of these plants owes its origin to the fact that they have long slender fruit-bearing "beaks," *Geranium* being derived from a Greek word meaning crane.

In the manner of their seed dispersal both the Lapland species and ours are noteworthy, for they belong to that interesting group having explosive fruits. The seeds are discharged by the sudden separation and upward coiling of the five parts forming the seed capsule. With such violence does this explosive action take place that the seeds are shot out to considerable distances.

Sprengel, the great German botanist, discovered that the nectar of the *Geranium* flowers is protected from the rain by fine and delicate hairs. Thus it is preserved pure for the insects that visit the flowers

WHITE MOUNTAIN-AVENS

This prostrate, tufted plant (*Dryas octopetala*), with white flowers about an inch and a half in diameter, is a typical alpine species of the Arctic regions. The flowers, which nearly always have eight petals, proclaim its position in the rose family.

The styles, about an inch long, are plumose and conspicuous when in fruit, reminding one of those of the graceful virgin's-bower (*Clematis virginiana*) of our roadside fences and those of the pasque flower (*Pulsatilla patens*) of our prairies. In all three cases the feathery style constitutes a flying apparatus, the tail-like plume resembling the parachutes of the seeds of the dandelion or wild lettuce in its behavior in the air. As in man-made parachutes, so in these parachutes of the plant world, the resistance to the air in falling is considerable, so that winds are apt to carry the seeds for some distance

THE MOSS CAMPION

Another name for this plant (*Silene acaulis*) is the cushion pink. Its old-rose-colored flowers grow in dense clusters on the mountains of Lapland up near the snow. The cushion pink is found also on the summits of the White Mountains of New Hampshire and throughout Arctic America.

THE MOSS PLANT

Cassiope hypnoides receives the first part of its name from Cassiopeia, mother of Andromeda, and the second part from the fact that the plant without the flowers closely resembles a moss. The white, bell-shaped flowers indicate that it is a heath. Like the moss campion this plant has established itself in the White Mountains, where it may be seen growing on Mount Washington. It is found also in other favorable localities in northern North America

The reindeer flower (*Ranunculus glacialis*) is a white buttercup which forms the chief food of the reindeer in the higher parts of the mountains reached by these animals. Photographed on the top of Mount Nuolja by the light of the midnight sun

The purple flowers of the Lapland rosebay (*Rhododendron Lapponicum*) are lifted scarcely more than two or three inches above the surface of the ridge of Mount Nuolja. This plant grows also from Greenland to Alaska, and as far south as the Adirondacks and the higher mountains of New England

Cotton grass (*Eriophorum Scheuchzeri*), in reality a sedge instead of a grass, is a conspicuous plant in the bogs of Lapland

The cloud-berries (*Rubus chamæmorus*), which develop from these large, white blossoms, are a rich yellow with a faint blush of red when ripe. They are an important food of the Lapps, who used to eat them with reindeer milk. The plants, which are only a few inches in height, often cover large areas of the heath.

The plant is circumpolar in distribution, and in Nova Scotia is known as the baked-apple berry. One of the most surprising facts about the distribution of this plant is that it grows at Montauk Point, Long Island. It is thought that the seeds were carried there by birds

THE FLOWER NAMED FOR LINNÆUS

Linnæa borealis was a special favorite of the great Swedish botanist whose name it commemorates. In Lapland it grows in countless numbers and here, on his visit in 1732, he saw and enjoyed it. It appealed to him because of its modest, retiring nature, and because of its beautiful little bell-shaped flowers with their delightful fragrance.

The American species, which is called twinflower, differs from the European in having the flowers funnel-form rather than bell-shaped, and the calyx shorter

Engraving on a limestone block, about three feet in length, detached from the overhanging wall of an anciently inhabited rock shelter at Sergeac, Department Dordogne, France. The outline of the horse, rude but firm and vigorous in execution, is representative of the second phase of this type of Palæolithic art. The first phase of the art rendered animal figures with no attempt whatever at perspective; while in the above instance the artist has sought to convey the idea of depth by representing all four legs of his subject. The work belongs to the cultural stage known as the Upper Aurignacian, and dates from about 20,000 B.C. The specimen was presented to the American Museum by President Henry Fairfield Osborn

European Prehistory

WITH SPECIAL REFERENCE TO THE WORK OF THE AMERICAN MUSEUM

By N. C. NELSON
Associate Curator of Archæology, American Museum

THE existence of man in times prior to written history won recognition at last as a scientifically demonstrated fact in the year 1858. This momentous event took place in Europe, where most of the pertinent discoveries had been made, and Europe ever since has been the chief center of prehistoric studies. Other parts of the world—and especially America—have contributed to the elucidation of the European story, but hardly more than that. Whether man and his culture originated in Europe is still an unsolved problem. To date, however, Europe alone furnishes the necessary facts for anything approaching a complete account, and, consequently, whoever wishes to inform himself thoroughly on the subject must in the end go to Europe.

The history of prehistoric studies has much in common with that of any other new branch of natural science. It is a record of intense collective and descriptive activity, with a respectable amount of scholarly interpretation and not a little even of popularization. Briefly, in the sixty-five odd years that have elapsed since this research was begun, the discovered and recorded monumental remains of ancient date, such as dwelling sites, workshops, quarries, mines, forts, temples, and tombs, have come to be numbered by thousands; and the movable relics of all kinds now gathered and housed in public and private museums—including those of America—must be reckoned by hundreds of thousands.

The interest aroused by these discoveries is boundless. Men in all walks of life have taken up archæology, more or less as a hobby it is true; but not a few today devote nearly their entire time to the subject. In the meanwhile the professional archæologist has appeared and already a certain amount of specialization is noticeable: some are interested chiefly in prehistoric art, others in industrial and technological problems, and still others in man strictly as a member of the animal species. A vast body of descriptive literature has developed and within the last fifteen years there have appeared from the presses of different countries, including the United States, no less than twenty compendiums or general—partly interpretative—treatises on prehistory. Nor is this all. Prehistoric man has taken his place not only in schoolbooks and bedtime stories but in fiction and poetry as well. Not many months ago there was published in New York City the translation of a five-volume novel (really five epic narratives) presenting in admirable fashion the origin of man and his rise from animal beginnings down to the discovery of America. The European author, a man of eminence in his profession, has taken the known facts of anthropology and in the light of modern biology and psychology has produced a fairly plausible and certainly a very stirring and suggestive account of the whole racial and cultural process. Surely, prehistoric man has come into his own!

And what, it may be asked, has America contributed to the advancement of European prehistory? The answer is: directly or indirectly a very great deal. In the first place, but for the discovery of America and—as a result of the voyages that followed in its wake—the discovery of the Pacific Islands, Europe would hardly as yet have perceived the reality or even the possibility of the Stone Age. In confirmation of this it is necessary merely to point out that for a period of three thousand years—the entire span of Europe's written records—all the common stone artifacts, such as axes and arrowpoints, were well-nigh universally regarded as of superhuman or celestial origin, suitable only for magical and medicinal purposes. That such objects could have been used by man for practical ends was deemed preposterous. The fact that stone as a substance for implements had not entirely gone out of use even in Europe passed unnoticed. Nor did the information brought by the discoverers and early explorers of America, where the natives everywhere were observed using stone weapons and implements, at once convince the learned world of its error. An entire century passes before we observe in the literature so much as a glimmering of light, and the darkness was not entirely dispelled until the red letter year of 1858, when, with the acceptance of a "prehistoric period" of human existence, the theoretically necessary conditions were automatically provided for the recognition of the Stone Age in the Old World.

In the second place, the American peoples occupy a unique position with reference to European prehistory. First of all, they are, most of them, sons and heirs of Europe, and for that reason, if for no other, have a special interest in her past. Then, Americans have been peculiarly favored by circumstances that have facilitated their ready understanding of things prehistoric. The notion of a Stone Age, for example, did not present itself to us as a debatable subject; it was and is an obvious fact. For while in Europe this primitive phase of human culture passed out some three to four thousand years ago, leaving not even a bare tradition of itself, among the aborigines in America it has survived in some measure down to the present day. In view, therefore, of these two special incentives, supplementing the normal interest in searching out explanations of human origins, Americans could hardly do otherwise than make notable contributions to the development of prehistoric studies.

There remains to be recounted more precisely what has actually been done in America, aside from the general dissemination of verbal information about our early European ancestors. In attempting this the writer can do no better than to recite some of the salient facts regarding European prehistory as pursued and developed by the American Museum.

MUSEUM BEGINNINGS

From its foundation in 1869 the American Museum has sought to keep abreast of both the scientific and the popular interest in all matters relating to the early history of man. "It is to be a temple of Nature," said Prof. Joseph Henry at the laying of the corner stone in 1874, "in which the productions of the inorganic and organic world, *together with the remnants of the past ages of the human family*, are to be collected, classified, and properly exhibited." Before these words were spoken, while the Museum was still housed in the old Arsenal in Central Park, a sizeable exhibit had already been installed of both European and American antiquities and, when the present building opened in 1877, what is now the bird group gallery was occupied almost exclusively by prehistoric archæology. Indeed, during the first twenty years the anthropological activities of the Museum were devoted chiefly to the acquisition and exhibition of archæological material. Not until 1888 did the institution—backed by popular approval, expressed in terms of liberal money contributions—invest in any large ethnological collections; and plans for the present expansion of the department of anthropology did not take shape until 1895.

THE EUROPEAN COLLECTIONS

The first European archæological specimen arrived at the Museum on April 29, 1872, and was the gift of Dr. F. W. Lewis of Philadelphia. It was a fragmentary implement of deer antler, taken from a Lake Dweller site in Switzerland. From that day until some time in 1884, when accessions from Europe suddenly ceased for a period of eleven years, the Museum received by gift and by purchase no less than 8000 specimens, representing all the then known prehistoric stages of culture. In 1895, European objects once more began to dribble in and ever since have been coming faster and faster until at present the American Museum possesses approximately 15,000 specimens. The accessions represented were obtained from more than five hundred different sites, scattered over all the countries of Europe, excepting Portugal, Holland, Finland, and certain of the Balkan states. Actually, however, the bulk of the material comes from the British Isles, Denmark with southern Sweden, Switzerland with southern Germany, Belgium, and France—the regions, in short, which have been most thoroughly investigated to date, and possibly also the regions which especially favored the life of early man. These precious relics illustrate the whole gamut of human invention, from the crudest hypothetical flint implements of Miocene date—say twenty millions of years ago—down to the modern-looking iron tools and weapons from La Tene Lake Dwelling deposits of about 500 B.C.

COLLECTORS AND DONORS

The story of the acquisition of these collections is not without interest, human as well as scientific. In the case of the older accessions very little is known as a rule beyond "locality of origin" and the name of the donor. Many individual pieces, to be sure, carry marks to indicate that they were discovered as far back as 1851, but the attending circumstances, as well as the name of the actual discoverer, are usually lost beyond recovery. It is only within the last twenty years that properly authenticated archæological specimens have begun to come in; and it is these recent acquisitions which alone make it possible for us to arrive at a correct classification of the earlier collections.

The available list of names of collectors and donors is nevertheless both formidable and interesting. The group residing in Europe includes such distinguished and more or less well-known personages as the late Oscar Montelius, of Sweden; Dr. C. Neergaard and M. M. J. Mathiassen (the discoverer of Maglemose culture), of Denmark; Prof. Nicholas Roerich, of Russia; Sir Hercules Read, Mr. Thos. W. U. Robinson, Mr. J. Reid Moir, Dr. Arthur Smith Woodward, Mr. Benjamin Harrison, and Mr. S. Hazzledine Warren, of England; Prof. A. Rutot and M. G. De Konincke, of Belgium; M. Henry de Morgan, M. G. L. Feuardent, the Marquis de Vibray, Prof. Louis Capitan, Prof. Henri Breuil, Dr. G. Lalanne, M. L. Didon, M. D. Peyrony, the Count de Limur, Dr. Henri Martin, M. V. Forbin, Dr. Paul Wernert, M. Estanove Jacques, and M. Zacharie le Rouzic, of France; Dr. Ferdinand Keller, Dr. Paul Vouga, and Hr. Otto Fehrlin, of Switzerland; Hr. Carl Gail of Germany; Dr. Aladár de Kovâch, of Hungary; Prof. Hugo Obermaier, of Spain; Prof. E. H. Giglioli, of Italy; M. Speros Condounes, of Greece; and many others.

A smaller but equally important group of American names are in one way or another intimately connected with the collections, for the most part as donors. These names, in the order in which they appear on the records, include Mr. Robert L. Stuart, Dr. J. C. Dalton, Mr. Andrew E. Douglass, Mrs. Robert L. Stuart, the late President Theodore Roosevelt, Mr. H. E. Winlock, Mr. Charles W. Furlong, Mrs. Y. P. Lee, Prof. C. T. Currelly, Prof. J. H. McGregor, Mrs. Charles Sprague Smith, Prof. George Grant MacCurdy, President Henry Fairfield Osborn, and Mrs. Henry Fairfield Osborn. Valuable gifts have also been received from such institutions as Columbia University, the American Numismatic Society, and the American Ethnological Society.

It seems but fitting to remark in this connection that the most generous of all the donors were intimately related to the institution. Mr. Robert L. Stuart, who served the Museum as its second president, set an example in 1876 by presenting the first collection of European antiquities, a collection that has the additional distinction of being the largest that the Museum has ever received. It consisted of "over three thousand carefully selected specimens" of Palæolithic flint tools and weapons, brought to America by M. Henry de Morgan from Amiens and other classic archæological stations of the Somme Valley in northern France. At the time, this collection was described as "the most complete and valuable series of such objects extant (that of Boucher de Perthes at Abbeville excepted)—" an estimate which, it is safe to say, holds good even today, at least so far as America is concerned. But, as if to make certain that the series should not be excelled, Mrs. Stuart, in 1883, added to it more than two thousand specimens, in part from the same region.

CLASSIFICATION AND EXHIBITION

Having acquired these valuable collections, the next problem confronting the Museum was what to do with them, how to insure their continuous interest for the public. No museum, so far as the writer knows, has adequately solved this question of ultimate treatment, although one or two European institutions have made excellent beginnings. Up to the present time, it is true, the situation has not been especially urgent: the more or less startling and spectacular facts about prehistoric man have been new, and public interest has responded to any miscellaneous display of ancient relics. Doubtless these displays will continue, for some time to come, to attract the majority of museum visitors as fascinating collections of "curios" if nothing more. But, obviously, if the material is to justify its existence, is to make a permanent appeal to the general public, as well as to the special student, some order and simplification must be introduced. The least attractive objects, such as rudimentary stone and bone implements, have an important story to tell, if only we can bring it out. To do this however, requires a number of things not always available even in the largest and most pretentious of institutions,—time and patience coupled with both knowledge and ingenuity.

The first step toward making an exhibit intelligible as well as interesting is to classify the material. Here several possibilities present themselves: we may group our specimens according to the substance of which they are made—as bone, stone, shell, etc.; according to the form of the objects, irrespective of their use; or according to their function or purpose. We may also group simply according to locality of origin or according to relative antiquity. Each of these systems of classification has its special advantages and disadvantages—if at all applicable; but, obviously, the last three are the most fundamental. The average man, on being confronted with an archæological specimen, invariably asks three questions about it: Where did it come from? How old is it? What was it used for? Any adequate museum exhibit must seek to answer all three of these legitimate questions.

For a number of years the American Museum has been experimenting with this exhibition problem. On the assumption that archæology is fundamentally a historical science and that history is incomprehensible except as a great continuous process, the chronological relations of our various prehistoric collections have been deemed of first importance. Fortunately the available archæological data lend themselves admirably to a concrete demonstration of the historical viewpoint as regards the material phenomena of culture. Today no less than twelve easily distinguishable culture stages (not to mention numerous subdivisions) are recognized in western

Europe alone and their time sequence is determined beyond all possibility of dispute by their stratified occurrence in undisturbed deposits, both natural and artificial. The fact of stratification or superposition does not, of course, prove that the implements of any particular level in a given deposit were derived by a process of modification from those immediately below, although detailed study of the artifact contents of contiguous strata has shown that such genetic relationship commonly exists. But whether traceable or not, these successive steps or stages in the evolution of ordinary human inventions seem designed by nature to serve as primary subdivisions in the classification and arrangement of museum exhibits of this character and have accordingly been so used at the American Museum. The hall of prehistoric man, as it happens, lends itself fairly well to this mode of treatment: the portion occupied by the Old World collections is oblong and is furnished with two rows of parallel table cases, each series of cases sufficiently spacious to accommodate a moderate-sized display of all the various culture levels, arranged in their precise order of stratigraphic occurrence.

One of these two rows of cases has been devoted to the strictly scientific presentation of cultural evolution as afforded by the antiquities of several different countries. No single country, however, is represented in our collections by adequate data for all of the twelve culture stages above referred to —in fact, in some instances such representation never can be effected, as certain of the stages do not exist. In order, therefore, to illustrate the general evolutional process for Europe as a whole, as well as to indicate the actual events in particular localities, the countries affording the best material for certain of the culture stages have been grouped to suit the chronological requirements. Thus France comes first, at the near end of the hall, and is represented chiefly by a full inventory of Palæolithic specimens. Denmark and southern Sweden come next with a fine Neolithic series. Finally, at the far end of the hall, Switzerland is introduced as furnishing, besides a good Neolithic exhibit, the best available specimens of the Bronze and Iron ages. Similarly, incomplete but parallel exhibits from other countries, such as Spain, Belgium, and the British Isles, are placed in certain of the adjacent upright wall cases. The subdivision within each of these local unit exhibits is stratigraphic, a table case or a shelf, according to circumstances, being given to each culture level.

Each of the culture level exhibits, moreover, consists of two parts: one, typological; the other, distributional and comparative. The former, placed at one end of the case, furnishes a small but comprehensive display of typical specimens, such as characterize the particular culture horizon dealt with—Chellean, Acheulean, Mousterian, and so on; the latter, occupying most of the available space in the case, is made up of segregated groups of representative specimens of the given horizon as they occur in different parts of the country treated. The one exhibit is designed to show the visitor at a glance all the known essentials of any particular culture stage; the other is designed to emphasize at once the wide geographic distribution of identical forms of implements and such minor local variations as occur.

The second row of table cases in the hall of prehistoric man is devoted to a somewhat schematized comparative exhibit, covering the entire Old World. The aim here is to do for the Old World what was done for France, Switzerland, and other countries in the preceding geographic exhibit,—to show the apparent intercontinental distribution of many identical or nearly identical culture traits, as exemplified by ancient as well as modern primitive tools, weapons, household gear, and other data. A strictly scientific presentation is impossible here at present; but if science has been sacrificed, it is hoped that the achieved simplicity of arrangement may be more intelligible to the general visitor.

The basis of the arrangement of this exhibit is stratigraphic. It opens with eoliths at the entrance end of the hall and closes with iron objects at the far end. Each of the seven double table cases consists of three sections, the middle one of which is devoted to European objects, while the two end sections are reserved for material from Asia and Africa respectively. The central, European, section of the case, it must be further explained, is furnished for each of the twelve culture levels with genuine specimens from one or more localities, according as the available collections permit; the Asiatic and African sections are supplied, as far as practicable, with similar but as yet not positively proved ancient artifacts. Wherever our Asiatic and African prehistoric resources have failed to fill their allotted sections, materials, in part of recent date, from Australia and the Pacific Islands have been introduced, partly for the purpose of filling the vacant spaces and partly to suggest the survival of ancient continental forms of implements in these outlying regions. Incidentally, the introduction of ethnological specimens also serves to show the possible ancient methods of hafting, as well as to suggest various uses for the prehistoric forms. Carried to completion, this plan of arrangement would present a combination time-and-space distribution, and would show at a glance the grand sweep of elementary human culture.

PUBLICATIONS

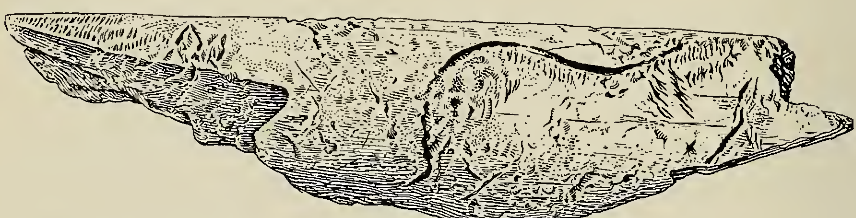
The subject of publications calls for but few remarks inasmuch as our collections remain practically undescribed. A few papers bearing more or less directly on the European material have, however, appeared from time to time in NATURAL HISTORY. The Museum collections also deserve some credit for having helped to inspire President Henry Fairfield Osborn for the great task of writing his well-known book, *Men of the Old Stone Age*, the first general treatise covering this field to be produced in America. This work has stood for a decade as the only considerable American contribution to the subject and not until the past twelvemonth have any American students of prehistory sought to supplement it. Now, however, we have all at once three new American publications covering the same field and rumor has it that other treatises are in preparation.

CONCLUSIONS

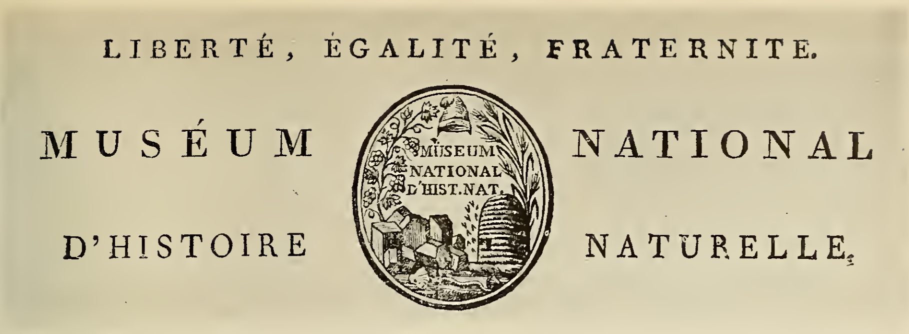
The first and most obvious conclusion to be drawn from all this intense activity concerned with matters prehistoric would seem to be that the world is mightily interested. Doubtless it always has been interested in human origins and will continue to be. Poets are not alone in believing that "the greatest study of mankind is man."

The second conclusion is that the world having rather suddenly had revealed to it a vast body of new and pertinent knowledge, certain far-reaching effects are bound to follow. Already the materialistically inclined, who are prone to gloat over recent achievements and recent progress, have experienced a rude shock. For if the fragmentary relics in our museums tell anything, it is that the foundations of our whole modern existence—economic, social, and religious—were laid deep and secure in the unrecorded past. The primary inventions relating to hunting, fishing, and food production; the protective devices against environmental conditions, represented by clothing, houses, and strongholds; the domestication of plants and animals as basic to agricultural and animal husbandry, making man relatively independent of nature's bounty; and, finally, the discovery and successful treatment of various metallic ores, resulting in tools and weapons both durable and efficient—all of these material equipments were developed and more or less perfected before (some of them long before) man had the leisure or the need for devising a mechanical method of recording his thoughts. In the light of all this, what original contributions to civilization has modern man made, the germ of which was not already present among our prehistoric ancestors? Some, no doubt; and yet certainly not so many as most of us are wont to think.

If this effect of the past is discernible in the essentially material side of modern culture, how much more certain, if less tangible, must the effect have been on the non-material side? The belated recognition of prehistoric man—or in other words the admission that things human were not placed on earth ready-made some six thousand years ago—has unmistakably taken a powerful hold on the modern mind. Every department of thought, if not of action, has been more or less visibly affected by the new knowledge. Some departments have been shaken to their foundations and are being rebuilt on new and broader lines. We do not yet know what the end is to be; but those most familiar with the new knowledge about man of the distant past look eagerly and confidently to the future.



Engravings of two incomplete figures on a fragment of bone found in the rock shelter at Limeuil, Department Dordogne, France, and presented to the American Museum by President Henry Fairfield Osborn. One of the horses has been destroyed except for the suggestion of ears and mane (see upper left-hand corner); the other (occupying the right half of the bone) is represented by the entire body and neck as well as the adjacent part of the lower jaw. The body parts proper are executed in bold outline, and in addition, the mane and body hairs are suggested by delicate incisions or shadings. This style is representative of the fourth phase of prehistoric art, contemporary with Magdalenian culture. The specimen dates from about 15,000 B.C. (From a sketch, twice natural size, by William E. Belanske.)



Early letterhead of the Jardin's Museum of Natural History, on a letter addressed by Lamarck and Geoffroy to Charles Wilson Peale, 1796. From the Osborn collection in the American Museum

The Jardin des Plantes

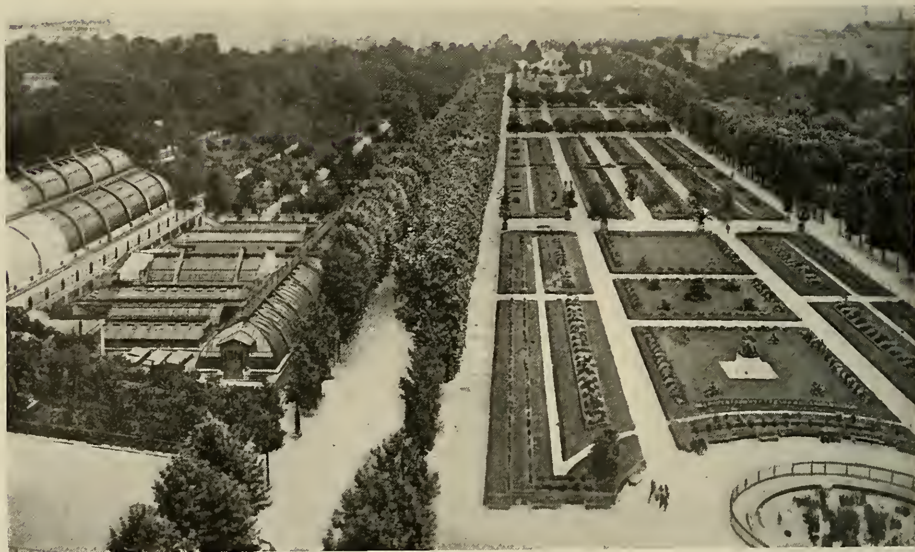
A PARNASSUS OF NATURALISTS

By BASHFORD DEAN
Honorary Curator of Ichthyology, American Museum

NATURAL history, like any other history, has had its great epochs. One of them had its flowering time in the year 1859, when the doctrine of evolution was expounded clearly and convincingly. Another epoch followed the discoveries of Leidy, Marsh, Cope, and Osborn, when a new palæontology was built up. Still another centered about cellular research. Of earlier epochs none were more fruitful than those which grew out of the scientific soil of the Jardin des Plantes in Paris. There it was that whole lines of natural history diverged during the first third of the last century from the brilliant researches of Buffon, Lamarck, Geoffroy Saint-Hilaire, and Cuvier. Indeed, there is scarcely an institution in the New, no less than the Old World, which is not in the debt, directly or indirectly, of this great French *pépinière.* Just as many of our professors found their zoölogical inspiration in Germany during the eighties and nineties, so our earlier generation gained its best results in Paris during the sixties, fifties, forties, and thirties. The bust of Prof. John S. Newberry in the fossil fish gallery of the American Museum recalls such a generation; in fact, no one who knew this eminent scholar could soon forget that his training was French. He showed it in his lists of authorities, in his manner of working, in a courtesy which suggested the Second Empire, even in the little mannerisms which dated from Cuvier himself.

Professor Osborn has asked me if I would prepare a brief article for this journal on the Jardin des Plantes in its relation to the development of natural history, suggesting that I write it, not as a problem in research, but as a matter of personal knowledge and experience.

None the less such an article should require careful bibliographical studies, for personal experience is apt to have little more than personal interest, though one may well come in contact with greater things during numerous visits to Paris in the course of the past thirty-five years. Indeed, no one can visit the Jardin des Plantes frequently without making interesting notes on



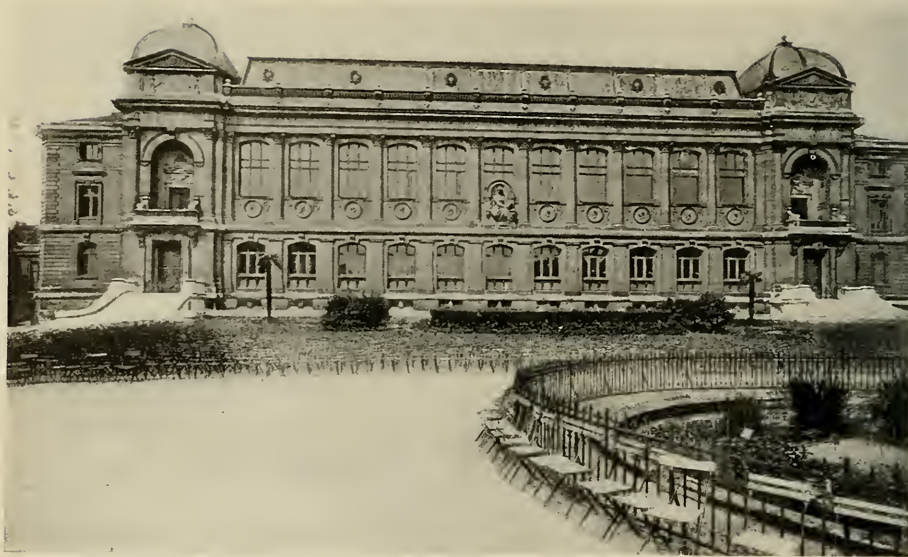
General view of the Jardin des Plantes

The House of Buffon (right), corner of Rue Buffon and Rue Geoffroy Saint-Hilaire

early French zoölogy. And no one can stand at the corner of Rue Buffon and Rue Geoffroy Saint-Hilaire, and see before him the venerable House of the Iron Cross, where Buffon lived from 1739 to the day of his death in 1788, and fail to realize that he is close to a Parnassus of naturalists: indeed, he may safely assume that *almost every noted zoölogist or botanist during the last eight generations has at some time stood at the same point and passed through the same iron gate in his search for greater knowledge.*

I remember clearly my own first visit to the house of Buffon in 1887, when I stood in front of the door and hesitated to make use of a formidable knocker in cut steel which had stood sentry there since the days of Louis XIV. I wondered even what might happen to me after the hammer fell and the reverberations in the old hall ceased. Luckily, however, I discovered that the door could be opened by any visitor, so I climbed at once the ancient staircase and found my way into the study of the director of the Jardin des Plantes, who was then Doctor de Quatrefages, a savant renowned for his researches in anthropology and evolution. The professor, I found, was a kindly gentleman, then about eighty years of age, who professed to have time to devote to a visiting youngster. He invited me in, took his place comfortably in an elbow chair which had been used by Buffon himself, and talked to me of the history of the Garden.

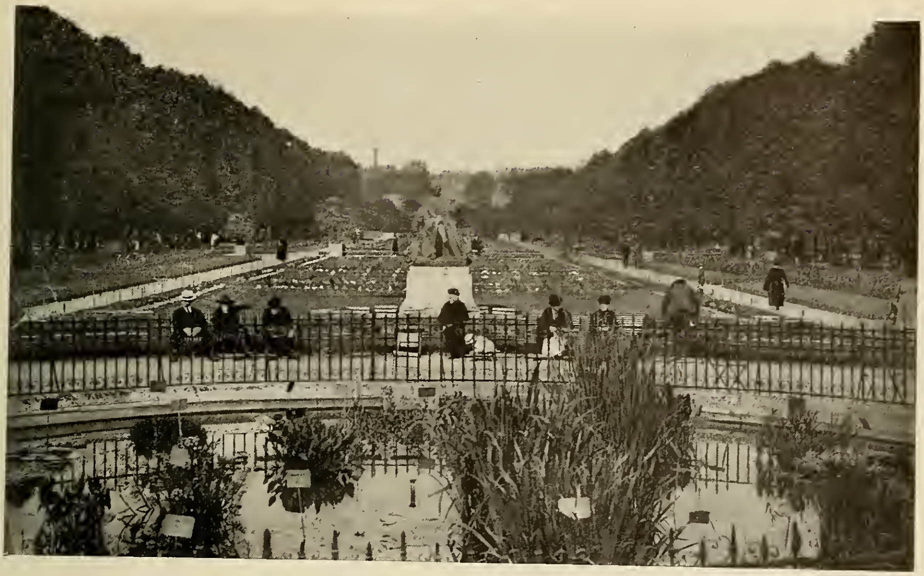
Prof. J. L. A. de Quatrefages (1810–1892) in the House of Buffon. Pencil sketch by Dr. Bashford Dean



The Museum of Zoölogy in the Jardin des Plantes

"Yes," said he, "in those olden times (the days of Louis XIII) one had a primitive idea of natural history. It should arouse curiosity, or it should be of medical interest. Its philosophical side was ignored. Indeed, it was the medical side of the Garden which then gave it its start—it was the Jardin du Roy, where medical plants were cultivated, where queer seeds from distant lands, gathered often by Jesuit priests, were received and propagated. In fact, some of the earliest plants sent from America found their abiding place here. Almost from this window I can show you a locust tree which dates from the seventeenth century; and yonder are great cedars of Lebanon planted a century and a half ago by Bernard de Jussieu. So it goes.

"Our menagerie is itself an outgrowth of the lion dens and bear pits which in early times flourished beside every kingly castle. Just as you recall that the great zoo of London grew out of the hutches of wild animals in the Tower of London when this was a royal palace, so you must picture the Jardin des Plantes as a king's glorified garden and menagerie. Indeed, our early botanists and zoölogists were little more than people of the royal household; for just as each king furnished quarters for his body physician, so also he provided for his herbalist, who was then little more than an apothecary, and his zoölogist, who was but a learned huntsman charged with the care of the wild birds and beasts 'patronized' by the royal family. In this regard, if one considers the animals of a royal menagerie, he has at once before him quite a numerous family. Even as such a naturalist should know the habits of birds that hunt and are hunted, which include a large part of our feathered friends, so he should be familiar with mammals that hunt and are hunted, which make up a goodly proportion of the guests of our modern menagerie. Into this company, of course, entered numerous exotic forms which came to a prince by gift—for just as today your president will be



Jardin des Plantes from the side of the Seine, with the statue of Lamarck

given a young bear if he travels in the Rocky Mountains, so would the European monarch in the eighteenth and seventeenth centuries receive tokens of interest and affection from subjects, and especially from foreign ambassadors, wherever they happened to be. A moufflon would come to the Grand Monarch from Corsica; a Barbary ape would be brought by a loyal sea captain from Gibraltar; or an ostrich would find its way from the sands of Egypt to Paris through a delegation sent to a caliph.

"In any event, it is safe to say that, when we look from the window of this ancient structure, we can actually trace the origin of botany and zoölogy in France. Most of the buildings, it is true, have been greatly changed, and for this we have to thank the great Napoleon, who took a personal interest in our Garden and gave us the means to construct houses for our living beasts and museums for our collections. And these, indeed, have survived most of the vicissitudes of Paris. We have had, it is true, many lean years in our work. Thus during the siege of Paris" (and the old professor, who had risen from his chair, eyed the horizon and tapped his finger slowly on the window sill) "we very nearly emptied the menagerie; we had no food for our animals, *so we ate them.* In the little restaurant yonder you could have eaten roast monkey (almost cannibals we were) for very little as money goes today. You could have tasted the meat of kangaroo and camel and bear. I am told that many of our beasts were unpalatable notwithstanding the best efforts of a competent cook, but they were surely better than rats, and you remember that, when food became scarce, many rats appeared on our menu as 'game patties.'"

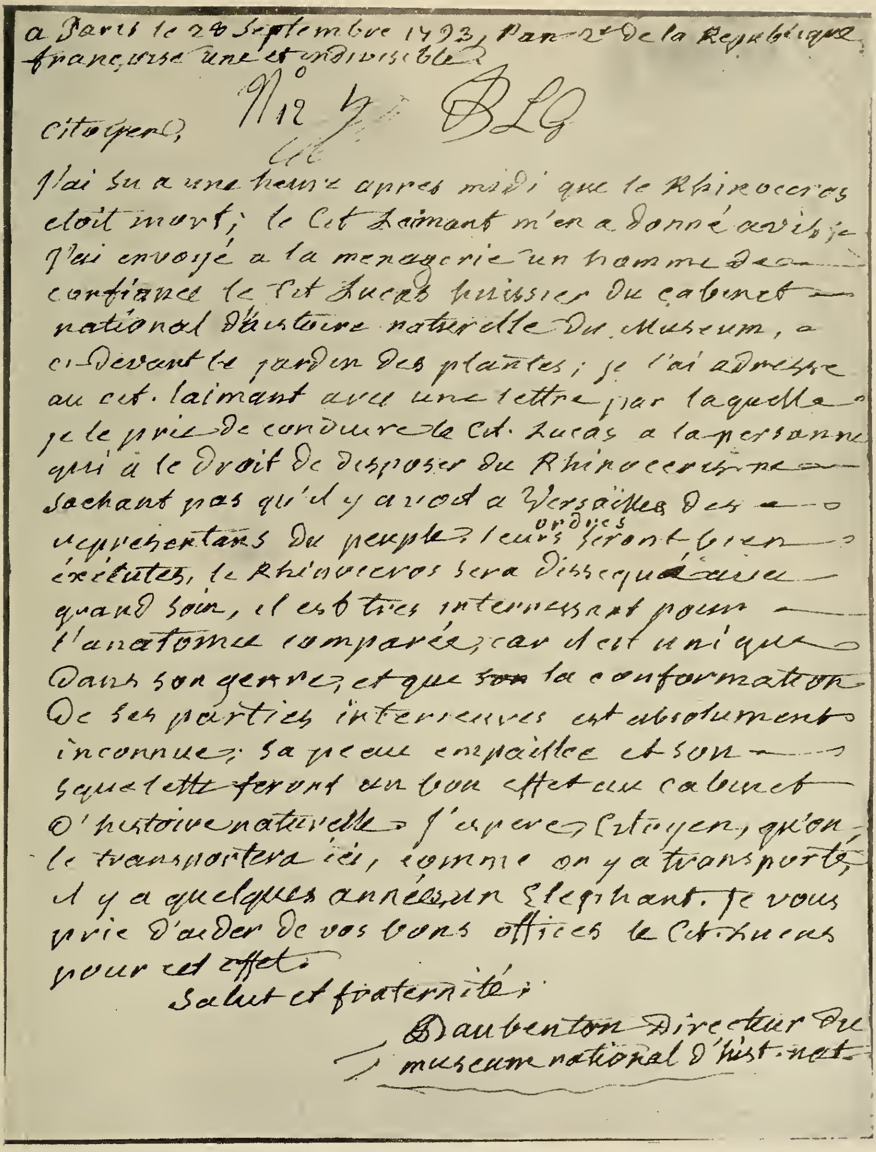
The professor turned, sat down again in the great elbow chair, and continued:

"In this room Buffon himself wrote and entertained. A wonderful man he, a courtier by trade even to the tips of his immaculate ruffles. I am told that he dressed with great formality when he wrote and that his elegance of style (*le style c'est l'homme même*) was dictated by the elegance of his costume, though one can hardly comprehend today in this dusty room how great ruffles and lace jabots could long remain spotless. Here it was, I have been informed, that he entertained Louis XV, when on state visits, accompanied by his lady friends, the monarch was pleased to spend an hour in order to hear M. de Buffon tell of the wonders of his Garden and of his delightful experiments. A favorite ape, which adroitly stole the king's handkerchief and at once presented it to a particular lady of the court, it is said, amused the king immensely and was the cause of a royal donation,—to the Garden of course."

Starting from the house of Buffon, one has not far to seek for interesting memories of great naturalists. Streets and monuments speak of Buffon, Robin, de Jussieu, de Candolle, Chevreul, de Lamarck, Geoffroy and Isidore Saint-Hilaire, Daubenton, Linnæus, de la Brosse, Haüy, Jacquemont, Brongniart, Claude Bernard. In one of the buildings professors of botany drew their students from all quarters of the world, and no peak was too high, no desert too vast, no jungle too dense to furnish for them herbaria. There in the lecture room a chance remark of a stranger caused a great teacher to call out "Who are *you* that say that? You must be Linnæus himself!" And he, indeed, it was, for the fame of the Swede had penetrated from remote Hammarby even to Paris. There it was that Lamarck carried on his botanical researches, sending his *Flore Française* to every great worker in the world, with its curiously artificial keys for finding the names of plants, which some of us remember even today in our early botanies. And here it was that Lamarck saw the light of evolution and published his *Philosophie Zoologique* (1809), which might well have caused the acceptance of evolution fifty years before Darwin. One may even conclude that if Lamarck had had the cordial support of Bonaparte at that time, when all manner of dreams came true, the history of the acceptance of the philosophy of animal life might have been widely different.

It happened, however, that he gained the enmity of the great man instead —and in a curious way, for in the midst of other philosophical researches, Lamarck studied meteorology and, as an early "weather man," he prophesied fair days and foul, and, alas, his predictions were wrong! Indeed, we can picture the wrath of Napoleon at these unhappy guesses, and we can see Lamarck at his reception meeting blazing eyes and hearing sharp words which told him to 'mind his business' and not 'make a fool of himself.' "Go back to your herbs, M. Lamarck,' and good day to you." This is said to have been the last interview which the Emperor accorded him,—an unpleasant memory which embittered his last days, when, poor, blind, almost forgotten, he lived in a street near the Jardin des Plantes, cared for by his devoted daughter,—a scientific Milton, dreaming of evolution as a Lost Paradise. "The day will come," said the daughter, "when the world will appreciate you"—a prophecy which came true in 1909, when a monument of Lamarck was formally dedicated in the Jardin.

Here it was, then, that modern science saw the beginnings of evolution. Buffon himself had formulated distinct evolutional theses as early as 1750, but he failed to maintain them in the face



a Paris le 24 Septembre 1793, l'an 2e de la Republique françoise une et indivisible

No 12

Citoyen,

J'ai su a une heure apres midi que le Rhinoceros etoit mort; le Cit Laimant m'en a donné avis; je l'ai envoyé a la menagerie un homme de confiance le Cit Lucas huissier du cabinet national d'histoire naturelle du Museum, a ci-devant le jardin des plantes; je l'ai adressé au cit. laimant avec une lettre par laquelle je le prie de conduire le Cit. Lucas a la personne qui a le droit de disposer du Rhinoceros ne sachant pas qu'il y avoit a Versailles des representans du peuple; leurs ordres seront bien exécutés, le Rhinoceros sera dissequé avec grand soin, il est tres interessant pour l'anatomie comparée, car il est unique dans son genre, et que la conformation de ses parties internes est absolument inconnue; sa peau empaillée et son squelette feront un bon effet au cabinet d'histoire naturelle. J'espere, Citoyen, qu'on le transportera ici, comme on y a transporté, il y a quelques années un Elephant. Je vous prie d'aider de vos bons offices le Cit. Lucas pour cet effet.

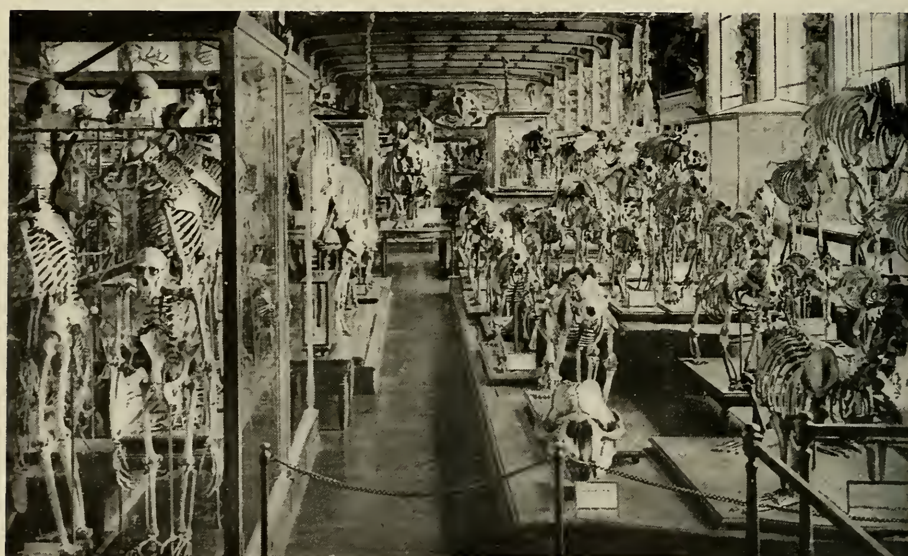
Salut et fraternité;

Daubenton Directeur du museum national d'hist. nat.

Letter written by Daubenton regarding a rhinoceros "dedicated" to the service of science—its organs to be dissected and its skin and skeleton exhibited. From the Osborn collection in the American Museum

of a powerful orthodox church, for he was too much of a courtier and too little of a martyr,—"give the church all the persiflage it wishes," he said irreverently, "for this makes stupid people quite happy." But Lamarck was of sterner stuff. He maintained his evolutionary views in spite of fierce criticism, desertion, persecution, and failure. Still, fail he did: he gained the enmity of Bonaparte; he was unable to collect and marshal facts which bore upon his theme. Nevertheless he came within a measurable distance of suc-

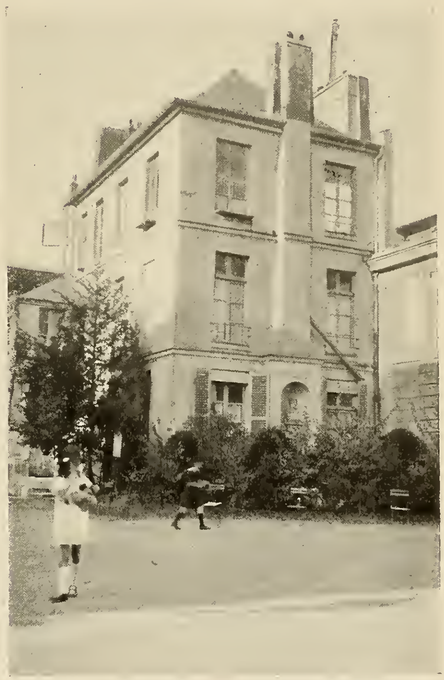
The Gallery of Palæontology



The Gallery of Comparative Anatomy

cess. For one thing, evolution was then in the air. Even as early as 1796, Geoffroy Saint-Hilaire was, with Lamarck, corresponding with foreign naturalists (as with Peale in Philadelphia) in order to enlist their help in demonstrating evolution; and we do not wonder that by 1830 (the year following the death of Lamarck) there came about a crisis in views regarding the origin of species which shook the foundations even of the French Academy!

The cardinal fact about the Jardin des Plantes is, as already noted, that it personified great epochs in natural history. At the time of the French Revolution, and just before and after, it was the home of an extraordinary outpouring of knowledge concerning man and his universe. It then witnessed the upbuilding of a new anthropology; it produced vast catalogues of "animated nature," seeking, describing, and classifying animals and plants from all parts of the world (bear witness the great volumes on Egypt); it outlined an evolutional philosophy; it foreshadowed in certain researches the work of Pasteur in disproving "spontaneous generation"—in fact, it was upon this earlier foundation that Pasteur was able to place the keystone of success. In physiology it paved the way for a Claude Bernard; in anatomy, and especially in comparative anatomy, its service was monumental. Under the leadership of Cuvier, it brought together facts concerning the structure of animals, both living and fossil, which served to build up a philosophy of animal structure and to demonstrate the doctrine of evolution—although Cuvier himself, curiously enough, had not a mind unbiassed and agile enough to follow the path which his own researches mapped out. One thinks of this as one walks in Cuvier's galleries among anatomical preparations and skeletons, which, for the rest, are today not inspiring to one who has not a zoölogical instinct,—for what is less attractive than a skeleton imperfectly *dégraissé*, turning black in spots, or a taxidermic specimen of 1830 from which all color has faded, or a ruminant's stomach standing waxy in a jar of yellow alcohol. None the less, even a casual visitor can see behind all these things (representing vast and devoted labor) the dynamic genius of Cuvier,—the stocky little man, thick of neck, with a mop of reddish hair, whose luminous eyes no student could forget, whose strong personality turned back the tide of evolution. Even in the third



The House of Cuvier

"generation" from Cuvier, I felt his influence one day when I unearthed in a dusty shop in the Rue de Seine a package of his letters and a lock of his sandy hair. With these things in my hand, my imagination pictured his lecture room, and I could almost hear him expound (with German accent) the homologies of bones and the history of mammals. . . .

Relationships of the Upper Palæolithic Races of Europe

By LOUIS R. SULLIVAN
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NOTE: This review is based largely upon an examination of the remarkable collection of cranial casts of early man in the hall of the Age of Man on the fourth floor of the American Museum. The illustrations are for the most part photographs of these casts and of modern skulls in the somatological collections of the department of anthropology of the Museum. In this article only anatomical relationships are discussed. The reader who wishes a more detailed consideration of these problems in a cultural background is referred to *Men of the Old Stone Age* by Henry Fairfield Osborn. The chronology of that book has been used as the basis of arrangement of this review. Professor Osborn's book contains detailed references to the abundant literature on the subject, which are omitted from this brief summary. The writer's indebtedness to such literature will be obvious. Grateful acknowledgment is also made of the privilege of reading an unpublished manuscript on the physical anthropology of Teneriffe in which the Crô-Magnon question is discussed by Dr. E. A. Hooten of Harvard University, and of the assistance of Dr. Milo Hellman in measuring the cranial casts.

FEW chapters in the history of human development offer so much of general interest as does the chapter dealing with the history of man in the Upper Palæolithic Period of Europe. The remarkable carvings and paintings of this period have evoked universal admiration and a desire to learn more about the people who made them. All of us are anxious to know what these people were like, what their racial affiliations were, what became of them, and whether or not they left any descendants. While much more work remains to be done before all of these questions can be answered conclusively, some of the probabilities and possibilities can be stated at this time.

Osborn includes four great cultural periods in the Upper Palæolithic of Europe: Aurignacian, Solutrean, Magdalenian, and Azilian. It will be convenient to discuss the peoples of each culture period separately and in the order given above.

THE AURIGNACIAN RACE OF CRÔ-MAGNON

It will be recalled that the prevailing type of man during the Lower Palæolithic was quite different from that of any of the modern existing races. This race is known as the Neanderthal and is usually assigned to a species distinct from modern man. Neanderthal man, or *Homo neanderthalensis*, was a short, thick-set, coarsely built man. His head was massive and flattened, with heavy overhanging eyebrow ridges, a large broad nose, and a receding chin. He had many other peculiarities which set him apart from *Homo sapiens*.

In striking contrast to this race is the prevailing type of man in the early Upper Palæolithic of Europe. This type has been called the Crô-Magnon race after the type specimen, "Old Man of Crô-Magnon," or "Crô-Magnon No. 1." It was characterized by very great stature, averaging at least 5 feet 10 inches and more in some localities. The head was long and low, but much higher than that of *Homo neanderthalensis*. The brain case was unusually large, in keeping with the enormous bodies of this race. The face was broad, but relatively low in vertical dimension, the orbits were excessively low, the nose was well arched and narrow, and the chin unusually well developed even when compared with modern European man. The femora (thigh bones) were very robust and very wide and flat in the upper portion of the shaft; the tibiæ (lower leg bones) were saber-like, flattened from side to side, and unusually long in proportion to the length of the femora,—a decidedly negroid character. The radii (fore-arms) were also rather long in proportion to humeral (upper arm) lengths. As described above, this type has been found chiefly in France and adjacent countries. It is found most frequently with Aurignacian cultural remains and has been generally credited with bringing Aurignacian culture and art into Europe. Some authors credit it also with the development of Magdalenian culture. Be this as it may, we know that the representations of the Crô-Magnon type become less common as we pass upward through the Magdalenian and Azilian, although individuals belonging to this type are found even in Neolithic times. The facts now available indicate that the Crô-Magnon type "had its day" in Aurignacian times.

What became of this type? Did it become extinct or is it represented among the living peoples of Europe today? More sheer nonsense has been written on this subject than on any other anthropological problem. Some idea of the degree of absurdity to which the discussion has degenerated may be obtained from a summary of the nations and peoples identified with the Crô-Magnons. Crô-Magnons have been claimed among the living populations of the Canary Islands, North Africa, Spain, Italy, Portugal, Bulgaria, France, Belgium, Holland, Germany, Norway, Sweden, Ireland, Wales, and Scotland. In addition the Crô-Magnons have been held by various authors to be identical with the Nordics, Mediterraneans, Celts, Deniker's Littoral race, the Basques, the Finns, the Esthonians, the American Indians, the Semites, and the Egyptians. They have alternately been described as blondes and brunettes. The one criterion seems to be a vague something called disharmony.

Without going into negative detail it is fair to say that few of these claims are accompanied by convincing proof. While all such claims are interesting possibilities, few of them are probabilities and they should not be taken seriously until accompanied by detailed and convincing evidence.

So far as skeletal remains testify, very few modern ones have been described that correspond in all respects to the Crô-Magnon type of the Upper Palæolithic of France and Italy. There is, however, one type smaller in size and differing from the Crô-Magnon in several other details, but corresponding to it very closely on the whole, which was quite widespread in Neolithic times and even in very recent times in areas around the south and west of the Mediterranean.

The transition to living peoples is not so easily made. One of the greatest sources of error in anthropology is the attempt to link up skeletal remains with the living population of an area. In the past such linkings have been made usually on the basis of some one criterion, such as the cephalic index. Now that the extreme complexity of human race relationships is beginning to be appreciated this practise is no longer approved of. In short, we are not now so certain of some of the things that were accepted as facts twenty years ago.

Although the Crô-Magnons differ

from the modern Europeans in several details, they were in many essentials Caucasian or Caucasoid. We are accustomed to think of them as a Caucasoid race related rather closely to the Nordic and Mediterranean. Certainly there is only a short structural gap between the Crô-Magnons and the Mediterraneans and Nordics. However, at present I do not feel that it has been demonstrated that the Crô-Magnon of the Upper Palæolithic of France is identical with or ancestral to either the Mediterranean or the Nordic races. I believe that it is best at present to regard the Crô-Magnon as an end form in evolution.

It does not follow that the type is extinct—in fact, this is highly improbable. It is almost a certainty that the blood of this race flows in the veins of some of the European peoples today. Probably small colonies of the type, more or less mixed, will be found in widely scattered parts of Europe. The smaller related race above mentioned exists in parts of France, Spain, and northern Africa. But these identifications of osteometric types with living types must be carefully and cautiously made. In spite of all the work that has been done, our knowledge of the living peoples of Europe is most elementary. It has been predicted that when we do know more of the extant peoples of the earth, colonies or islands of Crô-Magnons will be found not only in Europe and Africa but in other parts of the world as well.

Another factor which complicates the problem of identifying modern racial remnants with osteological types is the widespread and almost universal tendency of several groups of "racial remnants," "marginal types," "fringe races," "vanishing races," or whatever sort of races one prefers to call them, to herd together and mix up in inaccessible areas. There are several such ethnic islands which are well known,—notably the Pyrenees, the Caucasus, Madagascar, South Africa, the Malay Peninsula, the Philippine Islands, and the interiors of several Malay island groups, the northern Japanese Islands, some Polynesian groups, southern South America, and many other places.

THE AURIGNACIAN RACE OF GRIMALDI

Associated with the Crô-Magnon in Mentone, Italy, is another race, represented so far by only two individuals. But these two individuals are of such exceptional interest that they have been taken as types for a new race called the Grimaldi race. As I have already noted, the Crô-Magnon race was negroid in certain respects: its low face with a tendency to prognathism in some individuals and moderately long forearms and lower legs. But the Grimaldi individuals were negroids indeed. By this I do not mean that they were ordinary negroes, for it cannot be too strongly emphasized that there are as many or more well defined types of negroes as there are well defined types of Caucasians.

If we may judge from the two individuals found, one an adolescent male and the other an aged female, the Grimaldi race was a fairly tall one. The woman was about 5 feet 3 inches in height. If she was anywhere near being representative for the race, the men must have been at least 5 feet 7 or 8 inches tall on the average. The heads are very long and also rather large for negroids. The brain cases are relatively high.

CRÔ-MAGNON NO. 1 — AURIGNACIAN

CRÔ-MAGNON FROM GRIMALDI (After Verneau) — AURIGNACIAN

GRIMALDI NEGROID YOUTH (After Verneau) — AURIGNACIAN

Two crania of the Crô-Magnon type are compared with one of the Grimaldi negroid type. The Crô-Magnons approach the modern European types in the contour of the profile, in the marked development of the chin, elevation and projection of the nasal skeleton, sharp lower border of the nasal opening, and enlargement of the mastoid processes. They differ from modern Europeans in the excessively low orbits and very low, broad faces. The Grimaldi negroid youth on the right cannot be regarded as a variant of the Crô-Magnon type. The differences are too great and too consistently negroid. Some of the Crô-Magnons show evidences of Negro admixture. The Grimaldi negroid type approaches the Hottentot type

The faces are large, but low; the noses, broad and depressed at the root; the lower nasal borders are not sharp as in most Europeans; the faces, below the nose, project quite markedly; the chins are not prominent; and the teeth are large. The long forearms and lower legs of the Crô-Magnons are exaggerated and truly negroid in this type. The pelvis also is narrow.

The indications are that this race appeared, in Italy at least, before the Crô-Magnon. It apparently was never a very important race numerically in Europe. Several Neolithic skulls of this type have been found in Italy, France, and near-by countries. Even some of the modern crania from Italy approach this type. The inhabitants of several provinces of Italy have been identified with the Grimaldi race, but here again the identifications have not been based upon detailed and accurate observations. In general such identifications mean merely that the individuals identified as Grimaldi are negroid. Any one familiar with the history of Italy or the Mediterranean borders will appreciate the sources of error involved in such procedure.

Another interesting observation is that the Grimaldi race resembles most closely craniometrically skulls from South Africa described as Hottentot. The identity or relationship of these two groups—the ancient Grimaldi and the South African Hottentots—are more than a possibility. The identification is made difficult by the fact that the living Hottentots and the skeletal materials attributed to them are each badly mixed. Whole series of skeletons described as Hottentot are apparently predominantly Bushman. This is another example of the difficulty of making the transition from osteometry to anthropometry. This possible relationship is the more interesting because in some respects the Aurignacian art is similar to a South African art usually attributed to the Bushmen. But the Grimaldi crania resemble Hottentot crania much more closely than they do Bushman crania. It is not agreed upon just what this Grimaldi race contributed to Aurignacian culture.

THE AURIGNACIAN TYPE OF COMBE-CAPELLE AND RELATED RACES OF THE SOLUTREAN

When skeletal remains of Neanderthal men were found in sufficient numbers to prove that they were the remains of normal representatives of a race and not pathological specimens, it was the opinion of scientific men that they represented an ancestral type of man, a connecting link, as it were, between *Homo sapiens* and some such form as *Pithecanthropus*. Of late this idea has become unpopular and Neanderthal man is regarded as a side branch of the human family which diverged from the main stem in Pleistocene times and soon became extinct. This is in accord with the abrupt change of physical type between the Mousterian and Aurignacian periods mentioned at the beginning of this review. Some later finds of Mousterian, Aurignacian, and Solutrean man, however, make this transition seem less abrupt than it is usually portrayed.

In the first place, there is considerable variation within the Neanderthal race. Some of the specimens approach much nearer than do others to *Homo sapiens*. This is true both of Spy I and of the Mousterian youth in different degrees. In the second place, skeletal remains from the Aurignacian and the Solutrean have been found which, while undoubtedly closer to *Homo sapiens* than to *Homo neanderthalensis*, show unmistakable relationships to *Homo neanderthalensis* as well as to each other.

One such skeleton is that of Combe-Capelle, called *Homo aurignacensis hauseri*. While the supra-orbital development in this specimen is not so great, it suggests the Neanderthaloid form. The frontal region and face also indicate relationship. Yet in the totality of its characters it is undoubtedly *Homo sapiens* and clearly of the European variety. The stature is not great, but the brain is of good size, the head long and high, the face high and narrow, the nose relatively narrow and pinched up, the orbits are low, the dental arch is reduced in size, especially from side to side, yet the arch is not that of a modern European. There is little prognathism or projection of the face. The mastoid

LA CHAPELLE-AUX-SAINTS NEANDERTHALOID MOUSTERIAN — COMBE-CAPELLE TRANSITION TYPE AURIGNACIAN — MODERN EUROPEAN MODERN

The Combe-Capelle cranium is unquestionably related to the Předmost cranium shown in the figures that follow. In some respects it is more primitive than the Předmost cranium, yet in others it is more highly evolved and specialized. The chin is not so well developed as that of Předmost, yet the frontal region and the whole brain case is higher than that of Předmost. These types (Předmost, Combe-Capelle, and related types) would indicate the possibility that modern European man may have been evolved from *Homo neanderthalensis* or some such form. At the present time this seems a reasonable hypothesis

processes are large. The chin is not marked, but it is nevertheless perceptibly developed. While the external chin is not so well developed as that of some related forms, or of Crô-Magnon and of modern Europeans, the internal development of this region is very similar in all of these types. The genial tubercles are very well developed. The ramus of the jaw is massive. Above are shown the main views of this cranium compared on the one side with the cranium from La Chapelle-aux-Saints and on the other with a long-headed European skull from Germany. The transition from the Combe-Capelle skull to the modern German skull is not very abrupt. The Combe-Capelle skull is either the representative of a type actually ancestral to the race represented by the modern skull or corresponds very closely to such a stage in the evolution of the modern races. The transition to the cranium from La Chapelle-aux-Saints is the

LA CHAPELLE-AUX-SAINTS
NEANDERTHALOID
MOUSTERIAN

PŘEDMOST
TRANSITION TYPE
SOLUTREAN

CRÔ-MAGNON NO. 1
AURIGNACIAN

The theory has been advanced that the Předmost cranium shown in the center above is a hybrid between some such types as the Neanderthal represented on the left and the Crô-Magnon on the right. Although in many respects it approaches the form such a hybrid might be expected to take, it qualifies much better for a transiton type related on the one hand to *Homo neanderthalensis* and on the other to *Homo sapiens*, more especially the long-headed European varieties. The face of the Předmost cranium is more like the face of the modern European types than it is like that of Crô-Magnon

more abrupt, to be sure, yet I believe the photographs will show the general similarities of the Neanderthal man and the one of Combe-Capelle. If we insert Spy I between the specimen from La Chapelle-aux-Saints and that from Combe-Capelle, the transition is not so abrupt. I am inclined to agree with those (most recently Doctor Hrdlička) who maintain that Neanderthal man is ancestral to modern European man. It does not follow that the evolution necessarily took place in Europe and I do not agree with those who claim that the type of Neanderthal man known to us from Europe is ancestral to all modern mankind.

The anatomical objections to such a line of evolution—Neanderthal man, Combe-Capelle, European man—are, I believe, not insurmountable and consist chiefly in some dental differences about which we know very little either in modern man or in Neanderthal man. I wish to empha-

LA CHAPELLE-AUX-SAINTS NEANDERTHALOID MOUSTERIAN — PŘEDMOST TRANSITION TYPE SOLUTREAN — MODERN EUROPEAN MODERN

The Předmost cranium is here compared with the Neanderthaloid La Chapelle-aux-Saints and a modern European physical type. The relationships of these three types are much clearer than those of the preceding figure. The relationship of Předmost to the Neanderthal form is indicated by the supra-orbital development. Its relationship to modern man is indicated by the elevated brain case, incipient retraction of the face, development of the chin, enlargement of the mastoids, and reduction of the nose and face in width. On the whole Předmost man stands nearer to modern man than he does to Neanderthal man

size, however, that the line of evolution indicated is by no means complete and well balanced, for the transition types so far known are much closer to one type (*Homo sapiens europæus*) than to the other type (*Homo neanderthalensis*).

There are no cultural objections to such a line of evolution, for, as I have stated above, it does not follow that the evolution took place in Europe. The Neanderthal, Combe-Capelle, and related forms, as well as the modern Europeans, may have evolved outside of Europe and migrated into Europe, or a part of the evolution may have taken place outside of Europe and a part within. All that such a claim of relationship means is that *Homo neanderthalensis* with the Combe-Capelle and related types represent stages in the evolution of modern European man of the long-headed variety.

Closely related to the Combe-Capelle man are several other skele-

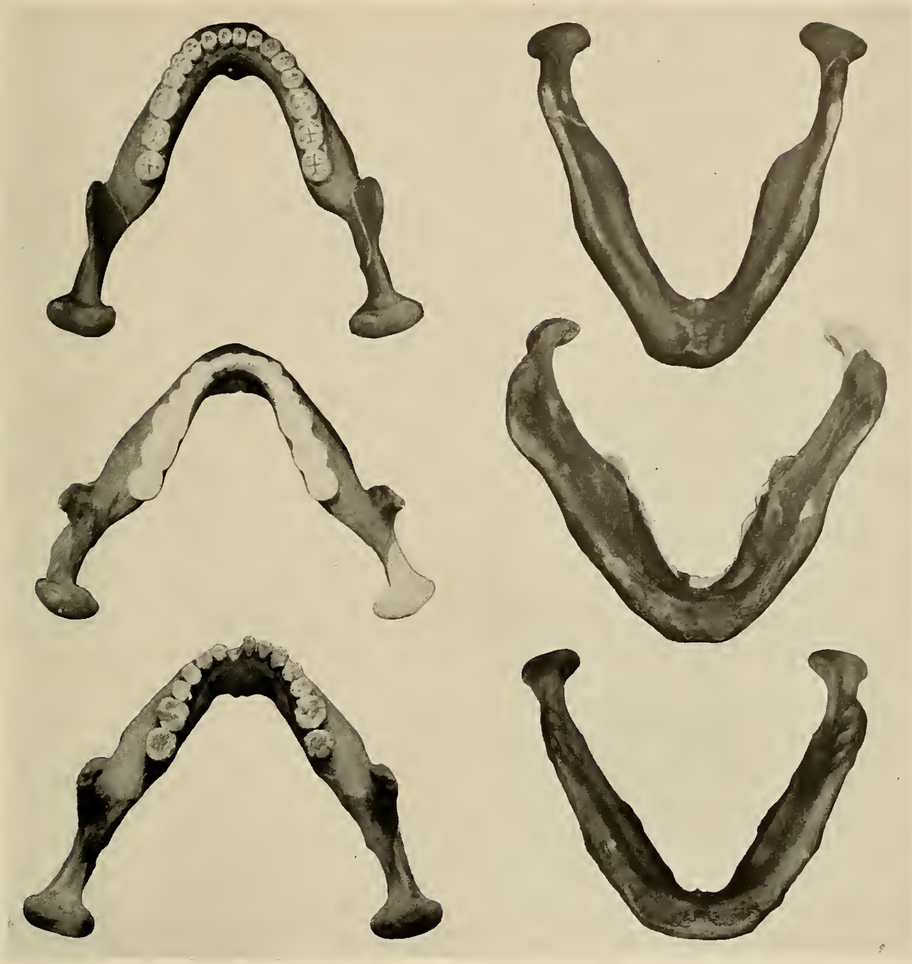
CRÔ-MAGNON NO. 1 — AURIGNACIAN | OBERCASSEL MALE — MAGDALENIAN | SMITH SOUND ESKIMO — MODERN

The male Obercassel cranium is compared with the Old Man of Crô-Magnon on the left and an eastern Eskimo from Smith Sound on the right. The most striking similarities in general form are with the Eskimo. The orbits approach the orbits of Crô-Magnon and the chin approaches that of the Crô-Magnon chin. If this similarity of a Magdalenian cranium to that of an Eskimo were an isolated instance, not much could be made of it, but another Magdalenian skeleton, the Chancelade, resembles, it is said, the Eskimo even more strikingly. Similarities of the culture of the Magdalenians to that of the Eskimo have also been noted. While it is possible that we have here a case of parallelism or convergence, it is at least equally within the range of possibility that we are dealing with a true racial relationship

tons from the Solutrean Period and from culture levels not satisfactorily determined. Such finds include the Brüx, Brünn, Galley Hill, and some of the Předmost remains.

The cast of a Předmost cranium in the hall of the Age of Man shows slightly closer affinities to the Crô-Magnon type than does the Combe-Capelle cranium. It is long-headed, but not so long as the specimen from Combe-Capelle, the brain case is lower, the orbits are also low, the nose very narrow, and the chin well developed. Like Crô-Magnon it has a long facial base (not a high face), which gives it a pseudo-prognathism not revealed in the facial angle. The mastoid processes are large.

Again, while the affinities of this type are close to Crô-Magnon and closer still to the modern Europeans, its more distant affinities on the other side to *Homo neanderthalensis* are indicated in the supra-orbital development, type of face, frontal region,

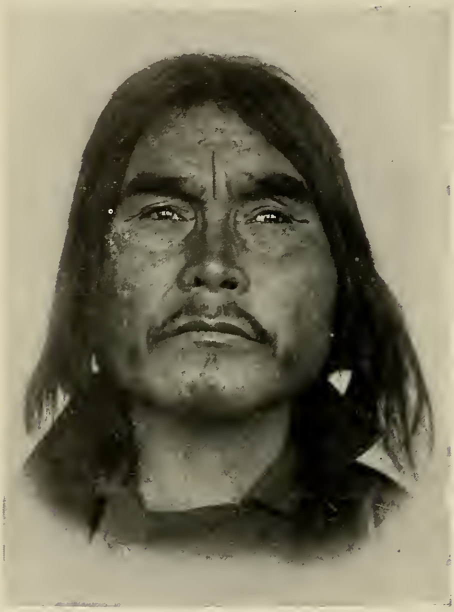


OLD MAN OF CRÔ-MAGNON (topmost row) | OBERCASSEL MALE (center row) | EASTERN ESKIMO (lowest row)

The lower jaw of the Obercassel male is compared with that of Crô-Magnon No. 1 above and that of an eastern Eskimo below. In width and massiveness the Obercassel mandible resembles most closely the Eskimo mandible. But the Eskimo jaw shown here has what is called a lateral (square) chin while the other two jaws have pointed median chins. The profiles of the jaws may be seen in the preceding plate

form of brain case, and dental arches. The photographs of these specimens on pp. 688 and 689 will help the reader to draw his own conclusions. One thing will be obvious and that is that the group of skulls generally known as the Brünn race (Brüx, Brünn, Galley Hill, Combe-Capelle, and Předmost) are not more primitive or lower evolutionary types than modern Australians. In the totality of their characters these types rank considerably above the Australians and several other modern types in the racial scale.

An alternative theory of hybridism has been advanced. Some anthropologists have accounted for Brünn, Brüx, Combe-Capelle, Galley Hill, and Předmost remains by inferring that these forms represent hybrids resulting from the crossing of the Neanderthal and Crô-Magnon races. Of all the finds mentioned in this group the Předmost remains are the only ones which could reasonably be accounted for in this way. If they stood alone, we might regard them as the remains of a hybrid or hybrids. But they are unquestionably related to the Brüx, Brünn, Galley Hill, Combe-Capelle, remains, which cannot be accounted for in this way because they have some characteristics which could not possibly be derived by direct inheritance from either the Neanderthal race or the Crô-Magnon race by any known laws of heredity. In fact, the theory of hybridism has as many or more obstacles in its path of acceptance as has the theory of transitional form. Many anthropologists have difficulty in believing that a race like the Crô-Magnon, which has been lauded to the skies and portrayed as almost a race of gods, intermarried with a race like the Neanderthal, which, according to some authorities, may have had no articulate language. But apart from all this and looking upon these skeletal remains as a related group, the evidence seems to indicate that Brünn, Brüx, Galley Hill, Combe-Capelle, and Předmost forms are transitional ancestral forms and not hybrids.



An idea what the Obercassel man must have looked like may be obtained from this portrait of an eastern Eskimo. That the Magdalenians of the type represented by the Obercassel and Chancelade skeletons were related to the Eskimo is still a debatable question, but there is no doubt that in face form they resembled the Eskimo here shown

Physically the types of the Solutrean should precede the dominant types of the Aurignacian. The Solutrean types continue on from the Mousterian rather than from the Aurignacian.

THE MAGDALENIANS

The acme of accomplishment in Upper Palæolithic art was reached in the Magdalenian Period. Hence, it is of interest to know which races contributed to the culture of this period. The race of Crô-Magnon is usually associated with this period and it is true that many of the skeletal remains recovered with cultural remains from this period are of the ordinary Crô-Magnon type. Up to the present time no skeletal remains of the Grimaldi or Brünn types have been recovered from this culture period. Yet it is not without its problem.

The skeletal remains of this period show a high degree of variability. Many anthropologists early pointed out analogies between the skeletal remains of this period and certain Arctic or Sub-Arctic types of man such as the Eskimos, Lapps, and Finns. One of the best of such presentations is that of Testut, who showed that a skeleton known as the Chancelade skeleton from Dordogne, France, resembled very closely the skeleton of an eastern Eskimo. The resemblance of the Chancelade cranium to the Eskimo cranium is striking.

The high scaphoid vault of the brain case is in marked contrast to the low and relatively flat brain case of the typical Crô-Magnon. The stature also is short, although the brain case is very large. As reconstructed, it is estimated that the stature is from 150 to 160 centimeters. Testut's own figures show clearly how this type diverges from the Crô-Magnon toward the Eskimo. This skeleton, together with a female of the same type, has been admirably described by R. Bonnet in the memoir of M. Verworn. Interest in this specimen centers on the fact that its skull too is Eskimoid. It so happens that we have in the American Museum an Eskimo skull that resembles the Obercassel skull very closely. The Eskimo skull is a male (Cat. No. 99–105) from Smith Sound. It is

TESTUT'S COMPARISON OF THE SKULL OF CHANCELADE WITH THE CRÔ-MAGNON TYPE AND AN EASTERN ESKIMO

CHARACTER	ESKIMO	CHANCELADE	CRÔ-MAGNON
Cephalic index	72.19%	72.02%	73.76%
Cranial capacity	1520 cu. cm.	1710 cu. cm.	1590 cu. cm.
Nasal index	42.6%	42.5%	45.9%
Orbital index	*87.8%*	*86.97%*	61.36%
Bizygomatic diameter	135 mm.	140 mm.	143 mm.
Facial index (French method)	*72.2%*	*72.8%*	63.4%
Stature	*154 cm.*	*150–160 cm.*	186 cm.

It will be seen that the Chancelade skull differs from the Crô-Magnon and resembles the Eskimo metrically in having high orbits, a high face, and short stature. To this could be added other details.

Another interesting skeleton of this period is that of a man found at Obercassel, near Bonn, Germany. shown with the male Obercassel skull on pp. 690 and 691. In addition to the general similarity in contour there is a fairly close correspondence in metric form. Although parts of the Obercassel cranium have been restored, certain measurements, as indicated in the table below, may be compared safely.

COMPARISON OF THE SKULL OF A SMITH SOUND ESKIMO WITH THE OBERCASSEL SKULL AND THE CRÔ-MAGNON TYPE

CHARACTER	ESKIMO (99-105)	OBERCASSEL	CRÔ-MAGNON
Cranial capacity	1645 cu. cm.	1500 cu. cm.	1590 cu. cm.
Face width	158 mm.	153 mm.	144 mm.
Length-breadth index	77.5%	74%	73.8%
Length-height index	76.4%	71%	65.3%
Breadth-height index	98.6%	96%	88.6%
Cranio-facial index	107%	106%	96.5%
Nasal index	41.2%	44%	45.1%
Orbital index	80%	*67%	59%
Bicondylar width (mandible)	141 mm.	132 mm.	127 mm.
Bigonial width (mandible)	124 mm.	133 mm.	107 mm.
Body height (mandible)	32 mm.	36 mm.	36 mm.
Symphysis height (mandible)	37 mm.	34 mm.	39 mm.
Femoral length	465 mm.	444 mm.	493–504 mm.
Stature on basis of femur alone	169.3 cm.	165.3 cm.	174.6 cm.
Original estimates of stature		172.4 cm.	180.0 cm.

*Orbital width by different technique.

OFNET SHORT-HEADED TYPE — AZILIAN | NEOLITHIC SHORT-HEADED TYPE — NEOLITHIC | MODERN EUROPEAN (ALPINE) — MODERN

There is a very close similarity in the three skulls shown above. The Neolithic brachycephal and the modern European (Alpine) are almost identical in every detail. The Ofnet brachycephal also resembles the other two very closely but differs from them in certain details of face form and chin development. The Ofnet brachycephals are usually regarded as ancestral to the modern and Neolithic Alpines. This is perhaps a reasonable hypothesis if we make allowances for certain changes which have probably taken place in modern man in the course of his development

While the resemblance of the two skulls is very close, the Obercassel differs from the Eskimo and resembles the Crô-Magnon type in a greater glabellar development, lower orbits, and a more median and pointed chin—in contrast to the lateral square chin of the Eskimo under discussion. The relatively longer forearms and legs of the Obercassel skeleton also link it more closely to the Crô-Magnon.

The problem, of course, is to decide whether we are dealing with a case of remarkable parallelism or real racial relationship. Whatever the solution, the result will be equally interesting. The fact that strong similarities in Magdalenian and Eskimo culture have been pointed out makes us hesitate to brush aside too hastily the conclusion that we may indeed be dealing with a true racial and cultural relationship. The modern Eskimo may be related to a type of man occurring in the Magdalenian of Europe. The alternative, of course, is that bodily form as well as culture are very flexible and easily altered or molded by environment. The acceptance of such a conclusion would have far-reaching effects upon our ideas of race relationships. If I were to

OFNET LONG-HEADED TYPE
AZILIAN

FURFOOZ MALE NO. 1
AZILIAN

NEOLITHIC LONG-HEADED TYPE
NEOLITHIC

The relationships of the long-headed types of the Azilian and Neolithic are not so clear as the relationships of the short-headed types. It is usually assumed that they are Mediterranean forms, but this has not been very clearly demonstrated as yet. Certainly they differ considerably from both the modern Mediterranean and Nordic types. It is difficult to tie up the Furfooz crania with any of the types so far shown. While they are rather short-headed, the male cranium shows some resemblances to the Ofnet and Neolithic long-headed skulls above

choose between the two evils at present, I believe I should prefer the hypothesis of race relationship between the people of Magdalenian Europe and the eastern Eskimo. It is certain that in facial form, at least, the Obercassel man looked like the Eskimo on p. 692.

THE PEOPLE OF THE AZILIAN AND LATER PERIODS

The Azilian is usually considered a transition period from the Palæolithic to the Neolithic. Somatologically it is characterized by the appearance of several new races. Our collections contain casts of the Ofnet and Furfooz finds and this review will be confined to a discussion of these remains.

The Ofnet remains do not represent any of the races so far mentioned. Some thirty-three skulls have been found at this site, but less than half of these are adult.

Three of these adults were markedly short-headed. One of these brachycephals is shown on p. 694 with a Neolithic and a modern brachycephalic European cranium. The relationships are apparent. It seems safe to say that in the Ofnet remains we have true representatives of a

FURFOOZ MALE NO. 1
AZILIAN

MODERN EUROPEAN ALPINE
RECENT

FURFOOZ FEMALE NO. 2
AZILIAN

The Furfooz crania usually give the name to the short-headed type of Europe. The Ofnet and Neolithic bracycephals are classified as representatives of the Furfooz race. Yet this identification is made with some uncertainty. The Furfooz remains were those of very small individuals and in many ways were untypical, especially those of the female. If we may judge by the mandible and other features, they were probably Caucasoid. While it is within the range of probability that the male skull shown above might represent an aberrant specimen of a group ancestral to modern European Alpines, considerable imagination is needed to make this transition and even more in the case of the female

type related and probably ancestral to modern Alpine European man.

The relationships of the long-headed Ofnet remains are not so clear. They have frequently been identified as Mediterranean, but this is by no means a certainty. The same is true of some of our Neolithic dolichocephals. They differ quite perceptibly from both the modern Mediterraneans and the modern Nordics.

The Furfooz remains are even more confusing. They have a tendency to short-headedness and consequently have been assigned to the Alpine race. Their relationships to the Ofnet brachycephals and to modern Alpine European man are rather doubtful. Certainly if they belong to the Alpine type they are very aberrant individuals and do not approximate the average of this type very closely. The small size of the individuals is also confusing. Yet, if one may judge from the associated lower jaws, they are undoubted Caucasians.

Before the relationship of the Azilian and Neolithic types can be determined for a certainty, much more work must be done upon the historic European races.

A GROUP OF MEN, MOST OF THEM ARMED

This painting is reproduced from an original in the great rock shelter of the Cuevas del Civil, near Albocácer, Castellón

A wounded warrior, painted in the rock shelter of Saltadora

Fossil Man from a New Viewpoint

A REVIEW OF OBERMAIER'S "FOSSIL MAN IN SPAIN"[1]

ILLUSTRATIONS REPRODUCED FROM THE VOLUME

By CHRISTINE D. MATTHEW

DURING the past century our knowledge of fossil man has passed from the domain of speculation to that of demonstrated scientific fact. The abundant discoveries of human fossils and human industries in western Europe presented in the main such orderly and homogeneous development as to incline some to the belief that the smallest of continents—structurally a mere peninsula extending westward from the huge land mass of Asia—had indeed staged the first act in the great drama of human civilization and industrial evolution. Further research not only disclosed certain discrepancies and variations in the supposed orderly industrial development in western Europe, but showed also that implements typical of Early Palæolithic workmanship, and frequently of unquestionable Pleistocene age, were to be found widely distributed throughout the Old World as well as in the New. Beneath the industrial remains of the precocious Age of Metals in the valleys of the Nile and Euphrates, along the coasts of the Mediterranean and within its ancient island empires were embedded the tools and weapons of men of the Old Stone Age. The remote wastes of the Sahara, the veldt of South Africa, the Siberian steppes, and the river valleys of distant India—all have yielded typical implements of these ancient hunters. And thus it became clear that the range of Palæolithic culture was far greater than was at first realized, and that its origin might be more probably attributed to Asia or Africa, from which it ultimately extended into Europe.

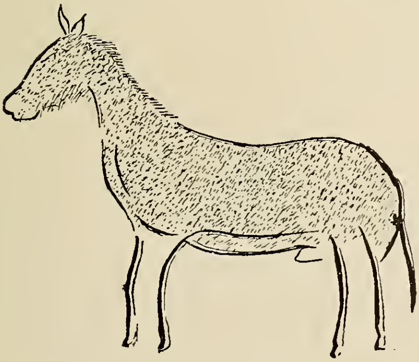
[1]*Fossil Man in Spain*, by Hugo Obermaier. With an Introduction by Henry Fairfield Osborn. Published by the Yale University Press for The Hispanic Society of America.

We are therefore familiar with the picture of Palæolithic man domiciled in Europe, and with the more recent aspect of Palæolithic man in still earlier times established in the East. It remained for Hugo Obermaier to supplement these with a view of Palæolithic man on one of the main-traveled highways, by which he entered Europe. In *Fossil Man in Spain* this view is made accessible to English-speaking readers. Originally published in Madrid (1916) by the Junta para Ampliación de Estudios e Investigaciones científicas of the Spanish Ministry of Education, under

A stag hunt, from a painting in the Cueva de los Caballos the title *El Hombre Fósil*, the appearance of this English translation is due to the initiative of The Hispanic Society of America, and in particular to its president, Mr. Archer M. Huntington.

Owing to the number and importance of the Palæolithic discoveries made in Spain since the publication of his work, it became necessary for Professor Obermaier to subject it to a sweeping revision which included not merely the correction and amplification of the original text, but the addition of much new material embodying accounts of, and conclusions drawn from, these latest Spanish discoveries. Consequently the English version contains much not to be found in the Spanish work, and devotes so much space to Palæolithic discoveries in the Iberian Peninsula that it has been appropriately entitled *Fossil Man in Spain.*

An appreciative introduction by Henry Fairfield Osborn shows with rare insight that, not only in historic but also in prehistoric times, the Iberian Peninsula was a debatable ground, subject to many invasions and characterized by a great variety of racial and cultural elements, each contributing its quota to the amazing and versatile genius of the Spanish people.



This wild ass is engraved on rock at Albarracin

The book is dedicated to the Duke of Berwick and Alba in graceful acknowledgment of the warm interest he has taken in Professor Obermaier's explorations in Spain.

A human figure, painted in the rock shelter of Saltadora

Following the plan adopted in his earlier work *Der Mensch der Vorzeit* and in Professor Osborn's *Men of the Old Stone Age*, Professor Obermaier gives a concise account of the fourfold evidence afforded by geology, palæontology, anthropology, and archæology regarding the life and environment of Palæolithic man in Europe. The geologic record showing the extent and character of the great glaciations of the Pleistocene, the plants and animals of the Ice Age, the climatic changes indicated by these, the fossilized human remains, the successive cultural stages indicated by implements found embedded in the deposits of ancient camps and rock shelters, and the notable artistic achievement displayed in painting, engraving, and sculpture—all these are briefly described in the light of the most recent discoveries.

The origin, extent, and relation of Palæolithic cultures are fully discussed, and are most effectively illustrated by maps and charts which show the chronologic succession, dis-

In this painting from the Cuevas del Civil a war dance of archers is represented

tribution, and probable migration routes of the various industries. Fossil human remains of proved or probable Pleistocene age are enumerated with comments on their racial characteristics and relationships, and the closing chapter gives a most enlightening account of the various industries marking the close of the Palæolithic and the transition to the Neolithic.

The unique feature of the work is that part dealing with the Iberian Peninsula. For years past Professor Obermaier has been a recognized authority on the Palæolithic sites of the Cantabrian region, and has taken a leading part in many important excavations. More recently he has devoted himself to the exploration of the rock shelters of eastern Spain with their remarkable mural paintings, and the shell mounds of the north, characterized by implements of the newly discovered Asturian industry. Being in close touch with other leading investigators of Spanish sites, he has been able to give a detailed account of the latest discoveries in the river drift of the Manzanares near Madrid, and a most extensive report of the numerous stations broadcast throughout the Iberian Peninsula from north to south and from east to west. His work therefore bears the hallmark of personal experience, and his testimony is that of an eyewitness.

During the Ice Age the great mountain ranges of Spain gave rise to a number of local glaciations, the extent of which is evidenced by their terminal moraines. All these are described, from the Pyrenees in the north to the Sierra Nevada in the south, including those explored by Professor Obermaier himself in the

A boar hunt, painted in the shelter of Charco del Agua Amarga

Picos de Cornión, and the estimated height of the snow limit during Pleistocene times is illustrated by cross-section diagrams of the Iberian Peninsula.

limited, and in consequence they would have little effect upon the climate of the lowlands and the Mediterranean coasts, where a survival of those species characteristic of

Archers painted in the Palæolithic rock shelters of Saltadora (above) and Alpera (below), in eastern Spain

a warm or temperate climate might reasonably be expected.

The Pleistocene and present fauna of Spain are compared, and it is shown that the characteristic "cold fauna" of the glacial stages is found only in northern Spain. In regard to the "warm fauna" found at various Palæolithic sites in Spain, Obermaier considers that the area actually covered by glaciers was very

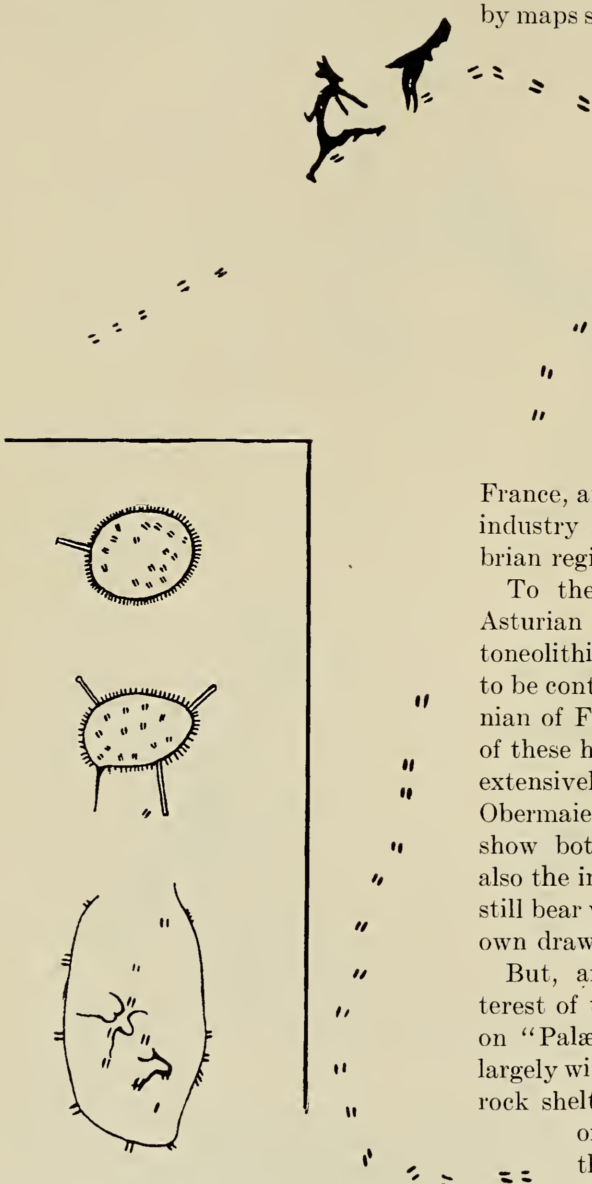
There is also a detailed list of Palæolithic sites in the Iberian Peninsula, classified according to regions and provinces, with particulars of the industrial deposits found at each site. With this for background, the distribution of Early Palæolithic industries—

Chellean, Acheulean, and Mousterian—is described and their probable origin discussed. The far more difficult question of the late Palæolithic industries, with Solutrean and Magdalenian in the north apparently contemporary with Capsian in the south and east, is amply illustrated by maps showing their probable origin and distribution, and offering a very convincing interpretation of the problem they present.

In the closing chapter, dealing with Epipalæolithic and Protoneolithic cultural phases, Spain still plays an important part. The final Capsian of Africa and southern and eastern Spain is identified with the Tardenoisian of northern France, and the origin of the Azilian industry is attributed to the Cantabrian region.

To the same region belongs the Asturian industry—distinctly Protoneolithic in character and believed to be contemporary with the Campignian of France. The scanty remains of these huge shell mounds have been extensively explored by Professor Obermaier, and the illustrations which show both their former extent and also the incrustations of breccia that still bear witness to it, are from his own drawings and photographs.

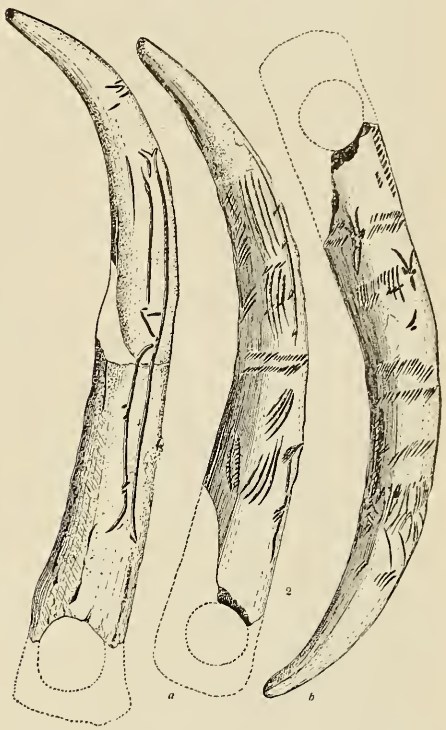
But, after all, the dominant interest of the book lies in the chapter on "Palæolithic Art," for this deals largely with the mural paintings in the rock shelters of eastern Spain which offer a striking contrast to those previously discovered. The realistic paintings in the caves of southern France and northern Spain include numerous portrayals of animals, but are marked by the almost complete absence of any genuine group compositions, and also of



Representations of animal tracks:—The large picture, that of a well-defined spoor which a hunter is following, finds place in the rock shelter of Morella la Vella. The inserted picture represents three traps or corrals from the cave of Pileta portrayals of human figures. The designs found in the shallow caves and recesses of the wild rocky gorges of eastern Spain include numerous spirited groups and frequent representations of human figures. And these daring, impressionistic sketches of warriors, archers, and hunters supply first-hand information in regard to the dress, ornaments, weapons, and methods of hunting affected by the men of the Old Stone Age. A spirited stag hunt, a gathering of armed men, a gentleman in great haste pursuing a wild boar, another pounding his fist and saying (presumably) "I told you so," a wild ass etched in careful detail, a "war dance" (or could it be a prehistoric "daily dozen"?), corrals with tracks of trapped animals inside, a hunter following a well-defined spoor in the open, a wounded chieftain falling in his death agony—these are some of the pictures portrayed by fossil man.

In discussing the psychology of this Palæolithic art the author is careful to remind us that this can be only a matter of conjecture, but presents a most interesting and reasonable interpretation of its probable motives.

It is safe to say that no reader of *Fossil Man in Spain* will question that Professor Obermaier fully proves his claims that "The cave art of western Europe, especially of eastern Spain, constitutes one of the most important and fortunate discoveries ever made in behalf of archæology" and that



Perforated staves of stag horn ornamented with engravings of fish, ibex heads, and other decorative designs. From Cueto de la Mina

"Day by day it becomes clearer that Spain is destined to play a most interesting rôle in all that concerns the study of Palæolithic Man."

Photograph by Julius Kirschner

EDMUND OTIS HOVEY

For more than thirty years associated with the department of geology, American Museum and for fifteen of those years its curator; editor of the AMERICAN MUSEUM JOURNAL (now known as NATURAL HISTORY) during the first ten years of its existence; an officer and active worker in several societies devoted to science and exploration, and the author of important contributions in his field of investigation,—Doctor Hovey served the cause of learning with devotion and efficiency up to the day of his death

Edmund Otis Hovey
1862-1924

LATE CURATOR OF GEOLOGY AND INVERTEBRATE PALÆONTOLOGY, AMERICAN MUSEUM

By JAMES F. KEMP
Professor of Geology, Columbia University

THE sudden death of Dr. Edmund Otis Hovey on September 27, came as a great shock to a very wide circle of colleagues and friends. To an extent not often equalled by a geologist, Doctor Hovey had been for many years a traveler and observer, and his journeyings extended from the extreme north of Greenland to the southern latitudes of Australia and New Zealand. The official positions which he had held during the thirty-five or forty years of his scientific activity were such as to give him an exceptionally large acquaintance at home and abroad; hence, the grief and regret at the all-too-early termination of his work are world-wide.

Doctor Hovey was born in New Haven, Connecticut, September 15, 1862, and thus was at the time of his death just past his sixty-second year. His father, the Rev. Horace Carter Hovey, was a minister who occupied Presbyterian and Congregational pulpits, and, like Doctor Hovey's mother, whose maiden name was Helen L. Blatchley, came of colonial New England ancestry. The Rev. Horace Hovey had strong geological interests and was a Fellow of the Geological Society of America. He was graduated from Wabash College, Indiana, in 1853; attained his D.D. in 1883; and, in consequence of holding pastorates in the drainage basin of the Ohio River, was able further to develop an interest in caves that dated back perhaps to his early youth. Regarding these formations he left several contributions, including a guidebook to the Mammoth Cave of Kentucky. Some twenty-seven titles are attributed to him in the bibliography of North American geology; his earliest papers began during the boyhood of his son, whose thoughts were not unnaturally directed toward geology.

Edmund Otis Hovey received his earlier education in the public schools of Peoria, Illinois; Kansas City, Missouri; and New Haven, Connecticut. He entered Yale in the fall of 1880 and was graduated with the class of 1884. Thereupon, he taught school for two years, serving as principal at Janesville and Elk River, Minnesota. In 1886 he returned to Yale to pursue graduate work in geology, looking toward the Ph.D. degree, which he received in 1889.

During this period he was for two years assistant in the mineralogical laboratory and came into close association with one of the choice spirits of American science, the late Prof. Samuel L. Penfield. He wrote his dissertation under the special charge of Prof. James D. Dana and chose for his subject, "The Trap Ridges of the East Haven-Branford Region." The paper was published in the *American Journal of Science*, pp. 361–83, November, 1889. It is an accurate and careful record of the detailed geology in a district eight or ten miles by four or five, embracing not only matters of petrographic interest, but some structural problems calling for skill in interpretation. The young geologist gave evidence of conscientious fidelity in his descriptions and of much independence in his interpretations, which differed in important respects from those given the phenomena by preceding, older observers.

For the three years, 1888–91, Doctor Hovey was assistant principal of the Waterbury High School in Connecticut, and then, for a year, its principal. In this busy manufacturing city he gained many friends and is well remembered even to the present day by those who became attached to him so long ago.

While on leave from his school duties, he passed the year, 1890–91, in Europe. Instead of constantly traveling, Mrs. Hovey and he took up their residence, for periods of a month or more, now in this city, now in that. In Naples, for example, with its great opportunities for the study of Vesuvius, they established their home in a small apartment and kept house, learning, thereby, incidentally much of Italian life and customs. In the same way they found quarters in Heidelberg, where Doctor Hovey matriculated in the university and worked during the semesters in the laboratory of the famous teacher, Professor Rosenbusch. Among his fellow students was J. J. Sederholm, now director of the Geological Survey of Finland and Doctor Hovey's life-long friend.

Doctor Hovey's ambitions lay in the line of professional geological work; accordingly, in 1892 he accepted the appointment as superintendent of the Missouri State Exhibit of Minerals at the Columbian Exposition, which was opened in Chicago in 1893. Doctor Hovey brought together a notable display of the lead, zinc, and iron ores, and of the coals, fire clays, and other products of this very richly endowed state. On January 1, 1894, after the exposition had closed, Doctor Hovey joined the staff of the American Museum of Natural History, serving at first as assistant curator in geology, under the late Prof. Robert Parr Whitfield. In 1901 he was promoted to associate curator, and on the decease of Professor Whitfield in 1910, succeeded to the curatorship, an office which he held and in the active duties of which he was engaged at the moment when, near the noon hour of September 26, he was suddenly stricken and removed to the Roosevelt Hospital. There, twelve hours later, he passed away.

In his thirty years of service with the Museum Doctor Hovey became thoroughly experienced in the instructive and effective display of geological specimens and illustrative materials. During his earlier years he was largely occupied, in collaboration with Professor Whitfield, in cataloguing the types and figured specimens of fossils which had found their final resting place in the rich collections of their department. When, as was often the case, the writer of these lines dropped in for a brief call or consultation, he usually found Doctor Hovey busied, during these years, over trays and trays of specimens, searching out and verifying those that were figured subsequently in the issued volume of record, a work of five hundred pages. In his later years Doctor Hovey did much editorial work for the Museum, and for the ten years, 1900–10, was editor of its magazine, then called THE AMERICAN MUSEUM JOURNAL, but now known as NATURAL HISTORY, and one of the most attractive of American publications.

In the service of the Museum, Doctor Hovey traveled widely and aided in securing some of its more notable treasures. Prominent among these is the Willamette meteorite. In order to bid for this specimen effectually, he went to Portland, Oregon, in the neighborhood of which the meteorite had been found. At another time, he visited Bisbee, Arizona, so as to study the geology of the great Copper Queen Mine and its environment, in preparation for the building of the exceedingly instructive model in the Museum, the gift of the late Dr. James Douglas, president of the company.

At the destructive outbreak of Mont Pelée, Martinique, in 1902, Doctor Hovey was promptly dispatched to study the volcano and collect for the Museum a suite of illustrative specimens. He brought back many volcanic products, including a number of bombs, and a remarkably good series of photographs, from which the vivid painting of the famous "spine," by Charles R. Knight, was prepared. This picture now hangs on the walls of the meeting room of the New York Academy of Sciences, in the Museum. The study of volcanoes, begun at Vesuvius in 1890, became a subject of special interest to Doctor Hovey and was carried on by him whenever the opportunity was afforded.

Doctor Hovey was a delegate to several of the meetings of the International Geological Congress, which offer such exceptional opportunities for forming international friendships and for seeing the most significant geological features of other lands. He attended the St. Petersburg Congress in 1897 and took part in its long excursion to Armenia and the Caucasus. He climbed Mount Ararat and brought back a series of fulgurites from one of its high peaks. Again, in 1903, he was a delegate to the session in Vienna and enjoyed the excursions in the eastern Alps. He was at the Mexican Congress of 1906 and joined in the preliminary excursion to the active volcano of Colima, which possessed special attractions for him. After the week of scientific meetings, he took part in the three weeks' excursion north on the Mexican Central Railroad, then eastward to Monterey, and, finally, south on the Ferrocarril Nacional Mexicano. He next visited the Isthmus of Tehuantepec. From all these trips he returned with specimens and photographs of great value in the exhibits and lecture courses of the Museum. Following the Congress of 1906, he was elected one of the corresponding members of the Sociedad Científica Antonio Alzate of the City of Mexico.

Doctor Hovey was a delegate to the First Pan Pacific Scientific Congress, which met in the Hawaiian Islands in 1920, and again viewed his favorite subject of study, a volcano. In 1923 he attended the Second Pan Pacific Scientific Congress, in Australia, and traveled extensively in New Zealand, bringing back many instructive photographs, which served to illustrate his lectures in the Museum courses.

In the spring of 1915 Doctor Hovey went with the relief expedition dispatched to bring back the party which had been sent out the previous year to explore Crocker Land. Doctor Hovey reached Etah, the station in the extreme north of Greenland whence Peary, several years before, had started on his dash for the Pole. Unfortunately the conditions made the return of the Crocker Land Expedition in the summer of 1916 impossible; so that it was not until the next year that the party, after a long, overland trip with sledges, was picked up by the relief ship. Doctor Hovey made one earlier attempt to move southward, but the physical strain proved too severe, and he was forced to return to the central station. A very interesting account of the geology of northern Greenland appeared from his pen in the issue of the *American Journal of Science*[1] for September, 1924. In clear and interesting language, and drawing both upon his own observations and those of the most recent explorers, he gives a review of our knowledge of this little-known region.

In 1907, when a reorganization of executive offices was undertaken in the New York Academy of Sciences, Doctor Hovey was elected recording secretary, and to the duties of his office were transferred those formerly discharged by a separate editor. For nine years Doctor Hovey held this office, a change being occasioned only when his protracted stay of two years in the Arctic made the appointment of a new and regular occupant of the double office unavoidable. The services that Doctor Hovey rendered to science in this connection were very important. Not only was the annual volume, the *Annals*, yearly put through the press under his direction, but thanks to his efforts the results of the Academy's Scientific Survey of Porto Rico and the Virgin Islands began to reach completed form. Doctor Hovey was above all things a careful and systematic worker and managed to carry these responsibilities as well as those to which we next pass so that no confusion or delay resulted.

Undoubtedly the relation in which Doctor Hovey came in touch with geologists most extensively and in the most important way was as secretary of the Geological Society of America. The society includes in its membership practically all the working and productive geologists of the North American continent and not a few residing abroad. It is strong, active, and influential. Since its founding in 1888 up to 1922, only three men had served it as secretary. Prof. John J. Stevenson occupied the office from 1888 through 1890. Ill health compelled him to diminish his cares so that, after seeing the Society safely through its infancy, he retired in December, 1890. Prof. H. L. Fairchild succeeded to the duties and remained in office seventeen years, until 1907. Doctor Hovey was then elected, and for sixteen years was the officer who more than any other was responsible for the conduct of the society's affairs. His administration was marked by a careful and systematic management. His knowledge of its history, its policies, and the spirit actuating its successive councils was thorough and accurate. No subject came up in his later years of administration, affecting in any way the policies of the society, without his prompt citation and quick finding in the records of all previous related action. The society had to face growing specialization and subdivision of old interests, once brooded under the wings of the parent organization. The palæontologists first organized an affiliated body, in close association with it. The mineralogists followed suit. The petroleum geologists were mostly in the mid-continent field and became inevitably a separate body, but with cordial relations with the Geological Society. Many geologists were and are members of both. The economic geologists formed a separate society in 1919 and maintain toward the Geological Society a position intermediate in intimacy between that of the palæontologists and mineralogists,

[1]A notice of this contribution appeared in the issue of NATURAL HISTORY for September–October, 1924, pp. 627–28.

on the one hand, with whom the relation is close; and the petroleum geologists, on the other, with whom the connection is one of sentiment and not organic. All these questions of policy came up during the years of Doctor Hovey's incumbency and in their decision he played an important part.

At the annual dinner of the Geological Society, held during the Ann Arbor meeting of December, 1922, a loving cup was presented to Doctor Hovey in token of the appreciation felt by the members for his sixteen years of faithful service and their high regard for him; and at the dinner, during the Washington meeting, in December, 1923, a beautifully engrossed testimonial from the council, as representative of the society, expressed in a more extended way the feeling of indebtedness of the society's guiding body. In no one of the many connections which Doctor Hovey had during his life, has he left more numerous or more devoted friends than in the Geological Society of America.

Doctor Hovey entered zealously into many activities of his home city, New York. He was an active member of and a worker in the Presbyterian Church. At the Century Club and the Explorers Club he was a familiar figure; at the time of his death he was vice president of the latter. He was also connected with the New York section of the American Institute of Mining and Metallurgical Engineers, in the membership of which were many of his friends. In later years, he made his home in Yonkers, coming daily to his office in the Museum.

Doctor Hovey was a prolific contributor to the literature of geology, and about one hundred fifty titles stand to his credit. Perhaps the most notable contribution related to Mont Pelée, in Martinique, and to La Soufrière, in St. Vincent. Soon after his return from an inspection of these volcanoes, he read, at the International Geological Congress in Vienna, an account of his observations. It was his plan and ambition again to visit the Lesser Antilles in 1925 and then, with the old notes and the new, to prepare his complete report.

Doctor Hovey was married September 13, 1888, in New Haven, Connecticut, to Miss Esther A. Lancraft, a graduate of Mt. Holyoke College and, in later years, president of its Society of Alumnæ. She died in 1914. On October 23, 1919, Doctor Hovey dispelled the loneliness of his home by his marriage with Miss Dell G. Rogers, of Springfield, Massachusetts. Mrs. Hovey, with one daughter, Constance, four years old, survives, and to them the thoughts of Doctor Hovey's many and devoted friends have often turned in recent weeks.

The Museum of Tomorrow

By GEORGE SARTON
Editor of *Isis*

THE arrangement of museums has been considerably improved within the last fifty years. Their scientific and their educational value has grown in proportion. They have now become, not simply conservatories, but true universities. And when I say that, I am not thinking of those museums—such as the Paris museum for example—which organize complete courses of lectures and which are thus in every respect the equivalent of a university faculty; I am thinking of museums only as museums, not as lecture halls or classrooms. Their silent teaching is probably their best teaching. Its value consists in its perfect adaptation to the special needs of each individual. Every thoughtful visitor to a museum gets out of it as much as he chooses or, more exactly, as much as he is capable of assimilating, as much as he deserves. There is no constraint whatever, there are no obligations but inner ones. The museum is entirely open to him and ready to answer every question which he may ask. More than that; it is ready to awaken his mind, to raise questions itself; to introduce new subjects, new thoughts; to open, as it were, windows offering him new vistas, broadening his mental horizon in every way.

For example, let us imagine a man, an intelligent man, knowing nothing of palæoanthropology—nay, having never heard or thought of it—finding himself by some combination of circumstances in the hall of the American Museum devoted to the Age of Man. He would be at first startled, then fascinated, and would spend perhaps a couple of hours examining the objects on exhibition and reading carefully every label. This visitor would come out of the Museum with a good introductory knowledge of the subject. He would then be very well prepared to read a book connecting and organizing the information already obtained; and having acquired some familiarity with the objects described, he would read it with real interest and profit. Indeed, even if the book were as up-to-date as the museum—which is not by any means certain—he would already have something which the book could not give him, for he would have seen the objects themselves, or perfect models of them, the very testimony bearing on the questions discussed,—and no book illustration can possibly take their place.

One of the many problems which museum curators have to solve is to determine the degree to which the silent teaching can be extended or, more concretely, what amount of information it is advisable to print on the labels. They have to assume that the visitor's knowledge is very limited. Yet their explanations must remain relatively short, in the first place, because it is impossible or inexpedient to teach a whole subject apropos of a special topic and, in the second place because labels of inordinate length would rarely be read. Even the most zealous visitor would find it hard to read, standing, many such labels; fatigue would soon relax his attention.

I love museums and have visited carefully a good many. I have read innumerable labels relative to subjects with which I was very familiar, and as many others regarding subjects of which I knew much less, if anything. My general impression is that the art of label-writing is on the whole very well understood. I have seldom seen bad labels. The greater number are very well composed but many are far too long. Yet, even when their length fatigued me, I did not see how they could have been materially shortened.

Labels which are too short are bound to be misunderstood, except by experts, or to remain enigmatic; if they are too long, they will not be read or they will exhaust very quickly the reader's zeal. Is there no way out? I believe I have found one.

Most museums, aside from their scientific publications, print various leaflets for the use of the average visitor and also post cards. The sale of such post cards must be very considerable, especially if they are really good. Each of these cards, as soon as it is sold, becomes a memento which extends the educational influence of the museum into thousand of homes, scattered all over the world.

The label problem would be admirably solved by a more systematic and intelligent use of these cards, and also of other museum publications. The main defect of the present system is that the public does not know sufficiently which cards are available. This information should be given to the visitor at the psychological moment, when he longs for it and is best prepared to take it in, that is, at the very moment when a certain object has awakened his curiosity and when he is making a more or less painful effort to read the explanatory label. Long labels should not be suppressed but supplemented by cards reproducing their text together with an illustration of the object explained. A number clearly marked on the label should refer the visitor to the corresponding card and would enable him to buy it easily before leaving.

The reading of a label would then become much less tiring because the visitor would not make any serious effort to memorize it. Neither would he be dismayed if he did not understand it well at once, for having noted its number on a slip of paper, he would depend on the possibility of obtaining a copy of it, to be perused at leisure.

The reform which I advocate is very simple and very humble; yet its introduction would imply a great progress. It would increase considerably the teaching value of museums. To illustrate this, let us suppose for a moment that a museum has been organized according to my views. That is, the main objects on exhibition are explained, as much as possible, on labels placed close by, at a convenient height, and printed in a beautiful and very legible type. Some other labels are added, whenever necessary, to give more general information relative to a whole group of objects. Thus far I have simply described the practice followed in every progressive museum. In my museum, however, each of these labels bears in the upper right hand corner a very legible number. As soon as a visitor enters the building, he is given a card containing on one side an explanation of these numbers and a plan of the museum or a brief list of the main collections. The other side is lined and blank. The explanation reads as follows:

When a label bears a number in the upper right hand corner, it means that the museum has published a post card (bearing the same number) representing the object in question and reproducing the label with possibly some additional information and bibliographical references. Write on the back of this card label numbers of the objects interesting you. The post cards (or other publications) relative to them may be obtained, by quoting these numbers, at the office near the exit.

In this way the visitor is able to acquire without fatigue and without trouble, the information which is of greatest value to him. He has also the opportunity of increasing his knowledge, should he so desire, for the post card bears the title of the best book or paper devoted to the subject.

I have spoken chiefly of cards, which represent the most general and the most important case, but other publications and (chiefly in art museums) photographs could be referred to on the labels by appropriate symbols. For example, the number of a label and post card being 245, the symbols 245A, 245B, 245C might refer respectively to a photograph, a leaflet, or a larger memoir or book relating to the same object. Thus the visitor reading in the upper right corner the number 245AC would know at once that he could obtain a post card, a photograph, and a book relative to that object. Moreover, each leaflet or memoir published by the museum would be referred to upon at least one post card.

Teachers visiting my museum either alone or with their classes could make use of this system in many ways. They might order cards in large numbers to be distributed to the children during a preparatory lesson; or, better still, they might take their pupils to the museum and invite them to choose the most interesting objects. The corresponding cards would be eventually ordered, studied, and discussed in the classroom, as well as out of it, and a new visit to the museum arranged to reexamine the objects, make further comparisons, and solve the difficulties encountered. It is not necessary to expatiate on this. The reader will easily conceive many other possibilities. It is clear this simple device would materially increase the educational value of the museum.

The application of my system would be relatively easy. The labels are made, the objects have been photographed; in many cases, the cards already exist. It would suffice to number them and to issue the little plan card explaining the system. Of course, it would be better to start with a sufficiently large number of cards representing many aspects of the museum. Some of these cards might be grouped into series and it should be made easy for visitors to obtain, according to their desires, the whole collection or separate series or independent cards.[1] The initial cost would not be great and the system would be soon self-supporting.

I may point out, furthermore, that the system is applicable to any museum, irrespective of kind or size. It would be easier, perhaps, to apply the plan in larger museums, because there an assistant would have no other duty than the sale and distribution of these cards. The scheme would be very useful also in smaller museums, not merely in serving their local community, but likewise in spreading their influence abroad, because interesting objects on view in small museums are likely to be less known than those sharing the vast publicity and prestige of the larger institutions. Each card is not merely a document for the student, a memento, a hint, but a true representative of the museum, a humble but faithful missionary.

[1]This has been done with considerable success by the British Museum. The influence exerted by the British Museum in that way is truly far-reaching. In 1922 the number of cards sold totaled about 700,000.

A GILYAK

The Gilyaks, it is reported, number 4649 individuals. Some time ago they occupied all the basin of the Amur River, but from there they were driven out by stronger tribes. At the present time they live partly at the mouth of the Amur, and partly on the Island of Sakhalin.

They excel in wood carving and make artistic representations of the bear, an animal that plays an important role in their religious ceremonies. Birch bark is also a material they employ in various ways and like the Golds (see pp. 714 and 715), they make garments of fishskin

Natives of the Russian Far East

PICTURED FROM STUDIES MADE BY V. K. ARSENIEFF

Politically Siberia is an eastward extension of Europe. It is not out of place, therefore, in an issue of Natural History in which Europe is given special emphasis to include some reference to the far outposts of Russian dominion in eastern Siberia and beyond. The illustrations introduced by the above picture have been supplied through the kindness of Mr. V. K. Arsenieff under whose supervision they were prepared by the artists A. H. Klementieff and N. P. Trafimoff for the great exhibition held at Moscow in 1923.

A GOLD MAN

There are 5016 Golds, living partly on the Sungari and Usuri rivers but chiefly on the lower reaches of the Amur River, not far from Lake Kizi. Though the Golds may be classed with the settled tribes rather than with the nomadic, the tie that holds them to their place of abode is after all a loose one. They leave a locality readily and migrate to another site.

The greater part of their lives is spent on the water, paddling in the inlets of the Amur or along this and other rivers. In hunting the sable they make long journeys, penetrating even into the most desolate parts of the Sikhota-Alin Mountains, and thus they have come to know, better than do any of the other natives, the rivers, the paths and mountain trails, the ridges and watersheds of the region

A GOLD WOMAN

The Golds wear embroidered garments, but this is not their only or most characteristic apparel. Decorated fishskin garments are also worn by them and because of this the Chinese call the Golds Yupi-tatse, "Fishskin people." A number of such coats are exhibited on the third floor of the American Museum, and in the cases devoted to the Golds may be seen also conical hats of the type of that worn by the woman in the picture. These hats are made of birch bark and are ornamented with colored figures cut out of the bark of that tree. Another type of head covering is that worn by the Gold man on the opposing page. This kind of hat, provided with earlaps and topped with the tail of a sable, is also represented in the collections of the American Museum

A LAMUT MAN

The Lamuts are seacoast Tungus and derive their name from the Tungus word *lam*, meaning "sea." They live part of the time on the upper reaches of the right-hand inlets of the River Lena, in Kolymsk, and in Kamchatka. Altogether they number 3130 individuals. Nowhere do the Lamuts have their own land, but they consider all land as belonging to them.

The bison supplied food, raiment, and shelter to our Plains Indians. The reindeer is no less useful to the Lamuts. It forages for itself and provides food and clothing for its master, in addition to transporting him from place to place. With its assistance the Lamuts are able to make their migrations

A LAMUT WOMAN

The fur garments of the Lamuts are of rather striking appearance, being usually decorated with designs produced by combinations of blue, white, and black beads. Both the costume of the woman above and that of the man on the opposing page have ornamentations of this character The large spoon she is holding is similar to one of wood on exhibit in the section devoted to the Lamuts on the third floor of the American Museum, and several smaller spoons of mountainsheep horn may there be seen. A flintlock of Russian manufacture similar to that grasped by the man is also on view in the section referred to, as well as wooden pipes with metal bowl of a type similar to that held in the right hand of the man

AN AINU

This venerable individual is a member of a race once widely spread over Japan. Today his people have dwindled to a few thousand, some of whom are on the island of Sakhalin, which up to the time of the Treaty of Portsmouth, was exclusively under Russian control but is now divided between Japan and Russia. The Ainus have a white skin and are heavily bearded, and in these respects form a contrast to the Japanese. They are the most humble perhaps of all peoples, lacking aggressive qualities.

The man is shown tuning a *tonkari*, or *mukko*, an instrument belonging to the psaltery type. Unlike the Japanese *koto*, which is laid on the ground or placed on a stand, the *tonkari* is held with the end having the tuning pegs up over the left shoulder. It is played with the fingers of both hands after the manner of the harp. The instrument that is most closely related to the *tonkari* of the Ainus appears to be the crocodile harp of Siam and Burma. Specimens of the *tonkari* are on view in the Ainu section on the third floor of the American Museum

NOTES

HERBERT L. BRIDGMAN

Herbert L. Bridgman, who recently died at sea in his eighty-first year, will be remembered for many things, for he poured the rich stream of his energy into a number of worthy activities and was the champion of many noble causes; he was, in the eloquent words of the Rev. Dr. Howard Dean French, "an adventurer in the service of mankind." His career in journalism, culminating in his affiliation with the *Standard Union of Brooklyn*, was throughout distinguished, and the confidence and respect extended to him by the newspaper world were evidenced by his election to the chairmanship of the New York Publishers Association and the presidency of the American Newspaper Publishers Association.

His interests, however, were not limited to his chosen profession. He was a member of the Board of Regents of the University of the State of New York and an earnest participant in public affairs. Throughout his life exploration claimed much of his attention. In 1897 he scaled the Enchanted Mesa in New Mexico. During the long years that Peary was stubbornly fighting his way to the Pole, Mr. Bridgman was actively assisting him. He commanded two auxiliary expeditions in support of Peary's project, that of the "Diana" in 1899 and that of the "Erik" in 1901, and as secretary of the Peary Arctic Club aided Peary materially in accomplishing the purpose to which he dedicated his life.

President Morris K. Jesup of the American Museum was also president of the Peary Arctic Club, and it was natural, therefore, that the two organizations should be brought into more or less close contact. Mr. Bridgman's interest in the American Museum received its impetus at that time, and it remained strong to the end. To the Peary Arctic Club and its officers the Museum is indebted for the gift of one of the sleds that made the journey to the Pole, as well as of photographic records and other valuable historic data. Thanks to the tact shown by Mr. Bridgman in the course of his visit, at the age of sixty, to the interior of Africa, a courteous welcome was assured other Americans entering the same general region, and thus indirectly the American Museum Congo Expedition profited from the reputation for fair dealing and good sense that had been established by Mr. Bridgman. In other ways, too, he was of great assistance to the Museum, many a time bringing it to public attention through the *Standard Union*. In recognition of his unswerving loyalty to the Museum and his never-failing helpfulness, he was accorded the unusual honor of being elected an Honorary Fellow of this institution.

INSECTS

An Insect Menagerie.—A departure from the orthodox museum exhibit has been made in the American Museum through the installation of a case containing a diversity of live insects. When the first specimens were introduced, they were allowed a free range of the case, but with the pressure of population resulting from constant new accretions it became necessary to confine the different groups in glass dishes, bowls, and aquaria, so that the pertinence of the labels might be preserved and confusion avoided.

Within the limits of a case a few feet square the visitor has been able to observe a range of animal habit as great as that represented in vertebrate menageries by the flesh-eating tiger and the herbivorous elephant, and a range of structure comparable to that of the water-living fish and the arboreal monkey. *Utethesia bella*, one of the most beautiful of the moths, has developed from caterpillar to adult in this insect menagerie. Beyond the glass dome in which it is housed with its principal food plant, the rattle box, is a dish in which *Sitodrepa panicea* is reveling. Because of its ravages in pharmacies, where it will feed without apparent injury even upon poisons, this insect is commonly known as the drug-store beetle. It appreciates as food what man nerves himself to swallow as a medicine, but by way of indicating the omnivorous character of *Sitodrepa panicea*, it is shown in the exhibit pasturing on corn meal. Insects of unsavory reputation like the cockroach and the unspeakable bedbug are also exhibited, but with labels so informing that one is reconciled to their presence. A box of cigars ruined for the smoker by a small beetle (*Lasioderma serricorne*) that chews tobacco is another feature.

Farther along are the interesting water insects,—the Belostomidæ, some of which attack even good-sized fish; the water striders that delight us by skating about on the calm surface of ponds and slowly moving streams; the water scorpion with a "tail" that serves as a breathing organ; and the aquatic larvæ of the dragon fly and damsel fly.

Specimens of the grass-green praying mantis formed one of the most interesting features of the exhibit. As this Note is written, one survivor is still on view, statuesquely waiting, with her traplike front legs raised not in prayer but in readiness to grasp the hapless insect that may approach her. A foamy egg mass on her twig and another on the glass wall of her prison were deposited during her period of captivity and are an evidence of the interesting biological happenings which the visitor who lingers about the live-insect case may have the opportunity to observe.

One of the attractive features of the exhibit is its very impermanence. A visitor may step in today and see a different group from that which he witnessed last week. Thus there is a constant replenishment of interest. Yet from another aspect even the insects that are replaced are permanently accessible. The live-insect exhibit is in a hall filled with cases of insect specimens and the labels applying to the live insects frequently have cross references to the collections, with the opportunities for more extended study that they offer the interested visitor.

The Lady Beetle Group.—Among the best friends of the farmer are the lady beetles, whose consuming purpose in life, from infancy to old age, is to destroy plant lice and scale insects. But for the vigilance and voracity of these allies of the horticulturist, the ravages of some of our insect pests would be even more appalling. In the mountainous regions of our West untold thousands of these beetles, their beneficent summer's task completed, fly to some height—the more lofty, the better—to secrete themselves in cracks and crevices of the rocks for hibernation. Here, with the return of spring, they may be seen pouring forth from their winter hiding place, a great sprawling stream of life in which the later outwellings may overflow those that preceded, until there is a piled-up struggling heap of insects that can be scooped up by the handful.

In some parts of our country—California, for instance,—the lady beetles thus hibernating are gathered, placed in cold storage, and shipped at the proper time to horticulturists whose crops are threatened by invasions of insect enemies. In this way, like shock troops held in reserve for some storming operation, the beetles are sent to strategic points instead of being permitted to wage war in desultory fashion.

A spring emergence of the kind above described is depicted in the most recently completed insect exhibit on the third floor of the American Museum. The scene is the top of Green Mountain, near Boulder, Colorado. In the foreground are the emerging insect hordes, in the far distance are the white peaks of the Snowy Range of Rocky Mountain Park, and between are deep cañons and rugged prominences. Yet the exhibit measures only about 3 feet by 4 feet!

The illusion of vast distance and commanding height is achieved in ingenious ways. The window through which the scene is viewed is so narrow that the eye does not take in the whole vista at one glance but has revealed to it only gradually the features of the landscape, thus simulating the conditions that obtain as one looks from some height upon the beauties of nature that lie to the east and south and west. The depth of the cañon flanking Green Mountain is admirably conveyed through the inability of the eye to range very far down its side, an abyssmal drop being suggested at the point where the eye is denied a further downward view.

The foreground of this effective group was made by Mr. Edward J. Burns, the background was painted by Mr. Arthur A. Jansson, both under the direction of Mr. James L. Clark, while field work and the general plan of the exhibit were the contributions of Doctor Lutz.

Two other exhibits in the series in which the Lady Beetle Group finds place are nearing completion. One of these shows an undesirable alien from Europe, the white cabbage butterfly (*Pieris rapæ*), in possession of a patch planted with the vegetable to which it is partial; the other illustrates phases in the life history of a butterfly that annually makes long migrations, the monarch (*Danaus archippus*), here shown in association with its favorite food plant, the milkweed.

BIRDS

The American Ornithologists' Union held its Forty-second Stated Meeting at the Carnegie Museum, Pittsburgh, Pennsylvania. There was a large attendance of bird lovers from all parts of the country who listened

THE LADY BEETLE GROUP, AMERICAN MUSEUM

with appreciation to the interesting papers, the presentation of which extended through the morning and afternoon sessions of November 11, 12, and 13. Indeed, so full was the program that on the morning of two of the days independent sessions were run simultaneously. The American Museum was represented by Dr. Frank M. Chapman and the other members of the department of birds, and in addition by Mr. H. E. Anthony of the department of mammals, Mr. J. T. Nichols, of the department of fishes, and Mr. F. L. Jacques, of the department of preparation. Of the fifty-six papers announced in the program, fourteen were prepared by members of the scientific staff of the American Museum, and were delivered in the following order:

"Progress of the Whitney South Sea Expedition" by Dr. Robert Cushman Murphy; "Mutation in *Henicorhina*" by Dr. Frank M. Chapman; "The Status of Kumlien's Gull" by Dr. Jonathan Dwight; "A Few Remarks on *Cyclarhis*" by Mrs. Walter W. Naumburg; "Distribution and Relationships of the Genus *Zonotrichia*" by Mr. Rudyerd Boulton; "Descriptions of New Birds from Costa Rica" by Dr. Jonathan Dwight and Mr. Ludlow Griscom; "The Systematic Position of *Bubalornis* and *Dinemellia*" by Dr. James P. Chapin; "An Ornithological Reconnaissance in Southern Chile" by Dr. Frank M. Chapman; "Bird-hunting in Unexplored Panama" by Mr. Ludlow Griscom; "Breeding Seasons of Birds in Tropical Africa" by Dr. James P. Chapin; "The Recent Status of the Bird Life of Cobb's Island, Virginia" by Mr. Rudyerd Boulton; "The Interrelation of the Campo and Amazonian Faunas" by Mrs. Walter W. Naumburg; "Some Problems of Geographic Distribution in Western Panama" by Mr. Ludlow Griscom; and "The Faunal Regions of the Western Hemisphere" by Mr. W. DeW. Miller. Mr. J. T. Nichols was to have delivered a paper on "Naming Shore Bird Tracks" but was prevented from doing so through the necessity of returning to New York earlier than he had planned.

One of the features of interest at the gathering was an exhibition of paintings by American bird artists; and both from the standpoints of the number of artists represented and the quality of their work this exhibition marked a notable advance over those held in other years. Among the new artists whose paintings were particularly admired was Mr. F. L. Jacques, who has but recently joined the department of preparation, American Museum.

To Mrs. Walter W. Naumburg, research associate in the Museum's department of birds, was accorded the honor of election as a member of the American Ornithologists' Union, a distinction limited to one hundred individuals and heretofore extended to only two other women, Mrs. Vernon Bailey and Mrs. Mabel Osgood Wright.

The National Association of Audubon Societies held its Twentieth Annual Meeting in the American Museum October 28. The business session, with the presentation of the annual reports, took place in the morning, the confidence of the association in its able directorate being manifested through the reëlection of those members of the Board whose term of service had expired. After a buffet luncheon, an Educational Conference was conducted by Mr. Edward H. Forbush, several of the members present discussing the opportunities for furthering the knowledge of birds among young and old through the facilities at the command of the association. Mr. Edward Avis then gave his delightful "Bird Song Recital," reproducing the notes of the field and forest with such astonishing faithfulness that it seemed hard to believe that tones of this liquid and flutelike quality could be engendered by the vocal organs of a man.

Mr. Avis was not the only individual who added to the instructive entertainment of the session. At the public meeting held in the Auditorium of the Museum on the evening preceding the official gathering, Dr. A. A. Allen gave an informing talk, illustrated by many excellent lantern slides and motion pictures, of his recent visit to Texas and the Everglades of Florida, where he engaged in a successful search for some of the rarer birds of the southern region of our country. Doctor Allen's address was preceded by one delivered by Mr. T. Gilbert Pearson, president of the association, in which Mr. Pearson pleaded for sane conservation.

EDUCATION

Western Reserve University.—October 9 was an eventful day in the history of Western Reserve University. In the morning Dr. Robert Ernest Vinson was inaugurated as seventh president of the institution and in the afternoon the new building of the school of medicine was dedicated. A large number of delegates representing universities, colleges, schools, scientific societies museums, and educational associations located throughout the country testified by their presence to the interest of the learned world in these vital happenings. The American Museum was represented on the occasion by Dr. H. L. Madison, acting director of the Cleveland Museum of Natural History, and by Mr. Lewis Blair Williams, of Cleveland.

Doctor Vinson succeeds to an office left vacant in 1921 through the retirement from active service of President Charles Franklin Thwing, who had discharged his duties with vigor and distinction for more than thirty years. In the interval between the retirement of Doctor Thwing and the inauguration of his successor, Doctor Williamson as acting president guided the fortunes of Western Reserve. With the heavy responsibilities that his appointment involves Doctor Vinson is especially well fitted to cope, for he has had not only an important career as a teacher but also administrative experience extending over many years during which he held the presidency of the Austin (Texas) Presbyterian Theological Seminary and subsequently that of the University of Texas.

In connection with the dedication of the new building of the school of medicine, it is fitting to recall that it is now more than eighty years ago that instruction was begun in the Cleveland Medical College, which subsequently became the medical department of Western Reserve. The first medical school building was erected at a cost of $20,000 during 1846–47. The second building, the gift of Mr. John L. Woods, who donated $243,000 to cover the cost of its erection, was begun in 1885 and dedicated in 1887. Although in the course of the decades that followed the facilities of the school were extended through the erection of a chemical laboratory building in 1898 and of the H. K. Cushing Laboratory of Experimental Medicine in 1908, it was not until this year that a third medical building was presented to the institution. This building, to the dedication of which the afternoon ceremonies of October 9 were devoted, was made possible through the sum of $2,500,000 generously donated for the purpose by Mr. Samuel Mather.

Rensselaer Polytechnic Institute, the oldest existing college of science and engineering in any English-speaking country, celebrated the one hundredth anniversary of its founding on October 3–4. The presidents of Yale, Cornell, the University of Wisconsin, New York University, and the Massachusetts Institute of Technology, the presiding officers of leading engineering societies of Great Britain, France, and Italy, of Canada and the United States, the president of the National Academy of Sciences, the Hon. Herbert Hoover, and Mrs. Elizabeth Van Rensselaer Frazer, a lineal descendant of the founder, were among the distinguished guests who participated in the exercises commemorating the event. A pageant illustrating significant steps in the development of the Institute and in the progress of science during the last hundred years was enacted on the campus.

Rensselaer Polytechnic Institute was not the first college in the United States to offer courses in science, but it is the only educational institution devoted to the sciences which has had a continuous existence for ten decades. Nor does its distinction rest on this ground alone. As originally planned by its founder, Stephen Van Rensselaer, it was to provide teachers for the instruction of "the sons and daughters of farmers and mechanics" in "agriculture, domestic economy, the arts, and manufactures." It was thus the first school of agriculture in the United States, antedating by nearly thirty-five years its nearest rival, the Michigan State Agricultural College. However, agriculture soon took a subordinate place in the curriculum and in time was dropped altogether. Amos Eaton deserves equal recognition with the founder, for to the intellect and vision of this remarkable man were due in no small measure the auspicious beginnings of the institution. A pioneer in educational methods, he was the first to introduce field work and laboratory routine into an American college, thus adding another claim of primacy to the several already enjoyed by the Institute. He looked upon it as "the *common workshop* for all colleges, academies, and other literary and scientific seminaries of learning" and aimed to make it in fact a graduate school.

Through its alumni Rensselaer Polytechnic Institute has spread its influence and its educational standards far beyond the walls of the institution. While its most distinguished triumphs have been in the field of engineering, its list of graduates includes a number who have made contributions of enduring value to the natural sciences.

CONSERVATION

Spare the Holly.—The use of evergreens in the celebration of Christmas is of very ancient origin. The mistletoe had its place even in the ritual of the Druids and in Scandinavian myth, the association of holly with the Yuletide is celebrated in ballads dating back to the fifteenth century, and the Christmas tree, adorned with its lights and decorations, bloomed on Holy Night at least as early as 1604.

We love the old customs of Christmas, but our very love for them is putting their continuance in jeopardy. The number of conifers annually chopped down to contribute to the Christmas cheer leaves a trail of desolation in our forests, and with the progress of the destruction we may be forced in time to the realization that a tree that wears its refreshing green throughout the year is preferable to one that is resplendent in glory for but a single day.

More serious than the annual demand for Christmas trees is the yearly toll taken of our depleted supply of holly. Nature provided this plant with leaves the sharp points of which are a deterrent to the attacks of animals, but its beautiful scarlet berries have doomed it to destruction at the hands of man. The outdoor Nature Club of Houston, Texas, has sent an appeal to the "Fellow Lovers of America's Outdoors," pleading for their coöperation in bringing about its discontinuance as a Christmas decoration in order that this symbolic plant may be preserved from possible extinction. In the interest of the very perpetuity of our time-honored Christmas customs it is imperative that nature be allowed a chance to recuperate.

REPTILES

Home of the Gopher Turtle.— Some years ago the late Mary Cynthia Dickerson planned a companion group to her last masterpiece, "The Florida Group." It was during a trip to Florida that she became interested in the habits of the gopher turtle and realized the great possibilities in representing the home life of these strange subterranean tortoises. Other undertakings, however, interferred with the fulfillment of Miss Dickerson's plan and the arrangement was practically abandoned at the time she withdrew from the American Museum. Recently, through the coöperation of several friends of the Museum, particularly Mr. Thomas Hallinan, Mr. T. D. Carter, and Mr. C. H. Halter, it has been possible to present a scene from the home life of the gopher turtle—if not on the same broad lines as those Miss Dickerson wished—at least in a way that is sure to arouse the interest of the visitor to the reptile hall.

Parts of two burrows are reproduced in the group, and in the case of one of them the interior is shown. The gopher turtles are represented as just starting out for a morning's forage for wire grass and other apparently non-digestible vegetation growing near their home. The eggs of a gopher turtle are seen in their sandy chamber just below the entrance to one of the burrows. Such a chamber is independent of the burrow, being excavated by the turtle solely for the reception of the eggs. Another clutch of eggs has already hatched and some of the young turtles are represented wandering among the dead leaves and other litter which fill the hollows between the dunes. Due to the size of the group not all of its details can be shown in a photograph, and these young turtles could not therefore be included in the accompanying picture. A gopher snake, disturbed from his resting place in a shrubbery where he has passed the night, is lying very quietly until he is sure that it is only a gopher turtle making all the noise in the near-by bushes. Gopher snakes have as gentle dispositions as the complacent tortoises with which they chum. It is only the rats and "salamanders," small burrowing mammals (*Geomys*), that ever feel the full strength of their powerful coils and sharp teeth.

The group, which was constructed by Mr. E. J. Burns and other members of the Museum's department of preparation working under the direction of Mr. James L. Clark, illustrates an interesting case of vertebrate symbiosis. A large spotted frog, *Rana æsopus*, crouches like a watchdog on a shelf which he has dug for himself at the mouth of the burrow. When a shadow passes over the burrow entrance, the frog quickly hops down into the lower depths. Whether or not he warns the turtle of the intruder is not known, but at least the turtle tolerates the frog's presence. The frog, unlike the turtle, does not breed near the burrow, but seeks for the purpose some pond in the pine forest. Burrows of gopher turtles are abundant in the pine woods of Florida, for it is here that we find sandy soil. The distribution of both turtle and frog

THE GOPHER TURTLE GROUP, AMERICAN MUSEUM seems to be confined to this sandy soil in which the turtle can easily dig.

There are three species of gopher turtles in the United States. Two of these turtles are Westerners which frequent the deserts of Texas, Arizona, California, and Nevada. The Florida gopher turtle is used extensively for food. An interesting account of "Gopher Pulling in Florida" has been described in Natural History by Dr. G. Clyde Fisher.[1]

FISHES

The American Society of Ichthyologists and Herpetologists held its Ninth Annual Meeting in Burton Hall, Smith College, October 25, 1924. The following officers were elected: president, Dr. Thomas Barbour, of Harvard University; vice presidents, Dr. Leonhard Stejneger, of the United States National Museum, Prof. H. H. Wilder, of Smith College, Mr. J. T. Nichols, of the American Museum; treasurer, Mr. Henry W. Fowler, of the Academy of Natural Sciences of Philadelphia; secretary, Prof. Emmett R. Dunn, of Smith College.

Among the papers presented was one by Prof. Albert H. Wright, of Cornell University, devoted to the description of a rare southern frog. The species in question is very like the bullfrog but its tadpole is quite unlike the "yellow tad" of the familiar bellower. Professor Dunn exhibited a series showing the development of a small West Indian tree frog (also found in Florida), wherein there is no tadpole stage, the young frog hatching directly from the egg. Mr. Nichols spoke of the fresh-water fishes of China, introducing the subject of geographical distribution. A discussion followed in which emphasis was laid on the importance of the faunal unit, an association of animals especially adapted to a certain area or climate and there dominant. The difficulty of delimiting so-called faunal areas except by the dominance of one or another faunal unit in a given territory was stressed.

Papers by Dr. E. W. Gudger.—Among the papers which Dr. E. W. Gudger has recently issued, in addition to those that have appeared in Natural History, where his contributions are always read with interest, are the following: "The Sources of the Material for Hamilton Buchanan's *Fishes of the Ganges*, the Fate of His Collections, Drawings, and Notes, and the Use Made of His Data," in the *Journal and Proceedings, Asiatic Society of Bengal* (New Series), Vol. XIX, No. 4; "On the Proper Wording of the Titles of Scientific Papers," in *Science*, Vol. LX, No. 1540; "More About Spider Webs and Spider Web Fish Nets," in the *Zoological Society Bulletin* for July, 1924, presenting certain interesting data in corroboration of his previous articles regarding this astonishing use of spider webs; and "Pliny's *Historia Naturalis*—the Most Popular Natural History Ever Published," in *Isis* (Brussels), Vol. VI, No. 18. Doctor Gudger has succeeded in tracing 222 editions of the *Historia Naturalis*, that were published between 1469 and 1906 Of these 190 were issued between 1469 and 1799, a span of 330 years. In addition he has traced 281 items of Pliniana (single books of Pliny's work, comments on his writings, etc.), constituting a grand total of 503 publications of natural history bearing. In view of this impressive aggregate, there is justification for Doctor Gudger's subtitle "The Most Popular Natural History Ever Published."

VERTEBRATE FOSSILS

Dr. Friedrich von Huene of Tübingen University is known to many friends of the American Museum as an authority on dinosaurs. Before the war he spent a year or more in America, studying in different museums and visiting the fossil fields. In 1921 he opened up a remarkable fossil quarry in southern Württemberg from which he secured a series of skeletons of the rare Triassic dinosaurs,—ancestors of the giant dinosaurs of later geologic periods. These skeletons are now being prepared at Tübingen. The collections were made under the joint auspices of the American Museum and Tübingen University, and the collection will be divided between the two institutions. The Museum looks forward to a fine representation of these primitive dinosaurs, known in this country chiefly from their footprints in the sandstones of the Connecticut River and elsewhere. Only two skeletons of Triassic dinosaurs have been found in this country—the two species of *Anchisaurus* in Yale University—and they are of small size and incomplete. The American Museum has only footprints, teeth, and a cast of the bigger Yale specimen as representatives of this important group. Fairly complete skeletons have been found in South Africa, but the Triassic dinosaurs are known principally

[1] Natural History, May, 1917.

from Trossingen in Württemberg and Halberstadt in Saxony. The best of the Halberstadt specimens are in Berlin. Three fine skeletons from Trossingen and another place are in the Stuttgart Museum; the new specimens will equal or surpass any of those mentioned. The preparation of two of the skeletons has been completed, Doctor von Huene informs us, and preparators are now at work on a third one.

Not long ago the Buenos Aires and La Plata museums in Argentina invited Doctor von Huene to study and describe the dinosaurs in their collections, and he spent nearly a year on this research, working in the museums and visiting the localities where the dinosaurs were found. The remains are for the most part those of gigantic amphibious dinosaurs, related to our *Brontosaurus* and *Diplodocus*, equally huge and of somewhat later geologic age. Doctor von Huene writes, however, that fragmentary remains of other kinds are also present. He visited the dinosaur fields and some of the fossil mammal localities in Patagonia, and writes of a remarkable series of skeletons of giant dinosaurs which were being taken out at the time he left. He made also a number of very valuable observations on the geologic age and succession of the formations in that region. These present a problem which has been much disputed, and his expert and unbiased observations and conclusions will carry great weight in deciding the controversy. He confirms completely the view that the dinosaurs are limited to the older Cretaceous formations, and the mammals are all of later age and not, as was formerly supposed, contemporary with the dinosaurs.

On completing his South American work Doctor von Huene went to South Africa, where he spent some months visiting the museums of Cape Town, Grahamstown, etc., and the various collecting grounds of the Karoo series of rocks, whence have come the vast variety and numbers of primitive reptiles of Permian and Triassic age. The American Museum has one of the four well-known collections of these remarkable and interesting primitive reptiles of South Africa, and the *Moschops* and *Endothiodon* skeletons in the exhibition halls of the Museum are a fair sample of their strange and curious character. Doctor von Huene secured a fine collection for Tübingen University, and is now on his way home.

It is a pleasure to note in his letters repeated references to the courtesy and aid received both from the government and individuals in Argentina and South Africa. As a result of his visit to the United States he has many cordial friends and admirers in this country who are appreciative that his high scientific standing and attractive personality are receiving recognition elsewhere as well.—W. D. M.

ASIA

Natural History Museum in Peking.—One of the indirect results of President Henry Fairfield Osborn's visit to Peking is a marked revival of interest in the project of a natural history museum for that great and historic city. Mr. Roy Chapman Andrews, leader of the Third Asiatic Expedition of the American Museum and *Asia* Magazine, writes, under date of August 11, that Wellington Koo, Minister of Foreign Affairs and Acting Premier (at that time), a graduate of Columbia University, is especially interested in the movement. A mandate has been issued by the President of the Republic, a society has been formed, and the museum project now has the highest official sanction. It has been approved at a meeting attended by three cabinet ministers, besides the Acting Premier and other prominent Chinese officials. It had previously been approved by Dr. W. W. Yen, Premier-elect of the Chinese Republic. It is essentially a Chinese movement, the only two foreigners in the society being Dr. John C. Ferguson and Mr. Andrews. A considerable amount of money has been subscribed by the Chinese officials personally and they are planning to secure government support.

The museum will open as an exhibition and educational institution and will take on functions of research in future years. A number of valuable and interesting specimens for exhibition and instruction were taken over by Mr. Andrews on his return to China and these are highly appreciated by the Chinese officials. Among those deeply interested is Dr. Kung Bah King, director of the Art Museum, which is now well established in one of the palaces of the Forbidden City. Chinese officials are giving attention to other vacant palaces with a view to securing appropriate quarters for the natural history museum, and as the specimens arrive they will be immediately installed in the site selected.

Particularly desired at the start are attractive educational exhibits to make a showing that will arouse and enlist public support. Among the specimens to be sent by the American Museum are two of the original dinosaur eggs and some of the original protoceratopsian material; the American Museum also contemplates sending some animals and birds which will make a beginning in zoölogy and will illustrate methods that the Chinese preparators may learn to duplicate.

NEW MEMBERS

Since the last issue of Natural History the following persons have been elected members of the American Museum, making the total membership 7814:—

Fellow: Doctor Thomas Barbour.

Honorary Life Members: Messrs. Don Rafael Grajales, Dimitrios Papademetrius, and A. R. Wilcox.

Life Members: Miss Louise W. Case, Dr. Malcolm H. Tallman; Messrs. Herbert L. Aldrich, Henry Waldo Greenough, M. D. Howell, Arthur Newton Pack, and William Rennult.

Sustaining Members: Dr. Joseph H. Abraham; Mr. Chas. M. Kohn.

Annual Members: Mesdames Henry H. Allen, O. T. Barnes, George E. Brewer, Jr., Irving J. Fox, S. H. Hartshorn, Eugene D. Hawkins, Ernest Ingersoll, Charles Mallory, J. S. Noffsinger, David B. Ogden, Fred. Starr, William Reed Thompson, L. Mc A. Thorn, Kinsley Twining; The Misses Evelyn Boteler, Mary Bussing, Jessie Chase, M. Dressel, Laura B. Garrett, Gladys A. Reichard, Emma C. Reynolds, Myra Valentine, Virginia Young; Doctors Ellis Bonime, Magnus C. Ihlseng, Mary Keyt Isham, Morton C. Kahn, Arthur Stein; Messrs. Theodore S. Barber, Louis G. Bendick, Storrs Brigham, I. L. Broadwin, Edward M. Brown, Geo. F. Brownell, Gordon W. Burnham, Charles S. Crow, Malcolm B. Dutcher, Edgar Ellinger, Edward R. A. Eschenbach, Frederic Fichtel, Jules A. Guillaume, Geo. Hamilton, Pascal R. Harrower, Julius Holz, Theo. C. Hovey, Arthur J. Jones, W. F. Marshall, I. D. Morrison, H. H. Morse, Wm. T. Payne, Jason Seabury Pettengill, Jesse F. Rosenfeld, Sidney C. Valentine, Oscar M. Voorhees, Francis G. Wickware; Children's University School, Lawrence School, Liberta School; Sisters of St. Dominic.

Associate Members: Mesdames James I. Kay, Walter A. Scott, J. R. Tindle, Hilda H. Wullen; The Misses Caroline A. Abbatt, Eunice R. Blackburn, Astrid L. Johnson, Mary E. Stevenson; Prof. Clodoveo Carrion; Col. C. deJ. Luxmore; Doctors Wm. Hewson Baltzell, Kennon Dunham, August T. Gast, J. S. Kelsey, Jr., Chas. T. Vorhies; Messrs. Duncan McArthur Anderson, Walter A. Angell, Rene Bal, Gardner R. P. Barker, Charles H. Blatchford, Simon P. Bomgardner, Roland S. Bond, Alan Boyden, F. C. Buckmaster, Joel W. Burdick, Leland B. Case, Harry A. Cash, W. L. Clause, T. W. Cloney, Louis W. Dalzell, F. G. Darlington, Jr., Walter Henry Daub, Jr., Jean Delacour, Alan C. Dixon, G. Tyrwhitt-Drake, W. J. Dugan, John Erickson, Philotheos K. Ferney, George M. Gray, Frank A. Halladay, Edward C. Hammond, Wm. Albert Harbison, A. S. Harkness, R. Bruce Horsfall, William C. Huebner. Wm. Prescott Hunt, Jr., E. J. Keeble, Joseph W. Kennedy, Julian Kennedy, Jr., Henry H. King, John W. Lawrence, Thomas Liggett, David R. Locke, John Howard P. Logan, William R. Maxon, Wm. L. Mitchell, Rodman Wister Moorhead, George Norris Morgan, Henry Jewett Orth, Jr., Haywood Parker, James B. Peter, Curt P. Richter, Wm. Rindsfoos, W. H. Robinson, F. W. Severance, C. Bernard Shea, W. K. Shiras, Crawford L. Smith, Chas. A. Stanwick, Alan Stone, R. S. Sturtevant, William H. Wheeler, 2d., Gerrit P. Wilder, S. H. Wilder, Amory L. Williams, David P. Willoughby, Edward A. Woods, Hikoji Yanagida.

THE AMERICAN MUSEUM OF NATURAL HISTORY

FOUNDED IN 1869

MEMBERSHIP MORE THAN SEVEN THOUSAND EIGHT HUNDRED

For the enrichment of its collections, for the support of its explorations and scientific research, and for the maintenance of its publications, the American Museum of Natural History is dependent wholly upon membership fees and the generosity of friends. More than 7800 members are now enrolled who are thus supporting the work of the Museum. The various classes of membership are:

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

*Persons residing fifty miles or more from New York City

Subscriptions by check and inquiries regarding membership should be addressed: George F. Baker, Jr., Treasurer, American Museum of Natural History, New York City.

FREE TO MEMBERS

NATURAL HISTORY: JOURNAL OF THE AMERICAN MUSEUM

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

AUTUMN AND SPRING COURSES OF POPULAR LECTURES

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

Illustrated stories for the children of members are told on alternate Saturday mornings in the fall and in the spring.

MEMBERS' CLUB ROOM AND GUIDE SERVICE

A room on the third floor of the Museum, equipped with every convenience for rest, reading, and correspondence, is set apart during Museum hours for the exclusive use of members. When visiting the Museum, members are also privileged to avail themselves of the services of an instructor for guidance.

THE AMERICAN MUSEUM OF NATURAL HISTORY has a record of more than fifty years of public usefulness, during which its activities have grown and broadened, until today it occupies a position of recognized importance not only in the community it immediately serves but in the educational life of the nation. Every year brings evidence—in the growth of the Museum membership, in the ever-larger number of individuals visiting its exhibits for study and recreation, in the rapidly expanding activities of its school service, in the wealth of scientific information gathered by its world-wide expeditions and disseminated through its publications—of the increasing influence exercised by the institution. In 1923 no fewer than 1,440,726 individuals visited the Museum as against 1,309,856 in 1922 and 1,174,397 in 1921. All of these people had access to the exhibition halls without the payment of any admission fee whatsoever.

The EXPEDITIONS of the American Museum have yielded during the past year results of far-reaching importance. The fossil discoveries in Mongolia made by the Third Asiatic Expedition, the representative big-game animals of India obtained by the Faunthorpe-Vernay Expedition, the collections of fossil vertebrates made in the Siwalik Hills by Mr. Barnum Brown, the achievements of the Whitney South Sea Expedition, and of other expeditions working in selected areas of South America, in the United States, in the West Indies, and in Panama, are representative of the field activities of the Museum during 1923. Many habitat groups, exhibiting specimens secured by these expeditions, are planned for the new buildings of the Museum.

The SCHOOL SERVICE of the Museum reaches annually more than 5,000,000 boys and girls, through the opportunities it affords classes of students to visit the Museum; through lectures on natural history especially designed for pupils and delivered both in the Museum and in many school centers; through its loan collections, or "traveling museums," which during the past year circulated among 472 schools, with a total attendance of 1,491,021 pupils. During the same period 440,315 lantern slides were loaned by the Museum for use in the schools as against 330,298 in 1922, the total number of children reached being 3,839,283.

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

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

The POPULAR PUBLICATIONS of the Museum, in addition to NATURAL HISTORY, include *Handbooks*, which deal with the subjects illustrated by the collections, and *Guide Leaflets*, which describe some exhibit or series of exhibits of special interest or importance, or the contents of some hall or some branch of Museum activity.

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

For a detailed list of popular and scientific publications with prices apply to

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INDEX TO VOLUME XXIV

TEXT

Names of contributors and articles are set in capitals and small capitals. Titles of works reviewed are set in Italics.

ILLUSTRATIONS