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

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THE GIANT PANDA

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From a Painting by Mrs. E. Rungius Fulda

ALASKA IN PLEISTOCENE TIMES

Lions watering with herds of bison, mammoth, and horses, on the shores of an ancient Alaskan lake to the north of Mt. McKinley

See "Alaska's Frozen Fauna," page 71

VOLUME XXX

NATURAL HISTORY

NUMBER ONE

JANUARY-FEBRUARY, 1930

THE SEARCH FOR THE GIANT PANDA

The Story of the First Expedition Ever to Collect the Strange Raccoon Bear Near the Border of Tibet—How the Field Museum Expedition Obtained the First Specimen of the Rare Beishung, an Animal Never Before Seen by White Men

By KERMIT ROOSEVELT

With Photographs by Suydam Cutting and Kermit Roosevelt

ONE of the least accessible corners of the world is that rugged mountainous country forming the borderland between China and Tibet. In these days of ubiquitous motor cars, it almost alone remains inaccessible to any form of motor traffic. Probably many years will elapse before it is opened up.

It is a wild and lonely region. Such inhabitants as there are, belong to very different races and speak widely differing languages. It is a fertile field for the ethnologist, but much must always remain a closed book, for there is little to be found in the way of written documents or inscriptions.

The Field Museum Expedition which my brother and I were leading, at first hoped to get permission from Lhassa to go through Assam and cross over Tibet into China. However, once more it proved impossible to "hurry the East," and it was not until after we were well embarked on the alternate route, through Burma, that the permission of the Tibetan authorities finally reached us. Unfortunately the season was too far advanced to allow of our returning.

Going up the Irriwaddy River from Rangoon, we bought mules at Bhamo and crossed over into Yunnan province in China. From Talifu we struck due north to Likiang and Yungning. We then entered the semi-independent kingdom of Muli. We could get no maps of this district which were even approximately correct.

It was midwinter and bitterly cold, with the snow lying deep on the mountains. The greater part of the time we were traveling at an altitude of between ten and fourteen thousand feet, and some of the passes over which we crossed exceeded seventeen thousand feet. The wind that swept down from the lofty snow peaks cut through our clothes like a knife, and each night we bundled on everything we could find before crawling into our arctic sleeping bags. Even so, it would be some time before we became sufficiently warm to be able to sleep.

The provinces of Yunnan and Szechuan are so remote from the Central Government that they are, to a great extent, a law unto themselves. During these last troublous years, brigandage has been

THE WALL OF TENGYUEH

The famous walls of China which in ancient times were built around its cities are now being torn down. The picturesque example shown above will probably not stand much longer

rife. Many of the bandits were formerly soldiers and took up their present trade as a result of receiving no pay and very scanty sustenance. Some of these outlaw leaders are notorious characters. We found the population of Likiang greatly disturbed at the report that Chang Chi Pa was planning an assault upon the town. His name means Chang, the stutterer. He is an ex-muleteer and bears a peculiarly sinister reputation. The country people repeated many stories of his cruelty, and it was evident that they placed implicit belief in the tales that they told us. One story was to the effect that every day he ate a human heart, both to impress his followers and to terrify his victims. He is no respecter of persons, layman and lama alike have suffered at his hands. He had hung up one of the lamas at Yunging by his thumbs to a tree, weighting his feet with rocks. Although the wretched man was rescued, he never recovered from the effects of the torture. The territory offers many advantages to the enterprising bandit, for it is almost impossible to capture him in his mountain fastnesses except through the treachery of some follower. Such is the poverty of the country, however, that it can offer but lean pickings to even the most active bandit. They can hope for but little from the inhabitants and must draw most of their revenue from the trading caravans that pass through.

Great bands of Tibetan marauders terrify this unfortunate country, and periodically, during the caravan season, take their toll of man and merchandise. We passed through several regions where the government was carrying on military operations against the bandits, but they never seemed to be very effectual. In the towns there were sometimes notices forbidding any inhabitant to have dealings with a bandit under penalty of death. Some of the notices naively instructed an inhabitant meeting a bandit, to kill him, but failed to specify just how this was to be managed.

We were fortunate, ourselves, in avoiding any disagreeable encounters. As a matter of fact, our caravan possessed little that would have been of value to bandits with the exception of our arms and ammunition, and presumably we would not surrender the former until we had finished the latter. At least twice we were in very close proximity to groups of bandits. On one occasion we had, for several days, been trekking down stream along the banks of a small river. It entered into a series of gorges, obliging us to turn off from the bank and cross over a snowy and well forested mountain. The night before reaching the cañon we spent in a small village where we were regaled with numerous accounts of banditry.

Early the next morning, a small party of natives set off on the trail ahead of us. It was not long before three or four of them came hurrying back to say that they had been attacked by bandits. In the little town we were told that on the previous evening word had been sent across the pass to the village situated where the trail rejoined the river, asking that some soldiers be dispatched to meet us at the top of the pass. We were strongly urged, however, to wait a few days to see if the bandits would not leave the district.

In addition to my brother and Suydam Cutting, there were with us two Kashmir shikarries. The latter we armed with our spare rifles, and since the reports did not indicate a large band of outlaws, we felt it very unlikely that they would attack. Our crossing was uneventful except for the occasional excitement of some native's insisting that he could see a bandit. We

FIVE MEMBERS OF THE EXPEDITION
From left to right: Jack Young, Herbert Stevens, Theodore Roosevelt, Philip Tao, and Suydam Cutting

A HALT AT A LAMASERY

While making an overnight stop at this Yungning lamasery, the party met Dr. Joseph Rock, the famous botanist and explorer

TIBETAN WOMEN

The origin of the Tibetans is hidden in obscurity, but their characteristic customs indicate that they are members of a very ancient culture

LOLO WOMEN

The Lolos were found to be pleasant companions and helpful hosts. Physically they reminded the members of the expedition of the American Indian

A MEAT DEALER AT LIKIANG

Such merchants are allotted certain days each week to display their wares. This system of market rotation prevents great competition

THE UPPER YANGTSE
This great river, cutting its way through the precipitous rocks, discharges about six billion cubic feet of silt at its mouth annually

HEAD LAMAS
Tibet is the principal seat of that form of Buddhism known as Lamaism. These Lamas are from the semi-independent kingdom of Muli

had entirely forgotten the guard that was supposed to meet us at the pass until we reached the village at the farther side, where we were greeted with anxious inquiries from the villagers as to their militia. It later developed that five armed men had been dispatched to meet us and that they had fallen in with the bandits, twenty in number, who had carried them off, rifles and all.

The other occasion when we came close to an encounter, was one rainy morning in April while crossing a high pass after we had turned south and were headed toward Indo-China. Four and a half hours brought us to the summit. The rain had degenerated into a heavy Scotch mist, at times so dense that it was impossible to see farther than a few yards. Snow lay on the trail, and the tea coolies bound for Ta Tsien Lu, were making heavy weather. They thronged the rude wayside hostelries which we passed from time to time.

Descending the farther side, we passed

two palanquins halted before an inn. One only was occupied and its occupant was obviously much wrought up, but we were unable to understand his troubles until we later met him at the Magistrate's at Tsingki Hsien, and learned that his companion had been plucked by bandits from the other palanquin. They had carried him and all his belongings off into their mountain haunts. All this had occurred only a few hours before we passed, so we considered ourselves fortunate. We had received no warning of bandit activities and were straggling along in the rain and mist in no very good form to protect our goods. The eager questions with which we were hailed while coming down the trail into town, and which had been completely unintelligible to us, were now explained. We never learned with what success the disconsolate Chinaman met in retrieving his friend.

SHAN WOMEN GOING TO MARKET
These people are members of a group of Mongoloid tribes of the Tai stock found throughout Indo-China, but especially in the Shan states

The parts of Yunnan and Szechuan through which we passed can by no

CROSSING THE YALUNG RIVER
The Yalung is one of the main tributaries of the Upper Yangtse, and has its origin in the little known highlands of northeastern Tibet

BRICK TEA BOUND FOR TIBET
The heavily loaded and ubiquitous Chinese porter is to be found on the rough trails throughout China. These porters sometimes carry as much as 400 pounds at a time, and the road to Tibet is nearly all uphill

stretch of the imagination be termed a big game paradise. It is no country for the inexperienced hunter nor for one who wishes to secure a large bag without undue expenditure of time and effort. An experienced hunter, who is not obliged to hurry, can, however, secure a varied bag, and be certain that practically every animal he collects will prove of great interest, with a very definite possibility of finding it a new species or subspecies.

The first prize is the giant panda, whose scientific name is *Aeluropus Melanoleucus*. The natives know him as the beishung or white bear. To the best of our judgment, he has a fairly wide area of distribution, but is to be found only in pockets, and is never abundant, even in these pockets. He lives in the bamboo jungles in altitudes varying between six and fourteen thousand feet. We came to the conclusion that it could be safely assumed that where there were no bamboo jungles, there were no beishung. Native information required careful checking, for even after a detailed description of the animal, accompanied by showing a plate depicting it, we could not rely on a native's word as to its presence in a district. Sometimes this was due to very hazy notions of coloration and the assumption that the white crescent on the black bear's chest entitled it to be called a beishung. At other times misinformation was wilful, either with the common impulse to give pleasant and agreeable news or because the native counted on earning some money as guide before his deception could be discovered. We took no one's word as guarantee of the presence of beishung. Where he actually exists, his droppings are frequent, and easy to find, and even easier to identify. His diet appears to

TWO FRENCH PRIESTS
Père Gaborian and Père Valerian. The former has spent 52 years in China

consist exclusively of the shoots and stalks of the bamboo. The Muping and Yehli districts were the only places where, after diligent and unceasing inquiry throughout the trip, we could be convinced of the presence of giant panda. Owing to their scarcity and the nature of the country in which they live, the prospects of getting a shot at one are very slender. With a pack of good bear hounds they should not be so difficult to secure.

The first time that we came upon indubitable traces of the giant panda's presence was in the Muping country, a hundred miles or so northeast of Ta Tsien Lu in the province of Szechuan. It was in March, and the snow lay deep on the mountains. We gathered half a dozen local hunters. Each man had a dog, small wiry animals, either black or brown.

For the next ten days we hunted that country thoroughly. We came across numerous signs, and once we found tracks two or three days old. The bamboo jungles were dense, and ten yards was about the limit of one's vision. The dogs were a distinct disappointment; their sense of smell was quite evidently only fair, and we felt that their only value lay in perhaps starting an animal, and driving him up a tree. We knew that we could not count on them for any sustained effort. Each morning at dawn we set out hopefully and each evening at dark we trooped in considerably less hopefully. At length we had to admit the slimness of our chances, and put our trust in coming upon a giant panda country farther on that would afford a better opportunity.

It was in the Lolo country that we next came upon authentic news of the animal.

A SUSPENSION BRIDGE IN SZECHUAN
The chains show that this bridge is an important one. Some of the "bridges" of this region consist merely of one or two suspended bamboo cables by means of which the traveler makes a precarious crossing

CHURNING TIBETAN BUTTERED TEA
This widely used preparation is made of very strong tea and rancid butter

We had been warned by the Chinese authorities living on the border of Lololand that we would run into trouble with the inhabitants. The missionaries also tried to dissuade us from going, but we thought that if we took things quietly at first, we could probably win over the local chieftains and secure their support. In this we were not disappointed, for after passing through the initial stage of thinly veiled distrust and hostility, we found the Lolos pleasant companions and helpful hosts.

They are a sturdy, upstanding lot, and physically reminded us strongly of the American Red Indian. They knew of the giant panda, but they said they were excessively rare. For this there did not seem to be any explanation since the Lolo regards the beast as a semidivinity, and does not attack it except in protection of his beehives. These the giant panda sometimes raids. It was near Yehli, perhaps two hundred miles northwest of Ningyuan, that at last our efforts were crowned with success.

THE MAGISTRATE AT CHINLUNG
This official was very friendly to the expedition

The beishung does not hibernate. We found fresh signs in regions where the brown and black bears were hibernating, and the one we shot was living in a locality where the black bears had not yet awaked from their winter's nap. We came upon his tracks one morning in the newly fallen snow. They were partly obliterated, for four or five hours had passed since he went by. Three hours' trailing through dense jungle brought us to the spot which he had selected for his siesta. We caught sight of him emerging from the hollow bole of a giant fir tree, and fired simultaneously.

The giant panda, from all we could learn, is not a savage animal. After the shooting, our Kashmir shikarries remarked that he was a sahib, a gentleman, for when hit he had remained silent, and had not called out as does a bear. In the nearest Chinese village, perhaps twenty-five miles distant, no one had ever heard of a giant panda, nor seen the skin of one. Other incidents of this nature continually confirmed our belief in the animal's scarcity.

In addition to the giant panda, we were fortunate enough to secure a fine group of the rare golden monkeys. These animals live at an elevation varying between eight and fourteen thousand feet and are regarded as a great prize by the natives. The coloring of the old males is a most striking, vivid orange. On their backs they have a mane four or five inches long of a less brilliant hue. One would think that they would be easy to distinguish, but the jungles which they inhabit are so dense and the trees so tall that it is by no means simple to find them.

RICE FIELDS OF NINGYUAN
In these elaborately irrigated fields, the Chinese of the district raise their principal crop. Every rice plant is set out by hand

AT THE CHINA INLAND MISSION, TA TSIEN LU
Kermit Roosevelt, the author of this article, stands fourth from the right in this group which shows the members of the expedition

THE SNOWY WASTES OF MULI

The greater part of the time the expedition was traveling at an altitude of between ten thousand and fourteen thousand feet

A BRIDGE ACROSS THE UPPER MEKONG

Despite the heavy construction of this bridge it is used for foot travelers only. It has been sturdily built, however, to prevent its being washed away by the frequent floods

MOUNT KOOHKA, IN SOUTHERN CHINA
A mysterious peak which is situated in the midst of an almost inaccessible region that few white men have penetrated. Its height is unknown

A LOLO HOME
This house, in the Yehli country, was used as a base camp of the expedition and it was near here that the giant panda was finally secured

We also collected the bhurel, or blue sheep, the sambhur, and the serow. We could have secured other game had we not been forced to bend our energies almost exclusively to getting the giant panda. For this reason, we were often obliged to neglect opportunities whereby we might have collected other animals of interest.

The expedition, however, was composed of many parts, and aside from the large game, much valuable material was collected. Four naturalists under the direction of Harold Coolidge, were sent direct to Indo-China, while my brother, Suydam Cutting, and myself had with us Herbert Stevens, the noted ornithologist from Tring. Mr. Stevens left the main body of the expedition at Likiang in order to proceed more at his leisure and to secure a more representative collection. There will be much of interest to be found in this collection when there has been an opportunity for working it out.

Capt. Kingdom Ward, the well known botanist, also formed part of the expedition, carrying on his work in the districts of southern Yunnan and that part of Indo-China in the neighborhood of Luang Prabang.

A night's halt in the Muli country

Early in May, Cutting, my brother, and myself reached Yunnanfu, which is the railhead for the French railway from Hanoi in Indo-China. Although we had only a relatively small collection of big game to show for our work, we were more than satisfied with the great good fortune that enabled us to bring out the first complete specimen of the giant panda. We have been unable to find any record of this beishung ever before having been collected by a white man, although since 1869 when a French missionary, Père David, first traded a skin from the natives near Muping there have been many efforts to shoot the animal. We felt that the success which crowned our work was due very largely to a fortunate combination of circumstances, and had we been told to return and bring out another panda, we would not have felt like offering any guarantee whatever as to our ultimate success.

IN QUEST OF THE QUEEN OF SHEBA'S ANTELOPE

IN TWO PARTS—PART I

An Account of an Expedition in Search of Abyssinian Nyala—The Strange Mosaic of Potentates and Bandits, Deserts and Jungles, Mountain Peaks and Sandy Plains, and Insect-infested Swamps that Formed the Background of the Sanford-LeGendre Expedition

By GERTRUDE SANFORD AND SIDNEY LEGENDRE

PHOTOGRAPHS BY GERTRUDE SANFORD AND T. DONALD CARTER

DJIBUTI, hot, dusty, its low, white buildings crouching under the sun, its streets filled with half-naked natives, was our landing place and first stepping-stone to Addis Ababa, the capital of Abyssinia. Thence we were to organize our caravan before plunging into the interior in search of the nyala. Away off in the distance, the barren, rocky mountains of French Somaliland stretched until they met the horizon and were no more. As themselves, they were uninteresting, but, representing the gateway to Abyssinia, they took on a poignant significance and a charm for which they were in no way responsible.

The expedition, which had as its object the collection of material for a nyala group for the American Museum, included Miss Gertrude Sanford, Morris LeGendre, Sidney LeGendre, and T. Donald Carter.

Mr. and Mrs. Southard, the American Minister at Abyssinia, were in Djibuti at the time. They did all in their power to aid us, and materially hastened what would otherwise have been a slow and heartbreaking task. Our equipment gradually found its way to the train, and we ourselves sank back (if such a thing is possible on the seats provided) and prepared for the three-day trip to Addis.

Until one reaches Dira Dawa, the country is desolate; great mountains of red rock rear their heads above the railroad, which twists and turns until one is afraid that the engine and rear car will collide. There is no sign of animal life, and only at the stations are humans to be seen. They issue from their wretched huts, bearing in their hands flat cakes of bread, "injera," or a jug of native beer, "tala." These they peddle up and down the train. You may buy the jug outright, or a drink; the latter method provokes arguments which fairly shake the miserable little train off its narrow rails: How much did you drink, and, should the next customer rush to buy the jug outright, what damage has been done by your drinking, and how much should he deduct from the original price? This argument is often ended by the departure of the train. The customer continues to hold the jug between both hands, the merchant runs beside the train demanding payment and declaiming to the world in the same breath that on the train there is a bandit whose ancestors had all been bandits, and whose children would undoubtedly be so. However, only the very young are caught in this manner; the old ones never let go their wares, but cling tightly, knowing the ways of men and especially of those who travel in railway coaches.

As we journeyed on from Dira Dawa, the vista changed. The great mountains were still there, but between them lay valleys covered with a coarse grass. Here and there a thorn tree raised its ugly head and then seemed to droop

NATIVE QUARTERS IN DJIBUTI
The homes of the Somalis are small, rounded hovels, roofed over with thatch, skins, and bagging, with no thought of sanitation

dejectedly at the sight of what lay about it. In these great arid spaces there was wild life: tora hartebeest, Soemmerring's gazelle, kudu, and dik-dik. There are also lions and leopards, but of these we saw nothing.

The first view one has of Addis is beautiful. Situated on the side of a mountain, surrounded by eucalyptus trees, it looks a haven of refuge after the heat and dust of the journey. It is only upon one's arrival that this illusion is dispersed. The station is the general meeting place for all persons who have nothing to do; consequently it is overflowing with humanity. Everyone carries a gun upon his shoulder, or is followed by a servant who acts as gun-bearer, thus attaining a certain amount of dignity in the eyes of his class. Coolies seize your baggage and treat it as their own. Once it has passed from your hands, there is nothing to do but to follow with the hope of eventually regaining at least part of what was once all yours. Here again Mr. Southard helped us a great deal by facilitating the passage of our baggage through the Customs. Without his aid, it would have been a long and tedious task, attended with much signing of papers, which no one is able to read.

The succeeding days were spent preparing for our trip. In Abyssinia, no one knows the meaning of hurry. Tomorrow is as good as today and, when there is work to be done, a great deal better.

In the midst of all of this, we received an invitation from the King, requesting us to dine with him the following evening. We dined in his private palace, and with a host and hostess as charming and delightful as His Majesty Negus Tafari Makonen, and Her Highness, the Queen, one could not but sigh when the time came to leave.

The palace is in perfect taste. Passing between the double line of guards, one enters a small anteroom, and from there, through colossal doors, into the Throne Room, where we were received.

Standing on a magnificent tiger skin, their Majesties awaited us. The King speaks French perfectly, and while he and Miss Sanford talked, the others conversed with the Queen and Ministers of State who were present. The dinner was a masterpiece of culinary art, prepared by his French chef Chambard. A native beverage, "tedge" was served, an amber-colored liquid, slightly sweet, made from honey that has been fermented and distilled. It is the favorite drink of the nobility. That of the common people is "tala." In color this is a dirty gray, resembling dishwater in its consistency and sour in taste. Bits of barley, from which it is made, float on the top, and it is a matter of time before an appreciation of its value is born in the palate of the stranger.

The morning after the dinner a man arrived at the hotel. Behind him followed a little boy, leading a splendid mule covered with embroidered velvet. Around his neck was a magnificent necklace of silver, and on his back two red pommels rose above a saddle made of various layers of embroidered velvet. The man, who acted quite important enough to be an ambassador, was extraordinarily secretive. He would see no one but Miss Sanford. When she finally appeared, he made a long speech in Amharick and placed the leading rein of the mule in her hand. Through various interpreters, (who always appear out of nowhere on such occasions), we discovered that this was a present to Miss Sanford from the King. The animal's paces were perfect and later it turned out to be the best mule that we had.

ABYSSINIAN SOLDIERS GUARDING THE RAILROADS
At each station the railroad is guarded by a stone block house, and, as trains pull in, the guard lines up at attention

The preparations for our caravan were drawing to a close. Morris LeGendre wished to get the men away as soon as possible, for, though the Abyssinians are faithful servants on trek, yet the attractions of a city do away with all ideas of work. He and Mr. Carter, therefore, set a day for departure. As usual, everything happened that could happen; the mules bucked off their loads; the men leading them let go of the ropes, and all the mules ran away, distributing the baggage over the country-side as they went. Finally, at 1:30, the caravan moved off as a body, with Morris LeGendre and Mr. Carter in the lead.

Miss Sanford and Sidney LeGendre rode back to the city to complete various matters that were still in that unfinished state so dear to the Abyssinian heart. It was necessary to procure piastres, the small coins which are current in the country. The value of these coins is beyond all human knowledge. Certainly one must be born in the country to understand the signs which condemn or lift a coin to the realm of acceptability. In Addis there are sixteen piastres to the dollar and any piastre is acceptable, but as one goes into the interior, only certain coins are taken. They must be brand new and very shiny. On the back of each piastre is the figure of a lion whose tail curls over his back in disdainful fashion. Should the tip of the tail point upward, then it is a good coin, but should the entire length of this creature's tail continue parallel to the ground, then no right-thinking person will touch it. It is also curious that only the Marie Theresa silver dollar of the year 1879 is acceptable; any other dollar is worthless; hence the Government is forced to stamp all of its dollars 1879, no matter what the date of their coinage.

The difficulty that presents itself in

ABYSSINIAN NATIVES AT THE STATION
The arrival of a train always excites the keenest interest, and the entire population of the town flocks to the station

MARKET SCENE AT ADDIS ABABA

Throughout the city there are numerous open-air markets where most of the trading is carried on. Among the wares that are bartered for, are mules, cattle, hay, firewood, grain, salt, rice, and peppers

obtaining these piastres is extraordinary. Miss Sanford and Mr. Le Gendre went to the Treasury, where they were told they could not have any unless they brought an order from the Lord High Treasurer. They went to his house and were told that his uncle had just died and that he was at the funeral, where he would mourn for seven days and seven nights. During that period he would not return to his office or house. It was impossible to delay departure for seven days, so they went to the wake in search of the Minister of Finance.

They came to a great round tent in the center of a grove of eucalyptus trees. From the interior issued the throbbing of drums and the hum of voices. Miss Sanford and Mr. LeGendre sent a boy in with the message that they would like to see His Excellency on matters of finance. Before they had time to catch their breath, they were led into the tent and found themselves in the center of a circle of men who were seated upon the ground bewailing the deceased. Certainly there are many more desirable places in which to carry on business than in the middle of a funeral party, but longer delay was out of the question. Miss Sanford carried on the business, for the Minister spoke only French. After a great deal of talking, the old man drew forth a notebook, and, writing upon a page, tore it out and gave it to Miss Sanford. This was the order on the Treasury to give piastres in exchange for dollars. Rushing to the guardian of the State's wealth, they presented the slip and demanded sacks of silver. Then arose an incident which cannot be duplicated in any country but Abyssinia. The Treasury refused to take the paper money which they themselves had printed and issued. In exchange for the silver piastres, they would accept only the silver Marie Therese dollars issued in

A NATIVE GENTLEMAN WITH HIS RETINUE
A man's standing in Abyssinian society is gauged by the numerical strength of his bodyguard, which must accompany him wherever he may go

Italy. The money safely stowed away in saddle bags, Miss Sanford and Mr. LeGendre set out to overtake the caravan which was now several days ahead.

Rejoining it at Mojo, all worked on reapportioning the loads to each mule. Morris LeGendre devised a very clever method of preventing the boxes from slipping from the pack saddle by extending a strip of wood from each end of the case so that it reached to the fork of the saddle, thus holding the box from going either forward or backward. The loads were held in position through the use of a sling hitch, which was far superior to the Abyssinian method of securing a load by simply winding a machana around and around the load and mule until all was supposed to be secure, which never proved to be so.

We had brought the regulation burro saddles, made by Flynn. These fitted the mules perfectly and were a great aid in avoiding the sore backs so common among the pack animals of this country. The wretched condition of the mules, driven by the *nagadis*, the professional caravaneers, is unbelievable. The skin along the back bone is completely rubbed away, leaving the raw, bleeding flesh, in which great ulcers, rimmed with flies, exude pus that flows down the sides of the animals in ugly patches. However, such a back is no hindrance to these men, for they will pile on their loads irrespective of the pitiful sight.

The trails, dusty and hot, crept out of the dawn and were immediately covered with caravans winding like giant, distorted serpents, for always the tail end was the most populous. For some unknown reason, natives will always congregate behind the last animal and, singing and shouting, will pursue their way, irrespective of slipping loads and straying mules in the front.

Shortly before arriving at the Hawash River, we passed a magnificent pageant: natives mounted on superb Arab steeds pursued one another. The pursuer carried a spear in his hand and, standing in his stirrups, would cast it at his enemy, who was galloping away in full flight. The latter attempted to ward off the lance with a small shield which he carried strapped to his left arm. One perfect specimen of manhood, leopard skin thrown over his shoulder and a lion mane over his head, was the winner of all prizes. He seemed to be part of his horse, and each throw was a hit. Apparently he was some great personage, for the crowds roared with approval each time his turn came to attack.

That night our camp was pitched on a bluff, overlooking the Hawash River. Dirty and shallow it was, at this place, yet it is the principal river of Abyssinia. Originating in the north, it disappears in the great swamps of the Danakil country. Very little is known of its final end, for the Danakil are a ferocious tribe, exceedingly warlike, with the reputation of killing any stranger found within their boundaries.

Somehow our caravan had not managed to arrive in its entirety. The cook, an important item to our minds, and three mule boys, were unaccounted for. We did not leave the following morning, hoping that they would come in during the course of the day. Meanwhile Mr. Carter and Morris LeGendre secured several specimens of the exceedingly common Egyptian goose and yellow-billed duck, as well as guinea fowl, but game was not plentiful, for one of the main caravan routes crossed here and natives were constantly driving their cattle to the river or bringing skins and coffee to Addis.

CAMEL TRAINS IN ADDIS ABABA
Coffee and hides are the chief exports of Abyssinia, and these are brought into Addis Ababa from the outlying districts by pack mules or camel caravan

THE "TREE OF LIFE"

The *shiftas* (bandits) who have been captured by the government are hung from the boughs of this tree, which is situated in the center of the town. This is dire warning to the citizens

Late that evening our head mule boy arrived with the news that our cook and other boys had lost their way and were at Toka market. It was a day's journey away, but nevertheless on one of the routes to Lake Zwai.

The following morning as the sun crept over the horizon, turning the river into a stream of gold and lavender, across which great black shadows threw their points from shore to shore, we crossed with our caravan.

As the sun rose the heat increased. It came as a drawn sword off the plains, drove through our helmets, and seemed to pierce our brains. The red rocks glared and faded in the heat waves.

A mountain range lay before us. We crossed it and on the farther side found a great plain hemmed in by tall mountains. It looked like the bottom of a bowl. In the center were two gigantic fig trees. They were Toka market. Once a week the natives of the surrounding country met to trade. Here we found our lost boys, and camped for the night.

In the morning the chief of the district asked if he might accompany us to Lake Zwai, for he did not wish to travel alone for fear of *shiftas* (bandits), who are the curse of the country. He arrived with fifty men. All were armed and the greater number were mounted.

Bora Spring was our destination, for there, we were told, was water, and a curious type of klipspringer found only on the surrounding mountains. When we arrived, there was scarcely any water to be found. A thin trickle crept from a cleft in the rocks at the bottom of a deep gorge. It required hours of irritating waiting and arduous labor before all of our fifty-eight mules were watered.

At sunrise Miss Sanford, Mr. Carter, and Sydney LeGendre climbed Bora Mountain, hoping to secure the extraordinary klipspringer that the natives had spoken of, and possibly also a kudu, which, it was said, roamed these hills in great numbers.

Morris LeGendre took the caravan on to Lake Zwai, where the others joined him that evening, having been unable to secure any specimens.

Lake Zwai lies sixty miles south of Addis. From a distance its waters look like the bluest in the world, sparkling and turning to silver under the sun, but on closer inspection they are a dirty, reddish color, so filthy indeed that it is impossible even to bathe in these waters unless they have been previously strained through a cloth.

Bird life was abundant. Spur-winged and Egyptian geese, teal, shovelers and yellow-billed ducks, as well as numerous cranes, storks, herons, ibises, and a large flock of white pelicans were seen either on or near its shores. A curious red fish found in the lake proved to be very palatable. The shores are swampy, there being no rock or gravel beaches. In the distance low hills seem to rise from the lake in all their barren hideousness. Here kudu were to be found, according to a native who assured us that he was the greatest hunter in that part of the country, if not in Abyssinia. Not sufficiently hardened to the stories of these master tale spinners, we yielded and followed him to the hills. All day we climbed and that evening slept on a bleak plateau, waterless and gameless. Where there was to have been game, there were only caves, and where there was to have been water, we found the dried bed of a stream.

It was useless to continue to listen to the advice of these men. They knew nothing about their own country, due to their fear that they would be robbed and

PACKING UNDER DIFFICULTIES
Mules were always obstreperous until broken to their packs, and, although held by five men, they often succeeded in bucking off the loads

killed or enslaved, if they ever entered the territory of another tribe. They possess a very vague knowledge of the types of animals by which they are surrounded and know nothing at all about their habits. In hunting, when they see a wild creature, they immediately raise themselves to their full height and point. Such tactics are not conducive to securing the nyala, a very cautious and easily frightened animal. If we were to succeed, it was plain that it would be necessary to rely solely on our own judgment.

Taking one pack mule, on which we placed our blankets and food, the four of us started on a tour of exploration toward Mount Chilalo, whose green slopes could be seen from our camp. We explored the mountains, we explored the country around it, we questioned the natives, but nowhere could we find a trace of the nyalas. They seemed to be unknown, a thing of the imagination only.

Our food gave out and we were reduced to living on the game we could shoot. At sunset we saw two fat geese waddling on the side of a hill that sloped into a stream. Carter crept over the ground while we stood and watched. Would he never be close enough? He was raising his gun. It was incredible! He could never get them at that distance. What was he thinking of? There was a report. We expected to see the pair happily winging their way toward a safer dinner, but no, there they were, flapping about upon the ground. Our boys rushed toward them, shouting and brandishing their knives, for it is essential that they cut the throat of any animal they wish to eat. No amount of yelling would stop them, and Mr. Carter arrived just in time to prevent their cutting the necks of both. One had been slightly damaged, but not irrepar-

THE KING'S GIFT

Miss Sanford with the mule and trappings presented to her by His Majesty, Negus Tafari Makonen. The saddle blanket was of green velvet embroidered with red and gold. The halter was also gaily decorated

HIS MAJESTY, NEGUS TAFARI MAKONEN
Riding on a mule, and under a silken umbrella embroidered with gold, the king of Abyssinia leaves the parade ground after witnessing native celebrations which followed the annual ceremony of the blessing of the river

ably. They were our first important specimens—two blue-winged geese, a bird found only on the high plateaus in Abyssinia.

Returning to our camp two days later, we bewailed the fact that we could not find a map which had been drawn for us on the back of a book by an old Belgian coffee planter. Here he had shown exactly what mountain ranges to go to, and, in fact, even on what mountain we might find the nyala. Had we left it in the train, or was it in one of our rooms at the old ramshackle hotel in Addis? Would it be worth while for one of us to take two horses and by changing back and forth try to make a rush trip to Addis? Wouldn't it be useless, for we were not sure even that the book was there? In the midst of our discussion, Hassan, our old interpreter, came to the front of the fly under which we were sitting.

"I beg your pardon," he said, "but I heard you talking of a book. I borrowed one from your supplies before we left, in order to improve my English."

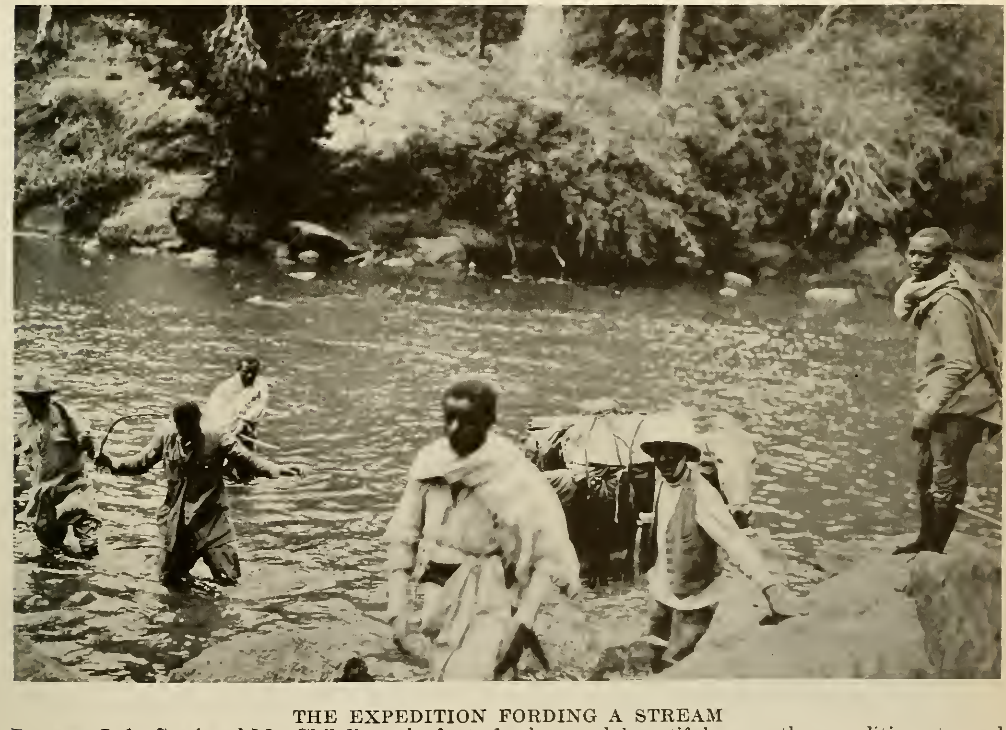
We looked at one another. It was absurd, impossible. How out of a hundred books could he have brought the one—the one with the map? A false hope, it was foolish even to think it could be true. He was coming back with a book in his hand. Handing it to Morris LeGendre, he stood waiting. No one said a word. Morris held it for a moment and then threw back the cover. There was a moment's silence and then he let out a great "Whoop!" There was the map!

In a moment we had found our position. It was noon, but orders were immediately given for the breaking up of the camp. Tents were struck, mules were packed, and well within two hours we were on our way.

CAMP AT THE FOOT OF CHICKA MOUNTAIN
It was here that base camp was established and the main part of the caravan remained, while the surrounding hills were scoured for zoological specimens which were brought in periodically for preparation

MORRIS AND SIDNEY LEGENDRE AT CHICKA CAMP
The expedition's camp in the Chicka Mountains, situated in a grove of trees on a tiny stream, was at an altitude of about 8000 feet, and the evenings were always spent before a greatly appreciated camp fire

TOKA MARKET
Underneath these two huge wild fig trees, growing in an otherwise almost treeless plain, the expedition's caravan camped for the night. The natives from the surrounding country gather here once a week to trade; otherwise the region is uninhabited



THE EXPEDITION FORDING A STREAM
Between Lake Swai and Mt. Chilali, at the foot of a deep and beautiful gorge, the expedition stopped for lunch. Here they found the first large trees seen in a number of days. It was here that they saw the first black and white *Colobus* monkeys

A LOCUST SWARM

While camped on the Hawash River in February, the expedition encountered the first locusts. Thereafter the party was continually running into vast clouds of these devastating insects. This was especially true near Mt. Chilali

Two days before we arrived at the base of Chicka Mountain, we came to the edge of a great plain. It stretched its length into the distance until Chicka and the southern end of the Chilalo range suddenly rose and cut it off. Great herds of cattle grazed apparently ownerless until we had passed, then heads emerged from the tall grass where the herders had secreted themselves, for these people live in constant fear of bandits all their lives. No attempt has been made agriculturally to develop the resources of that rich soil, used only for the grazing of their cattle. It lies untilled and barren where, in place of its brown grass, green stalks of corn and rippling waves of wheat could lift their heads to the hot sun.

Our camp was situated in a grove of trees on a tiny stream that leapt and laughed at our feet. Behind us Chicka Mountain rose, its sides dotted with the houses of the local nobility, for here lived Pasha Tasama, the chief of the Arrussi country. Though we had permission from the King to hunt where we pleased, yet it was necessary to present ourselves with this letter before each local dignitary. Accordingly we despatched our interpreter to the Chief to ask him to dine that evening. He returned with the news that the Chief was not there. The next morning we repeated the proceeding, with the same result. Having had past experience in trusting a subordinate to fulfil a mission, Morris LeGendre went himself. Three hours later he returned with the Chief's son and an invitation to call on Pasha Tasama the following day. The son, who dined with us that evening, gave a great deal of useful information about the nyalas. According to him, they were to be found on Ancha Mountain, which lay to the southwest of Chicka. After we had seen his father in the morning, he would guide us there.

To pay a call in Abyssinia is a grave matter indeed. How many servants should one take? Are they to be armed, or would that be an affront? What should be the value of the present and when should it be given? These are matters that must be carefully considered, for the keynote of the Abyssinian is his pride. An insult is never forgiven, it will always rankle in his heart though he may appear as friendly as ever.

A visit to such a great chief unescorted by an armed guard would be unforgivable. Every rifle and side arm in the camp was brought into use, and we sallied forth as did the knights of old. Our reception was marvellous! Servants were dragged from their quarters and lined up at the gate. As we rode through, they saluted and bowed according to their own ideas on the subject. No two did alike; this, however, did not appear to worry them in the least. We were ushered into a round house made of mud and straw. The floor was of beaten clay, but covered with beautiful rugs. Opposite the door was a chair, and on either side of the chair were arranged low stools. Our party was seated at the right of Tasama and on his left sat his chiefs and retainers. We were served coffee and tala as speeches flew back and forth, all amounting to the same thing: What a marvellous country, we said. What magnificent people they were. And they, on their part: How glad they were to see us, how much they admired Americans. Then came the great question:

"Tell me," said Tasama, "what is your purpose in coming to my country?"

Then Morris LeGendre answered, "We have come to your marvellous country in order to collect specimens of the rare animals which are to be found only here. These we wish to take back with us. In America they will be very carefully prepared so that they will look as if life has been given back to them again. Then they will be placed in a museum, so that all the world may come and see, and praise Abyssinia, the home of these beautiful creatures."

THE BLUE-WINGED GOOSE
This bird is found only in the higher lands of Abyssinia

After this had passed through the hands of our interpreter, I doubt if the Chief knew any more than he did before. After one of these conversations, we said, "Hassan, what have you been saying?"

"Ah," said he, "the Chief asked me what a museum was."

"And what did you say?" Morris Le-Gendre asked.

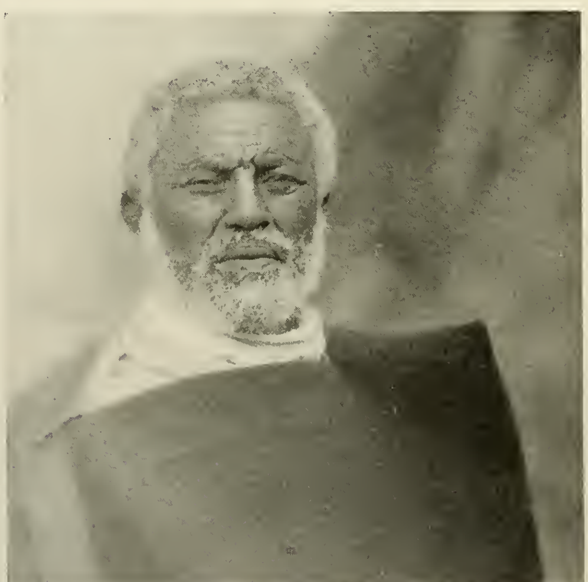
"I told him that it was a big room like a mission room at Addis Ababa, where you could go in and pray."

So much for interpreters!

That night Pasha Tasama sent us a goat as a present. We tentatively poked it in the ribs and sent back word that we hoped His Excellency would dine with us the following evening. The goat was killed and served in his honor, and even now I laugh when I think of his trying to chew that prehistoric creature. However, he was very polite and took his shoes off at dinner in honor of us. This is the greatest courtesy an Abyssinian can pay to his host.

Late the following day a pack train of four mules left our main camp at Chicka and disappeared amongst the rolling foothills in the direction of Ansha. The son of the Chief was our guide, and we four followed, thrilled with the knowledge that we were at last in the country of the nyalas which we had sought for so long.

TO BE CONCLUDED



CHIEF PASHA TASAMA

It was through the helpfulness of Pasha Tasama, chief of the Arussi country, that the expeditoin was successful in carrying out its plans

THE UNIVERSAL APPEAL OF THE AMERICAN INDIAN

Types of Indian Life in North America Illustrated by a Series of Paintings now on display at the American Museum

By CLARK WISSLER

Curator-in-Chief, Division of Anthropology, American Museum

PAINTINGS BY ARTHUR A. JANSSON

IT is true that all North European peoples love the American Indian. He does not appeal so spontaneously to the Asiatic nor to the South European. Almost two centuries ago French and other European writers extolled the Indian of the forest as the ideal man; his existence was held up as the antithesis of the old worn-out civilization of the time.

It may well be that the ideal Indian of that period was just as far from reality as is the ideal Indian of today, but the interest of the American in the Indian is real. Accompanying it is a universal and spontaneous interest in mounds and stone implements. The farmer or the boy scout picking up an arrowhead is immediately carried back in imagination to a life different from the present; at this spot, he says, a man once hunted the deer, or perhaps launched an arrow at his enemy. In brief, the old, whether it be historic or prehistoric, makes an instinctive appeal.

So, by the very nature of the subject, the Indian and his past touches one of the basic interests in human life. He was on the ground when the explorers came upon the scene. The pioneers, traders, trappers, and settlers dispossessed him, and in the clash that followed, local history was made. In like manner the places where the Indian lived, the sites of first settlement, and the old trails, are all objects of interest.

Mounds, stone implements, prehistoric graves, are all associated with the Indian, because his ancestors, both near and remote, were responsible for them.

There is no more inspiring and romantic period in our history than the settlement of the great valley of the Mississippi. It thrills everyone to think of the great forests and plains, the hidden dangers that lurked therein, and the fearless, heroic, forward movement of our forefathers into this region. There are to be placed at convenient points along the Old National Road, extending from Cumberland, Maryland, to St. Louis, a series of statues commemorating the pioneer woman, my great-grandmother and doubtless yours also. These statues are symbolic of the regard for the outstanding events of the pioneer period, which future generations will cherish. The Indian is a part of this pioneer picture; he is the human element in the background against which the achievements of our great-grandparents are projected. Without them and without due regard to the life of their ancestors, the true life of the pioneer can never be shown.

It is not strange, then, that interest in the Indian is universal and that he is so fixed in the popular mind. Yet, as conceived in the popular mind, shown in pictures, and described in story books, he is not necessarily the real Indian. Thus, if the word "Indian" is encountered, one usually visualizes a tall, athletic figure, partly nude, arrayed in a

THE EASTERN WOODLANDS INDIANS

In the eastern portion of the United States and Canada, and as far south as Pennsylvania or Maryland, the native Indians developed a culture that sets them off definitely from those farther to the south and west. Their habitations were usually of bark, and were dome-shaped; their canoes were either dugouts or were made of birch bark; in addition to being hunters, they also raised corn and beans; they had not learned to weave cloth, though they made baskets and pottery; and they could hardly be called nomadic

magnificent headdress of eagle feathers, and grasping the indispensable tomahawk. Also, we expect him to be a fine horseman and to live in a tipi. The truth of the matter is that this is but one type of American Indian, the Indian of our western plains, whereas there are many others of contrasting costume and mode of life. For example, the Alaskan totem pole makers did not live in tipis, did not wear feather headdresses, nor did they ride horses; so there is little or nothing in their mode of life to suggest the Indian as seen in art and in motion pictures. So fixed, however, is the notion that the real Indian must wear feathers and live in a tipi that, when Indians appear for the entertainment of white people, they feel it necessary to assume such a costume and sometimes to carry a tomahawk. In other words, the feather headdress and its accompaniments have become the conventional dress suit of all Indians.

When the English settlers came to New England, they found a type of Indian more or less common to the whole St. Lawrence and Great Lake country. He lived in the forest and used canoes to carry him along the rivers and lakes. He did carry a stone tomahawk and dangled the scalps of enemies from his belt; yet he did not live in a skin tipi, nor did he wear a graceful, drooping, feather head-dress. On occasion, he tucked a feather or two into his hair, or set them in a row around his head. He wore moccasins and a robe, and thus resembled in part the Indian of the Plains. His method of fighting was also similar. The first Indians to figure in the fiction and art of our forefathers were these forest Indians. King Philip was one of these and so are the characters that enliven Cooper's tales.

As the white settlements of the Atlantic Coast spread westward, they encountered the Indians of Pontiac, Tecumseh, and Black-Hawk, all forest Indians, but some of them living upon the edge of the open grassland of the Mississippi Valley. Later, settlers began to push out into these plains, and thus came into contact with the Sioux, Pawnee, Comanche, etc. The history and romance of this ever-moving border is one of the fascinating phases of the story of the white man in America, and the Indian who plays the chief rôle in this is a composite of forest and plains types. It is this composite Indian type that is cultivated in boys' camps and similar organizations, the costume, and housing, being that of the Plains Indians, the woodcraft, and ideals, being chiefly those of the forest Indians. For art and romance this is well enough, but if one wishes to know the Indian he must recognize a number of other types.

THE INDIANS OF THE PLAINS
The culture of these Indians was based almost entirely upon the buffalo. They were nomads, following the herds. Their tipis and their costumes were of skins. With few exceptions they were not agricultural and were not users of boats, the circular and hide-covered "bull boat" of the Mandans being the only developed type

The American Museum is now preparing models and paintings to show in series the main types of Indians in the United States, viz., the Eastern Woodland type, the Indians of the Plains, the Pueblo dwellers of New Mexico and Arizona, the California type, and the Alaskan. If we add the Eskimo as a contrasting type, we have covered the range of the aboriginal life within the bounds of the United States and Alaska. The illustrations accompanying this article were designed to bring out the contrasts in these aboriginal American types.

As one reviews these sketches, it appears that two types were in part agricultural, viz., the forest Indians of eastern North America and the pueblo dwelling Indians of New Mexico and Arizona. Yet these Indians differed greatly, as the pictures show; the Pueblo, or town dwelling Indian, lived in a semi-arid country where game was less abundant than in the well watered forests of the east, so, as may be expected, the forest Indian was still a hunter rather than a farmer, whereas the Pueblo Indian was more a farmer than a hunter.

Another interesting aspect of this is that among the forest hunters the women did what farming was done, while among the Pueblo Indians the men did most of the work in the fields. These facts alone would suggest that hunting was the primary occupation in the east and farming the chief activity in the west.

One reproach often hurled at the Indian is that he made his women do all the hard work; this notion developed in the European mind because the Indian of the forest regarded the secondary work of farming as woman's work, whereas European standards held farming to be man's work.

Further, to the European, hunting was delightful sport, and the tendency was to view the occupational hunting of the Indian as nothing but sport, also. Among the Pueblo Indians the situation was reversed, as we have stated, in which case a disinterested white observer might have seen nothing wrong, but would, in fact, have commented upon the industry of both the men and women.

In the main, however, the Indian tribes of the United States and Canada lived by hunting and fishing and such wild plant food as came to hand. It was only among the Pueblo village dwellers of New Mexico and Arizona and a few tribes in southeastern United States that agriculture can be said to have been the chief support.

If the reader gives close attention to the pictures as a whole, he will note that the scenery is different or that each type of Indian life is in a different geographical region. This is one of the important facts to bear in mind when studying Indian life. The forests east of the Mississippi constitute one kind of country in contrast to the treeless country just west of the Mississippi.

Not only is the contrast observable in vegetation, but in animal life as well. Herds of bison ranged on the prairies and plains of the west, while in the forest were deer of several species. A moment's thought will make clear the necessity for different modes of hunting and housing as between the forest and the prairie. So, in a general way, we can say that different types of Indian life will be found in those parts of our country which show distinctive general geographical features.

The types of Indian culture shown in these illustrations are then to be taken as geographical types, and could serve as a study in the relation of man to his geographical environment.

Looking at this from another point of view, it appears that there are different types of Indians in the several geographical regions, because in each in-

THE INDIANS OF THE SOUTHWEST
The culture of these Pueblo Indians was essentially sedentary. They were agricultural, they wove cloth and made baskets, while their pottery was of a high type. They inhabited dwellings that in most cases were permanent, and gathered in communities sufficiently large to be called cities by the early explorers. Even today some of the old pueblos are inhabited as they have been for centuries. With the Pueblo Indians, the Apache are included, though their cultural characteristics were more like those of the Plains Indians

stance they have found a way to live comfortably by exploiting certain natural resources.

When the white man first set foot on these shores, he was confronted by new conditions, not only the country but the plants and animals were strange. The history of the first attempts at settlement recounts a number of tragedies, the white man starving where the Indian lived comfortably. The whites who did succeed did so because they learned from the Indian how to track and hunt in the forest, how to cultivate a garden, and do similar work. Perhaps few in this day and time suspect that the Indian had something to contribute to the civilization that was to be America, and still less in number are those who recognize the magnitude of this contribution.

As we have stated, the first task confronting the white colonists in the United States was to learn how to live in this new country. The first settlements were in the forests of the Atlantic seaboard. The Indian had lived there a long time and had acquired a technique for the purpose which is now spoken of as woodcraft. The details of this woodcraft were taught the first colonists by Indians and, while it is true that the colonists made some changes in them, the woodcraft of the present as practiced by boy scout and other organizations is fundamentally that of the Indian.

Many Indian inventions were adopted with little change, as moccasins, snowshoes, birch bark canoes, toboggans, wigwams, tipis, and the like. The game of lacrosse was borrowed from the Indians. Along with these material contributions to the culture of the United States went certain concepts, as trail, warpath, war paint, scalping, counting coup, peace pipe, burying the hatchet, council fire, scouting, totem, and so on, all of which have enriched language and literature.

In the matter of geographical names the contribution of the Indian is conspicuous. At least twenty of the states comprised in the United States bear Indian names, while for rivers, lakes, and towns, the list of Indian names is in almost equal proportion.

In a less direct sense modern art has been enriched by the Indian, a large number of contemporary painters and sculptors working exclusively with Indian themes. Also the literature and folklore of the United States owes much to the Indian; he is the most unique and most fascinating character in fiction and border romance.

In general, to eliminate the Indian

THE INDIANS OF CALIFORNIA

Lower in the scale than other Indians were those of California, though their basketry had attained a considerable degree of perfection, and was often highly decorative. Despite this, however, their development along other lines was limited. Neither hunters nor agriculturists, they lived on acorns, wild seeds, roots, and fish. They never developed a boat, though their rafts—made of reeds—were in common use. Their habitations were hardly more than flimsy shelters made of brush

THE INDIANS OF THE NORTH PACIFIC COAST

The outstanding characteristic of these Indians was their extraordinary ability as wood carvers. Huge and highly carved dugout canoes, totem poles, wooden masks, and chests, all were examples of the wood carver's art. They wove excellent blankets, made highly decorative baskets, and lived in sturdy wooden houses. They were fishermen, drawing most of their food from the water

from the present culture of the United States would leave a great gap, would remove most of the non-European elements from contemporary American culture.

We have, however, omitted the economic contributions of the Indian. In general, a strong claim can be made for the fundamental character of economic factors; they are in many respects the foundation upon which governments rest. Food is, at least, indispensable. The Indian had developed the plant food resources of America to an unusual degree. Before 1492 the natives of North and South America had under cultivation some forty plants, many of which are now known to the civilized world; for example, alligator pear, lima bean, cacao, manioc, maize, peanut, potato, tobacco, and tomato.

The monetary value of these plants is enormous. As an illustration we may cite the estimated production for four of these plants in the United States alone; for the year 1927 it was as follows:

Maize	2,700,000,000 bu.
Tobacco	1,200,000,000 lbs.
Potatoes	400,000,000 bu.
Peanuts	860,000,000 lbs.

It would make a long story to enumerate all the ways in which the Indian has enriched American life and in turn the life of the civilized world. In any case, our present interest is to take note of the several different types of Indian life to be recognized when one sets out to make a serious study of the subject. The exhibits in the American Museum are grouped in halls, as far as may be, to correspond to these geographical types of Indian life, thus facilitating comparison and contrasts. They are also in natural sequence, so that one may, in imagination, cross the continent of North America on a stroll through these exhibits. The pictures accompanying this article also may be viewed in geographical order, beginning with the Indians of the eastern forests and passing westward to California, thence to Alaska, and finally to the shores of the Arctic Ocean.

THE ESKIMO

These people were universally hunters and fishermen. During the summer they were migratory, sometimes following the caribou, sometimes making long journeys for wood from which to make implements and sledges. They depended upon dogs as draft animals, and during the winter lived on the ice while they hunted seals. Two interesting facts about them are that they were the only natives of America who learned to use the arch (which made possible the snow houses in which they lived during the winter), and they developed tailored garments to protect them from the excessive cold

SEA SIRENS

The Strange Mammals from which Came the Ancient Ideas of Mermaids and Sirens

By GEORGE GAYLORD SIMPSON
Associate Curator of Vertebrate Paleontology, American Museum

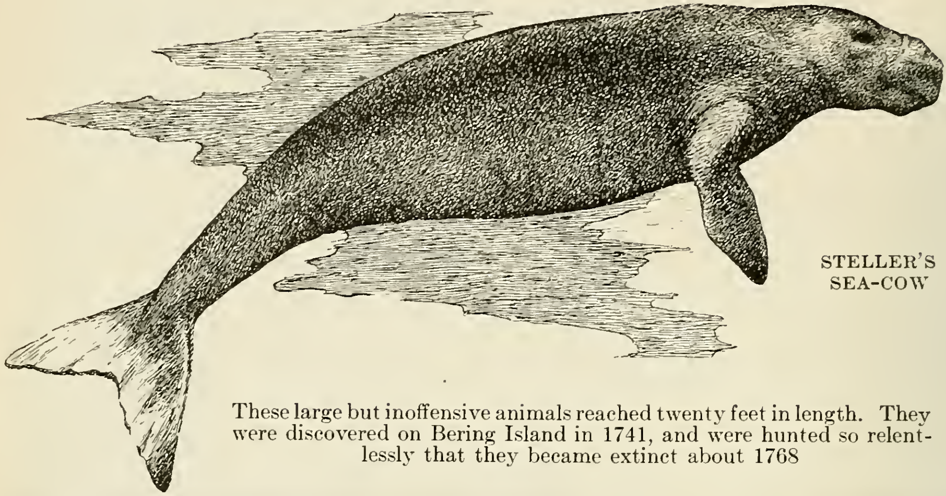
With Five Drawings by A. A. Jansson

"They [the sirenians] have two breasts on the thorax and hair on the upper lip, two facts which, seen from afar when they raise their foreparts vertically from the water, can have made them somewhat resemble women or men, and have probably given rise to fables of tritons and of sirens." Cuvier, Le Règne Animal, 1st Ed., Vol. I, p. 273, 1817.

Among the most widespread of legends and myths are those of creatures half fish and half human. The mermaids of English legend are familiar to us from childhood, and similar beings are spoken of in many countries. The rusalka of Russia is a water fairy; the Lorelei of the Rhine is not dissimilar; in classical antiquity we find the Tritons and sirens, and still earlier the Oannes of the Babylonians. Even the American Indians have legends of fishlike humans, or manlike fishes. These almost universal mythical creatures vary from fishes that talk and reason to human beings that dwell under water but are otherwise like ourselves. One of the latter appears in some old Irish records as a saint. Most characteristic, however, are those which are fishlike below the waist and human above, the typical mermaids and mermen.

THE FACE OF A MANATEE
Homely and stupid, the manatee takes life placidly

The efforts made by oversober scientists to reduce such marvels to coldly reasonable origins have in a few specific cases been only too successful. A captured seal or a demented woman found wandering on the beach, seen through the mists of later years, may become mermaids. It has been repeated so often as to be rather generally believed that the sirens of Homeric legend have their prototypes in marine animals, some of them living in the Red Sea, to which the name Sirenia, or the sirenians, has been given in recognition of this possibility. Similar legends have probably grown up more than once through the sheer ingenuity of the human spirit, for they appear among peoples who cannot possibly have seen or heard of these animals. Nevertheless, this is an interesting and quite possible explanation of the siren myth and we may believe it if we wish. Beware of



STELLER'S SEA-COW

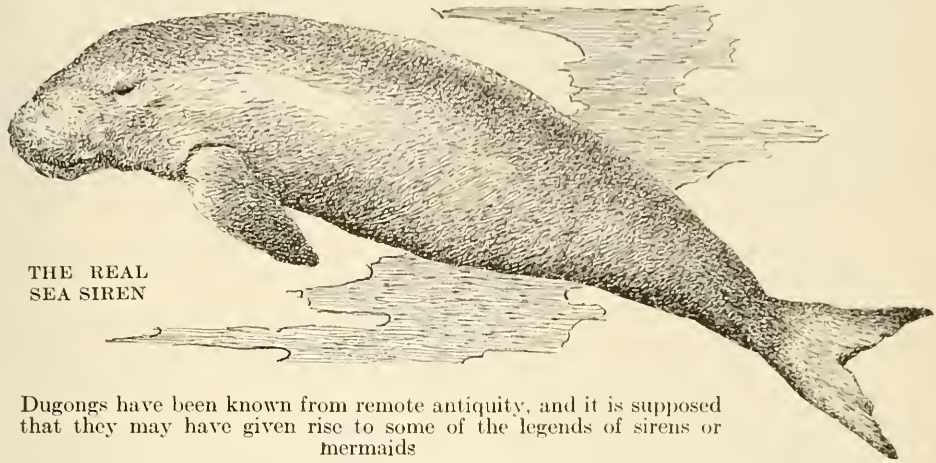
These large but inoffensive animals reached twenty feet in length. They were discovered on Bering Island in 1741, and were hunted so relentlessly that they became extinct about 1768

disillusion, however, for the sirenians are also called sea-cows (although, of course, they are really no sort of cows) and are as ugly and stupid as the sirens were beautiful and enticing.

And now I confess that the sirens were introduced here for their age-old purpose of luring the unwary. This article is devoted to sirenians and not to sirens, but the sirenians are strange and interesting on their own account.

There are and have been many different kinds of sirenians, some of which will be discussed in more detail, but all are of rather similar appearance. They live quiet lives in the water, from which they never emerge, and their whole appearance and structure is harmonious with these habits. The body is rather fishlike, but plump, and ending in a broad paddle or fin which is horizontal (as in the whales) rather than vertical. This fin is the chief means of swimming, and the hind legs, which we know to have been present originally, were useless and have so degenerated that no trace of them is seen in the living animal although there are internal vestiges. The front legs still have many uses and are retained, but modified into flippers. The head is extraordinary and rather grotesque. The ears are very small, and the eyes also are relatively minute or even slitlike. The snout forms a blunt, broad muzzle with stiff bristles. The upper lip is very coarse and blunt and may be split. The animals pick water plants by grasping them between the two halves of the lip. The body is apparently hairless, although a very sparse coat of small hairs may be found on closer inspection. Most of these creatures live in or near the sea, but they seldom venture into deep water and some of them are found far up the courses of large and relatively sluggish rivers. Their food is exclusively vegetable, consisting of succulent sea and water plants, and they are inoffensive, stupid animals, generally very shy once they have learned of man's evil intentions toward them. In size the living sirenians vary from the Amazonian manatee, about 7 feet long, to the Australian dugong, which may reach 15 feet, but Steller's sea-cow, now extinct, was as much as 20 feet in length.

Sir Thomas Browne encouraged conjecture as to what song the sirens sang. It may be rude to insist that their animal prototypes sing no songs, but are, in fact, almost voiceless and very unmusical.



Dugongs have been known from remote antiquity, and it is supposed that they may have given rise to some of the legends of sirens or mermaids

Of the living sirenians the manatee is perhaps the most interesting to us. Although seldom seen, some of these animals still survive in Florida. This is the extreme northern limit of their range, but they also occur in the West Indies, and along the Atlantic Coast and up its rivers not only in Central America and in northern South America, but also in Central Africa.

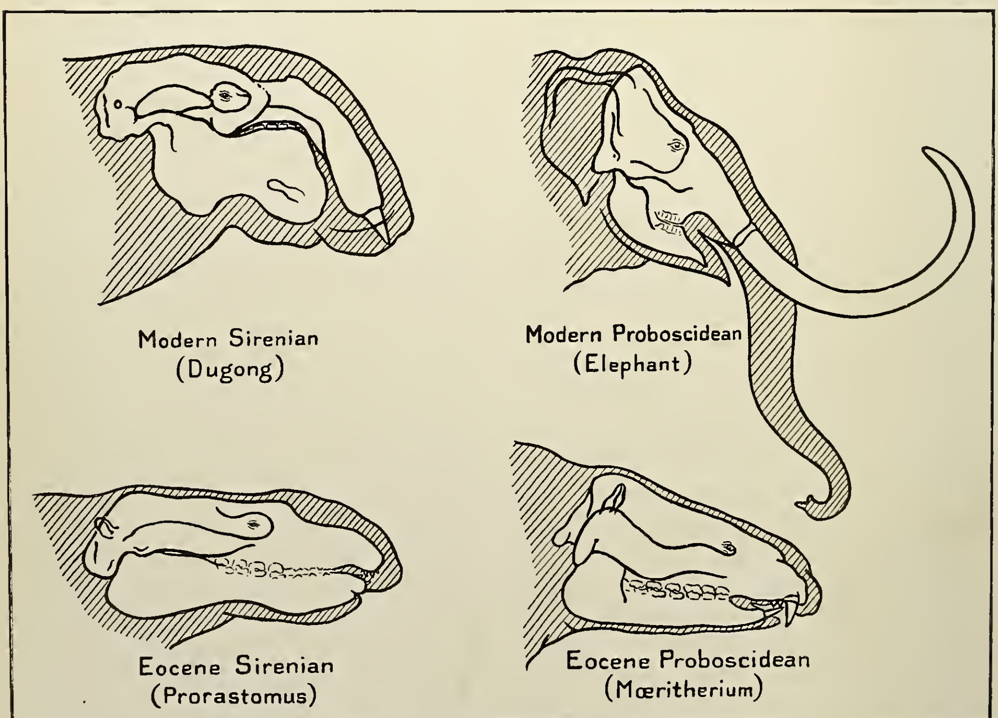
The manatee was one of the first American animals to be made known to Europeans. Pietro Martire d'Anghiera mentioned it as early as 1500 as occurring in Santo Domingo, and Oviedo, Gomara, and many other early chroniclers also record its presence in the Americas. I do not know when the African manatee, which is very like our own although classified as a different species, first came to European attention, but apparently it was not described by scientists until the American form was well known. It is referred to in Adanson's *Histoire Naturelle du Sénégal* (1757) but at that time Senegal had already been visited by Europeans periodically for some three hundred years. The animal was, of course, well known to the natives and some of the earlier travelers probably mentioned it.

Poets have more than once cast aspersions on names, but the name "manatee" is involved in a bit of history unimportant, perhaps, but sufficiently curious to be of some interest. The English word is derived from the Spanish "manatí" which in turn, as all authorities agree, is of West Indian origin, coming from the Carib "manatui" or "manattoui." Now, it is a peculiar fact that certain West African negroes of Mandingo stock (their own name said to be derived from this same word) call their manatee "manti," "mande," "mani," or by some variant on this root. The Carib "manatui" may have been adopted by the Indians from the "manti" of Mandingo slaves and hence carried back across the Atlantic by the Spaniards. This ingenious explanation has been seriously proposed, but the remarkable similarity in the Mandingo and Carib names is probably only a coincidence, for the name "manati" appeared in Europe as early as 1500 and "manatui" must have been current in the Caribbean before that date.

Manatees are especially characterized by their split upper lips, absence of tusks, grinding teeth continually replaced from the rear throughout life (a unique arrangement), and rounded tail fin.

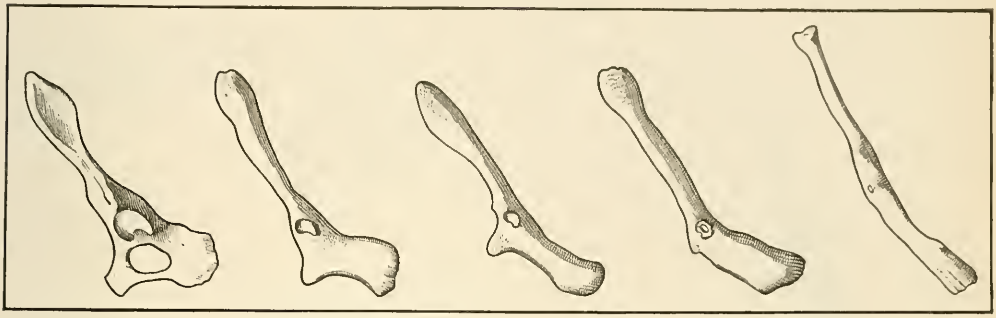
The dugong, living in the Red Sea near the oldest western civilizations, must have been known from remote antiquity, although the oldest references are rather ambiguous. Some scholars hold that the "thachash" covering the Israelite tabernacle was the hide of the Red Sea dugong. An inscription of Sargon at Khorsabad speaks of the king's having built "palaces covered with the skin of sea-cows" and it is probable that the word "sea-cows" was used in the modern sense, rather than for seals as has also been suggested. The earliest modern and unequivocal first-hand reference to the dugong is apparently that of Führer von Haimendorff, who visited the region of the Red Sea in 1565. Dugongs, of which there are three distinct species, live not only in the Red Sea but also along the shores of the Indian Ocean and adjacent waters from Madagascar to Northern Australia and the neighboring islands to the Philippines. The name dugong is of Javanese or Malayan origin. This is one of the few instances, like *Hippopotamus* and *Bison*, of identity between common names and scientific names, for *Dugong* is the technical name of the genus, although it has also been called *Halicore*, a name derived from two Greek words meaning "sea-maiden," another allusion to the supposed connection between sea-cows and sea sirens or mermaids.

If the sirens really were glorified sirenians, their origin must be traced to the dugong, the only sirenian with which the ancients can have been acquainted.



SEA-COWS AND ELEPHANTS
The oldest sirenians and the oldest proboscideans (lower figures) were rather similar in appearance and were probably derived from a common ancestry. Today their descendants are very different, for they have been progressively modified in keeping with their diverse modes of life. To bring out the structural changes in the heads of these animals, these drawings have not been made to scale

To the impartial eye of science no creature is repulsive and no action to be judged from the standpoint of human virtue, but one cannot help a feeling of regret that these sirens are distinctly unlovely, or a feeling of surprise that they possess the virtue of almost passionate attachment to their young.



HOW THE SEA-COWS LOST THEIR HIND LEGS

The remote ancestors of the sea-cows had normal legs and walked on land, but, as they took to life in the water, their hind legs became smaller and smaller until now they are represented only by internal vestiges. This progressive loss, one of the most striking evidences for evolution, is well shown by the hip bones or pelvis of fossil and recent sea-cows. The pelvis of the oldest known form (on the left) is like that of a land mammal. In the progressively later forms, as shown here, it becomes much altered, and the attachment for the thigh bone becomes small and functionless, until in the recent dugong (on the right) the pelvis is a long rod of bone of no use in locomotion

Dugongs differ from manatees in many ways, but most obviously in the possession of two tusks, larger in the males, in the small number and degenerate character of the grinding teeth, and in the tail which is forked rather than evenly rounded.

These two, dugongs and manatees, are the only kinds of living sirenians, but until about one hundred and fifty years ago there was a third, Steller's sea-cow or rhytina.

The history of knowledge of Steller's sea-cow is shorter, more exactly known, and more tragic than that of the manatees or dugongs. In 1741 the Danish explorer Vitus Bering, under a commission from the Russian government, took refuge on the island off the coast of Kamchatka which now bears his name. During the winter 1741–42 Bering himself and many of his men died, but part of the company survived, subsisting chiefly on the flesh of a bulky but helpless sea-cow then abundant along the shores of this island. On the return of the party, this animal was described by William Steller, a naturalist who had accompanied Bering. There were various reports of its former existence over a wider area in the North Pacific, but at this time it was confined to Bering Island and to the smaller nearby Copper Island, both of the Commander Group.

The work of Steller inaugurated the fur trade of the Bering Sea and during the following years many exploring and sealing parties, chiefly Russian, visited the islands and lived largely on the flesh of the sea-cow. In 1754 it was extinct on Copper Island but still fairly common on Bering Island. The last of these strange animals was probably killed in 1768. A later date is sometimes given, but this seems to be the last actual record of the animal seen alive, and a later party is said to have found none living in 1772. In any event, there is no doubt that Steller's sea-cow has gone the way of the dodo and is totally extinct, a fate which long has threatened any animal whose death is of any use to man, especially those so defenseless as this great stupid creature.

A MANATEE

Manatees still live in Florida and along various coasts and rivers in America and in Africa. They are among the least widely known of all animals. Although they look somewhat like whales or like walruses or seals, they are not closely related to any of these

A number of skulls and skeletons have been discovered since its extinction and are preserved in various museums.

Aside from its great size, Steller's sea-cow was especially characterized by the absence of any functional teeth. Its tail was forked and in general it was rather similar to the dugong, but its head was smaller in proportion to the very bulky body.

Although they occur in our own country, living sirenians are less known popularly than perhaps any other group of animals. Their past history is still less widely known, but it is one of the clearest and most interesting examples of some of the principles of organic change and adaptation.

In Egypt in rocks which were formed near the beginning of the Age of Mammals have been found the remains of an animal ambiguously named *Eotherium* (more properly *Eotheroides*), the dawn beast. This is a sirenian, but one very unlike those living today. The whole structure is more primitive, more like that of other mammals. The teeth are much less modified than in later specimens, agreeing in number and to a less degree in form with characteristic primitive land mammals. Most extraordinary is the fact that this animal had functional hind limbs, as shown by its small but complete and normal hip bones.

This animal and others of about the same age but less well known cast much light on the origin and relationships of sirenians. The naïve idea that sirenians are "fishes with hair" was outgrown more than a century and a half ago. They are warm-blooded, their young are born alive and suckled by the mother; in other words, they are true mammals. Like the whales, which are also mammals, they are extremely modified for aquatic life. In fact it was once commonly supposed that they are closely related to the whales, but the fossil sirenians clearly show that this is not the case. They are related not to the whales but to some of the hoofed mammals, apparently especially to the elephants.

It is a far cry from the elephant to the dugong today. Two less similar mammals can hardly be imagined, yet they represent continuous development in two directions from a common ancestor, if the evidence of the more or less intermediate fossil types is rightly understood. The ancestral group must have included small animals, quadrupedal, living on land. One line of descendants remained on land, developed tusks and a proboscis, became large and heavy—the elephants and their allies. Another line, perhaps living in marshes or along lagoons at first, became increasingly committed to the water where it sought its food. At first amphibious, it later became so fully aquatic that even a temporary stay on land is now impossible. The hind legs were lost, a tail fin developed, the other sirenian characters slowly acquired.

The course of many of these changes can be traced in the series of fossil sirenians of different ages. The oldest fossil forms, already mentioned, had functional hind limbs. In later types the hip and hind limb bones are progressively reduced. The front part of the skull in most cases becomes turned downward, tusks are usually developed, the nasal openings are placed farther back on the head, and other changes, too numerous to specify, take place, for the most part in adaptation to aquatic life and the available types of marine plant food.

Most of the known fossil sirenians are dugongs, in a general sense. That is, while differing in details and in the extent of their specialization from the living dugongs, they resemble the latter more closely than they do any other living types. From these we learn that dugongs were once much more widespread than at present. They are found not only in Egypt, and in various places in Europe—Italy, Austria, Germany, France, Belgium, England—but also in the West Indies, the Atlantic Coast of the United States, and even in California. At one time primitive dugongs must have lived along the coasts of most or all of the continents although they are now almost confined to the Indian Ocean.

Steller's sea-cow was probably only a specialized and local descendant of one of these early types of dugongs which became very large and lost its teeth.

One of the most curious facts about this history is its surprising incompleteness in one respect: the early ancestry of the manatees is quite unknown. In Florida, for instance, where manatees are among the most striking of animals today, one would surely expect to learn something of their ancestry. Collecting in the older rocks of that state has indeed revealed several types of fossil sirenians, but before the relatively recent Pleistocene Epoch, or Ice Age, these are all dugongs and cannot have been ancestral to the manatee. Where the manatee originated and how it came to replace the dugongs in the Atlantic Ocean is one of the many mysteries of this strange group of animals.

From a distance the crater of Ngorongoro looks like a long, low ridge

THE GRASS TRAILS OF EAST AFRICA

The United States Department of Agriculture Sends an Expedition to East Africa—Research Concerning the Possibility of Raising the Food Grasses of East Africa's Great Grazing Lands on the Farms and Ranches of the United States

By LEONARD W. KEPHART

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EVER since the day, more than twenty years ago, when Theodore Roosevelt laid aside the burdens of high office and departed for Africa on the world's most famous hunting trip, the words "East Africa" and "big game" have had almost a synonymous meaning. One means virtually the other. In the popular mind there is probably no mental picture of East Africa except as the home of lions, elephants, and ostriches, for the glamorous tales of high adventure on the game trails have almost blinded us to other features of that very fascinating land.

For a region that is as commonly visited and as widely discussed as East Africa there is a surprising lack of geographical information. The country has been traversed many times in all directions, yet no very useful maps have, until quite recently, existed. Accurate details as to rainfall areas, topography, roads, and settlements are difficult to obtain. As to adequate scientific data on soil types, vegetation distribution, growing seasons, and the like, they simply do not exist.

This unsuspected state of affairs immediately became apparent when preparations were begun, early in 1927, for an expedition by the United States Department of Agriculture to East Africa for the purpose of collecting the seeds of African grasses. The expedition had been in mind for some years, and when funds rather suddenly became available, we found ourselves confronted with a disconcerting lack of information. Hurried inquiry in libraries and among travelers who had been in East Africa failed to produce very tangible results, and we finally sailed from New York with only a hazy kind of idea of what lay before us. Later we learned that much advice that would have been invaluable to us could have been obtained at the American Museum of Natural History, but unfortunately this source was overlooked. By the rarest good fortune we arrived in East Africa at almost exactly the best season for our purpose—the middle of June.

Our task was to collect the seeds of all the grasses upon which the great herds of wild and domesticated animals in Africa subsist. Some of these, it was hoped, would prove useful when grown on farms and ranches in the United States.

Strangely enough, although East Africa is one of the greatest grazing lands that the world has ever seen, the identity of the grasses that grow on its plains and in its glades was practically unknown. A few of them had been given botanical names, but their distribution and the extent to which they were a factor in the livelihood of the animals was very much a mystery. We were working therefore in a virgin field.

The first thing that any young expedition does in East Africa is to go five hundred miles up-country by rail to Nairobi. This brings one up into the highlands away from the heat on the coast and into the heart of the game country and the settled areas. In Nairobi one settles down for a few days in one of the very comfortable hotels while one looks around and gets the lay of the land. At first the strangeness of the scene and the unaccustomed manners of the country are rather overpowering, but by the end of a week one has picked up a few words of Swahili, acquired a native "boy," listened to a great deal of excellent advice,

A WATER HOLE

In the dry season water is obtainable only at the isolated water holes which are scarce, and the expedition had to depend on these for its water supply. To such spots animals come for miles around. The water hole pictured here is more desireable than many

A WELL-DEVELOPED SECTION OF EAST AFRICA
This group of buildings forms a part of the Scott Agricultural Substation of the Kenya Department of Agriculture. It is located at Nairobi

ELEPHANT GRASS
Vast areas of Central Africa are covered with giant growth. Travel through it is not only difficult in itself, but is apt to be hazardous owing to the possible presence of elephants and buffaloes

and purchased a few items of equipment, most of the latter of which, to be sure, is later discarded. Within ten days one is beginning to lay plans for a tentative foray out into the "blue."

Fortunately for us, the immediate vicinity of Nairobi proved to be an excellent locality for collecting grass seeds. The town lies at the western edge of the famous Athi Plains at a point where they begin to rise into the Limuru highlands. The business part of the town is on the plain with the residential area spread out over an expanse of several miles in the surrounding hills. In one direction are the dry plains composed of a black, waxy, soil, covered with tall waving grass and dotted with little thorn tiees. In the other direction are the rolling uplands of deep red soil, which, because it is entirely lacking in organic constituents, becomes as dry as powder when the rains cease and incredibly sticky as soon as the rains resume. The red soil, however, is very fertile, and originally supported a heavy growth of wild olive, podocarpus, and other forest trees. These are disappearing rapidly now that the hills are given over to the Kikuyu native reserve and the European coffee farms, with the result that the timber problem in Kenya is acute. However, the opening of the forest has brought in an abundant growth of the luxuriant "Kikuyu" grass, one of the great sod-forming grasses of the world. Other grasses abound in the well-watered hills, and we were able to collect seeds of more than forty species without going more than five miles from Nairobi.

At the end of a month we were ready to be off on our first real "safari." As a preliminary test of ourselves and our equipment, we had decided to visit the Aberdares Mountains, a bleak, uninhabited highland some eighty miles to the northwest. We were particularly anxious

THE EUPHORBIA OR CANDELABRA TREE

Vegetation in East Africa sometimes grows to a grotesque size. This tree is a close relative of the tiny, weedy spurge that is found in American lawns

IN THE NATIVE RESERVE ON KILIMANJARO

Tanganyika Territory has not undergone the development by white men that has so changed Kenya colony, but the natives are coming more and more into contact with the outside world

THE HIGHEST GRASSLAND IN AFRICA
Possibly in the whole world there is no higher grassland than this rocky stretch near the summit of Mount Kilimanjaro. The summit in the distance is hidden by a snowstorm

ON THE SIDE OF KILIMANJARO
This enormous extinct volcanic mountain rises at the southern edge of the great grasslands of East Africa. The giant heather in the foreground of this picture stands ten feet high

LOOKING INTO THE CRATER OF NGORONGORO

In this crater which is twelve miles across and which contains lakes, forests, marshes, and grasslands, live scores of thousands of game. This unique spot is now a game preserve

KILIMANJARO FROM THE RAILROAD STATION OF MASHI

The snow-capped peak at the left is nineteen miles distant from the town in the foreground, and rises 17,000 feet above the elevation of this railroad terminal

KIKUYU "SHAMBAS" OR GARDEN PATCHES

The Kikuyus are an agricultural people who raise corn, beans, and bananas. The shrubs in the middle distance of this picture are castor bean trees, the oil of which is used by these natives as an ointment as well as an edible oil. The "fences" are of living grass

to obtain the grasses that grew on the high mountains because only those would have experienced the cold that they would have to endure in America.

In looking back at that first short safari I smile at the great earnestness with which we made our preparations. Later we would start off on much longer and more difficult trips quite cheerfully and at an hour's notice, but that first jump out into the blue was a serious affair. We were about to face the mystery of Africa.

As a matter of fact, travel in Africa, for two tenderfeet, was not without an element of danger. The grass trail follows the game trail, and where the game trail goes there is certain to be more or less of a hazard. Old-timers learn to anticipate difficulties or to avoid them, but tyros like ourselves were liable to blunder into situations that were disagreeable, to say the least. For long distances travel was likely to be through country uninhabited except for wandering Masai tribesmen and wild beasts. Food had to be carried along. Water occurred only at isolated water holes. Should anything happen to the motor car, as it frequently did, there was no one to call upon for help. If the petrol gave out, we would have to walk. If a rhino came charging out from behind an ant hill or a lion invaded the camp at night, we would have to shoot. If we came down with fever, as we were certain sooner or later to do, we would have to depend on our own doctoring. None of these prospects were conducive to levity in those initial preparations.

By dint of much good luck and some good management the Aberdares trip came off without mishap. We climbed for hours through dense forests of magnificent big cedar trees, where the mud in the path was punched full of enormous footprints made by passing elephants. Occasionally the bark of a tree would be rubbed smooth eight feet from the ground, where an elephant had stopped to scratch his back. Great piles of rhino droppings showed where these cantankerous beasts had just passed by. The long, white hairs of a *Colobus* monkey under a bush were all that remained of a leopard's feast. At last we came out on to great moorlands of grass and sedges. Here a death like silence prevailed. In two days we saw not even a bird, and even the wind moving the grass made no sound. Gigantic heathers and senecios grew in the more sheltered places and gave a fantastic effect to the weird scene. A cold mist blowing across the heights added discomfort to the eerieness of the place, and we were glad when we plunged once more into the cedar forest and began the descent to the warmer and more friendly lowlands.

These cold, forbidding moorlands are a characteristic feature of the upper reaches of all the African mountains. They reach their extreme development perhaps on the Ruwenzori range, the almost impenetrable, rain-drenched mountains that lie on the border between Uganda and the Belgian Congo. They are found, however, on all of the tropical mountains, and represent a real barrier to exploration of their summits.

From the Aberdares we turned our attention to Kilimanjaro, the overlord of African mountains just over the Kenya border in Tanganyika. Kilimanjaro is nearly twenty thousand feet in height and, because it rises from a plateau of only about twenty-five hundred feet, shares with Mount McKinley the distinction of being the loftiest actual mountain peak in the world. On its slopes can be found

A KIKUYU WOMAN
The load on her back is *Themeda* grass, intended for the thatching of her hut. This is the only purpose for which these people harvest the grasses of their region

A RELATIVE OF THE "FOXTAIL" WEED OF OUR CORNFIELDS

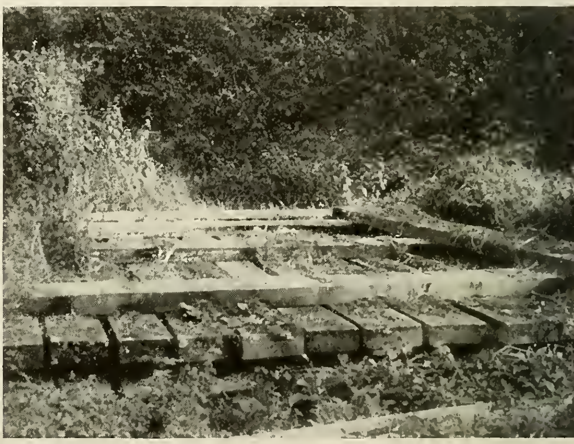
(*Above.*) *Setaria sulcata* is a fine forage grass that grows in moist places. Its American cousin is sometimes known as "pigeon grass"

EAST AFRICAN CEDAR

(*Right.*) Though these cedar planks have been covered by jungle growth for eight years, they are still sound. Other woods would have decayed in a month

KIKUYU GRASS

(*Below.*) *Pennisetum clandestinum* is the predominating grass in the highlands of East Africa, and is one of the finest sod-forming grasses in the world



THE MOST NUTRITIOUS GRASS OF THE AFRICAN PLAINS

(*Above.*) *Themeda triandra* is not only the most nutritous but is also the most abundant grass of the region

NATIVE PORTERS

(*Left.*) The Ruwenzori Range is one of the wettest spots on earth, and toward the top is very cold and disagreeable. The porters demanded triple pay before they could be induced to make the journey

AN AFRICAN FOREST

(*Below.*) Most of the forest trees of East Africa are of little commercial value, with the result that structural timber is very scarce

the widest range of flora of any spot of equal area on the globe. As a British officer remarked, "You can throw a snow ball from the top of it and knock a coconut off a palm tree at the base."

Toward the top of Kilimanjaro, in the saddle between the two summits, we found what may be the highest vegetation to be found on earth—a little species of fescue grass lodged among the rocks of the Kibo summit. Kilimanjaro is nearly within sight of the Equator, and summits of eighteen thousand feet, with sufficient rainfall to support vegetation, are not common in that latitude.

From Kilimanjaro we undertook a long, hard safari to the great extinct crater of Ngorongoro, two hundred miles by trail to the west. A certain legendary interest attaches to Ngorongoro, for its twelve-mile bowl is said to be the home of incredible numbers of wild animals. Naturally we were anxious to visit the place because great numbers of animals meant great quantities of grass. To add to our curiosity, it had been reported by T. Alexander Barnes, in his book, *Through the Great Crater Land to the Congo*, that the floor of Ngorongoro was carpeted with a luxuriant clover, the only reference to clover in East Africa that we had ever seen. A short time after Barnes visited the place, it was explored by Mr. James L. Clark of the American Museum, and his wife, who were the first Americans ever to reach it.[1] Since then it has become a lodestone for hunting parties, who, however, have so overshot the herds that Ngorongoro has recently been proclaimed a game reserve and further shooting is prohibited. Not even Jackson Hole, in Wyoming, approaches Ngorongoro as a natural game sanctuary.

We reached Ngorongoro on foot after an eight-day safari. From a distance the great crater looked like a long, low ridge, rising from the plains, but on climbing the ridge, we found ourselves looking down into a gigantic hollow more than a thousand feet deeper than the plains around it. To the eye it seemed merely a broad, flat plain, surrounded by a mountain wall, but when the glasses were brought to bear, we saw forests and salt lakes, swamps and rolling hills, and literally myriads of grazing animals, chiefly zebras and wildebeest. Later, in walking across the floor of the crater, we found ourselves passing for hours through tremendous herds of animals, which parted in front of us, galloped madly to the rear and closed in again behind. Even the bands of lions that infested every swamp failed to make appreciable inroads on their numbers.

Unfortunately we found no sign of the clover that we had come so far to find. The grass of the crater was chiefly a species of *Cynodon* closely related to the Bermuda grass that is common in our Southern States. At intervals there were areas of *Themeda triandra*, the ubiquitous oatlike grass that affords the chief grazing of the African plains. For days we searched for the clover without success, while our food supply for ourselves and our porters rapidly approached the danger point. At last, just as we were about to give up and return empty-handed, we found a fine clover growing along the southern rim. I do not know whether this was the clover described by Barnes, but it was the most promising clover that we found anywhere in Africa.

The second highest mountain in Africa is Mount Kenya, a vast pile rising sheer from the plains exactly on the Equator, eighty miles north of Nairobi. In company with an official of the Kenya Department of Agriculture, we climbed to the base of the snow-covered pinnacle. Here again we found the moorlands, this time composed of great tufts of grass which stood on pedicels three feet tall. The only means of passage was to jump

[1]See "The Highlands of the Great Craters," By James L. Clark. NATURAL HISTORY, May–June, 1924.

like a chamois from one teetering clump to the next. If, as frequently happened, one of us failed as a tight-wire equilibrist, he plunged to his knees in ice-cold, oozy muck. In three hours we made approximately a mile, then the freezing fog shut down and we had to return to our camp, where we froze all night on the Equator.

Our last safari was far to the west—to the range of Ruwenzori. We did not attempt to climb to the summit. That is a task for elaborately equipped mountain climbers and has been accomplished only three times, the last by an American party, in 1928. We did, however, climb to the top of one of the passes. From a jutting spur of the mountain we could look far across the wilderness to the south. A broad expanse that seemed to be a snow field marked the waters of Lake Edward. Beyond them, a hundred miles or more from where we stood, rose the faint blue outline of a majestic peak. We had hoped that we would see that peak, for it marked the final resting place of a gallant man. A year before, to that very day, Carl Akeley had laid down his life on the slopes of Mount Mikeno.

It seemed a fitting place for our little journey to come to an end. With such facilities as we could, we each, in his thoughts, saluted his memory. The brooding stillness of the jungle is his requiem.

There will be many more expeditions to East Africa. The wealth of its flora is scarcely imagined. But the days of its primitive wilderness are rapidly passing into history. It is good that among those who witnessed the passing were men like Akeley who, seeing it, appreciated, and in appreciating, recorded.

A BAOBAB TREE
The queer objects in the branches of this tree, sometimes known as the cream-of-tartar or the elephantiasis tree, are native honey boxes

WHAT PRODUCES SPECIES?

Recent Laboratory and Field Work Give a Solution to a Problem of Long Standing

By G. KINGSLEY NOBLE

Curator of Amphibians and Reptiles, and Experimental Biology, American Museum

ONE of the most recent developments in museum work is the attention being given to living material. In some cases this results from the interest of the public in living as well as in mounted specimens. Hence, combination zoo-museums are being established. In most instances, however, the condition has arisen because the curator finds himself unable to answer many fundamental questions concerning his material without reference to live specimens. The importance of live material is well shown in the recent work which has been done on that old and often debated question: What produces species?

In considering the question of species origin, attention must be focused first upon the chromosomes, or the dark-staining bodies of the egg nucleus, for these are known to be the bearers of all the hereditary characters received from the maternal parent in most animals. Further, chromosomes make up the bulk of the head of the spermatozoön, the only material received from the paternal parent, and hence must include the principal if not the only hereditary factors derived from the father.

Geneticists and cytologists have shown that when changes or mutations occur in the determiners in either eggs or sperm, individuals are produced after fertilization which differ in one or more characters from their parents. The many races of pigeons, for instance, have arisen by mutation from the rock pigeon of Europe. Is this mutational change in the domesticated pigeons the same phenomenon as evolutionary change among pigeons in nature? If not, what other change in the chromosomes, since from the nature of the reproductive mechanism it must be in the chromosomes of the male at least, could possibly produce an evolutionary change?

Darwin was familiar with large mutations, but he rejected them as a possible source of species formation. He appealed to the small heritable variations found in all species of animals as furnishing the material for species production. Modern genetics has demonstrated that these small differences are also due to chromosomal changes and they arise and are inherited in the same way as the large heritable mutations. Where multiple factors determine the presence of a single character, the latter may show great variation with only the slightest difference between the various grades. In brief, the gradual modification of a character and a discontinuous change have exactly the same basis, namely, mutations in the genes or determiners lying in the chromosomes.

In view of this fact, the recent work of geneticists is of the greatest significance to naturalists. Muller and others have shown that X ray and radium could induce mutations in both animals and plants. Very recently Goldschmidt found that exposing the eggs of fruit flies to a temperature of 37°C for ten to twelve hours produced many new types of flies which bred true. Babcock and Collins found that fruit flies placed near radioactive rocks in nature doubled their normal rate of mutation. There are many places in the tropics where the eggs of fruit flies would be subjected to temperatures of 37°C, and other regions where radioactive minerals form accumu-

THE CAVE SALAMANDER
Typhlotriton, reared in the dark, becomes blind less than two months after metamorphosis

lations. The explorer going into the field today may look upon the environment as having a direct influence on the rate of evolution and may take steps to measure these physical factors.

Is the effect of the environment merely to stimulate the rate of mutation? One of the most perfect adjustments of an animal to its environment is found among the permanent cave inhabitants which are frequenty blind and colorless. Naturalists have assumed that this blindness was hereditary and have wondered why the only blind salamanders are found in caves. Mrs. C. H. Pope and I have reared the young of one cave species, *Typhlotriton*, which differs from the other cave forms in retaining both eyes and pigmentation until the time of metamorphosis. We found that if we reared young in the dark the eyeballs eventually withdrew slightly into the head, the eyelids fused to the same degree found in nature, and the retina which had been functional during youth underwent degeneration. Controls which were reared at the same temperature in the light, retained and further developed functional eyes. The lids never fused and the retina never dwindled. Further, light-reared individuals were more pigmented than dark-reared ones. *Typhlotriton* had been losing its eyesight during every generation probably for many centuries—there is no fossil record—and yet it was potentially able to retain and elaborate functional eyes if the stimulus (direct or indirect) of ordinary daylight was available to it. The unfavorable environment of the cave had not been able to produce any permanent effect on the eyes or coloration of this salamander. Many animals owe the full expression of any

THE INFLUENCE OF LIGHT
The same species reared in the light retains and further develops both its eyes and its pigmentation

A PROTECTIVE DEVICE

The young Haitian lizard *Sphærodactylus difficilis* has a tail tipped with white. Since the tip is frequently agitated, enemies are attracted toward it instead of toward the vital head region of the lizard. The tail drops off when seized. but nature does not provide for a second attack in the same way. A new tail grows out but is devoid of the conspicuous white tip. The lizard with the regenerated tail is standing over a disk the size of a dime. The lizards shown above were raised from eggs in the American Museum's laboratories

character to the influence of a favorable environment during development, but there is no evidence of an environmental effect becoming inherited.

It is a commonplace that animals are adapted to their environment. If they were not in more or less harmonious relation with the habitats in which they live they would eventually succumb. Darwin suggested that the environment directs evolution by permitting only those creatures to survive which happen to be fitted for the particular habitat in which they occur. Whether or not the environment is such as to speed up the rate of mutation, good, bad, and indifferent characters will appear as a result of changes in the chromosomes; and a close functional correlation between an animal and its environment will develop in the course of time due to the failure of the less fitted to live. This would seem to be generally true but it is not the whole story. Recently Prof. D. M. S. Watson, in his address as president of the Section of Zoology of the British Association for the Advancement of Science, said: "I do not know of a single case in which it has been shown that the differences which separate two races of a mammalian species from one another have the slightest adaptive significance." According to Waston, selection by a favorable environment could thus not have produced these racial differences.

What is it then, which has produced species or races of animals? It has long been recognized that "without isolation no species" will be formed. The chromosomes of the fertilized egg lie in pairs, one of each pair derived from the father and the other from the mother. Most mutations occur in only one of each pair of genes in the chromosomes, and in many cases may not express themselves as a structural change in the first generation due to the dominance of the other member of the pair of genes.

If individuals are isolated from the remainder of the species and allowed to inbreed, the characters will appear and become fixed due to the increased chance of mating of animals carrying the same factors. Isolation speeds up evolution in the sense that it enables characters to appear. Further, such characters are often not subjected to the sieve of natural selection.

Naturalists have long been familiar with the fact that if wide-ranging species reach islands they split up into distinct forms. For example, the Savannah sparrow has a very extensive breeding range but the individuals which return consistently to Sable Island, off the coast of Nova Scotia, have accumulated enough mutations to be recognized as distinct species, the Ipswich sparrow. Similarly, the meadow mouse, *Microtus*, isolated on Muskeget Island, off the coast of Massachusetts, has evolved into a form differing sufficiently from the mainland species to be called a distinct species. For birds and mammals, geographical isolation is of the greatest importance in the origin of species, for such isolation permits mutations to become fixed.

Where a barrier cuts into the range of a species of bird or mammal, the individuals on either side are usually sufficiently different to be called distinct races. This is not because the environment on either side of the barrier is different, but primarily because the barrier permits isolation. Of course, if the environment is different, the sieves of natural selection on the two sides of the barrier are not the same. In such cases the two races would continue to diverge in evolution until they form distinct species.

EVOLUTION REPEATS ITSELF

The same characters may reappear in different lines of descent. Modern chameleons (right) have redeveloped some of the characters of ancient reptile types. One species has a dorsal crest resembling that of Dimetrodon; another, tusks like those of Triceratops

NATURAL SELECTION

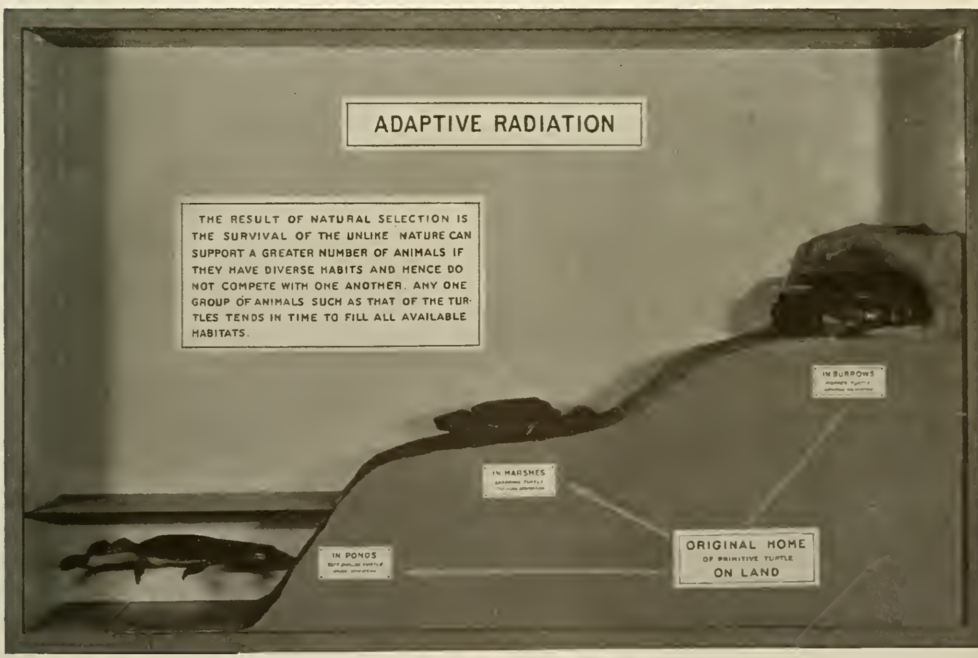
A part of the natural selection exhibit in the Hall of Reptiles at the American Museum. Biological principles are represented in this schematic way in order to bring out more clearly the concepts involved

Geographical isolation is the most obvious but by no means the most frequent kind of isolation that occurs in nature. The red-backed and the slimy salamander are two common species of *Plethodon* found near New York. As shown by Shelford, the latter is more sensitive to dry air than the former, and this would explain why the latter is usually found in more moist situations than the former. Further, the former lays its eggs under logs or stones in the woods, while the latter seeks a subterranean retreat to lay its eggs. Lastly, the two species are of very different sizes and hence would not compete for the same food. If, due to a morphological or physiological change, a derived stock is thrown out of competition with the ancestral group and cross-breeding is prevented, the first step in the origin of a new species has been made.

It is not difficult to find species in nature still unborn. For example, a variation of the common Japanese tree frog, *Rhacophorus schlegelii*, has been recently found to lay its eggs in frothy masses on leaves over water instead of in holes in the banks of rice fields. The differences in head form and body size between the two are so slight that the variation is not considered a good species. Since the two forms are apparently completely isolated during the breeding season, they will continue to accumulate mutational differences and increase the divergence. Systematists, for the most part, have not been concerned with the characters which are creating the species. These are usually physiological differences which throw their owners out of competition with their relatives.

One of the least understood features of species formation is that the same characters frequently reappear in not closely related forms. This was explained in the case of insects by assuming that certain species were obnoxious to birds which might prey upon them; and other species, more tasty perhaps, gained protection by mimicking the former. It has recently been shown by Collinge that, although on rare occasions, birds have been seen to seize butterflies, an examination of over a hundred thousand stomachs has revealed that birds eat few butterflies. Some birds, such as the African wagtails, Dr. J. P. Chapin informs me, do feed extensively upon butterflies, and in this case birds may have played a part in destroying certain kinds of butterflies in preference to others. In general, birds would seem not to have been the selective agent. Mimicry is, moreover, a common phenomenon in both animals and plants. Birds of totally different families in different parts of the world may resemble each other so closely that only a specialist would distinguish between them. The same is equally true of snakes, lizards, and frogs. Such convergence may have been aided by similar kinds of habitats as in the case of certain Old and New World tree-frogs of different families. But when we find the same phenomenon occurring on a large scale in plants, where the seeds of the vetches for example, may closely resemble those of the lentils, as Vavilov has shown, the utility of the character would seem to have played little part in its genesis.

Why, for example, should the chameleons, which are a particularly inoffensive group of slow-moving arboreal lizards, have developed both casques and spines on their heads which closely resemble those of the dinosaur *Triceratops*? We might imagine that the great rhinoceros-like *Triceratops* developed its equipment of head-spikes by gradual selection, and we might even make a calculation as to the thousands of smaller-horned ancestors which must have gone down before the onslaught of the great carnivorous dinosaurs before *Triceratops*, the perfect reptilian citadel, evolved. All this would



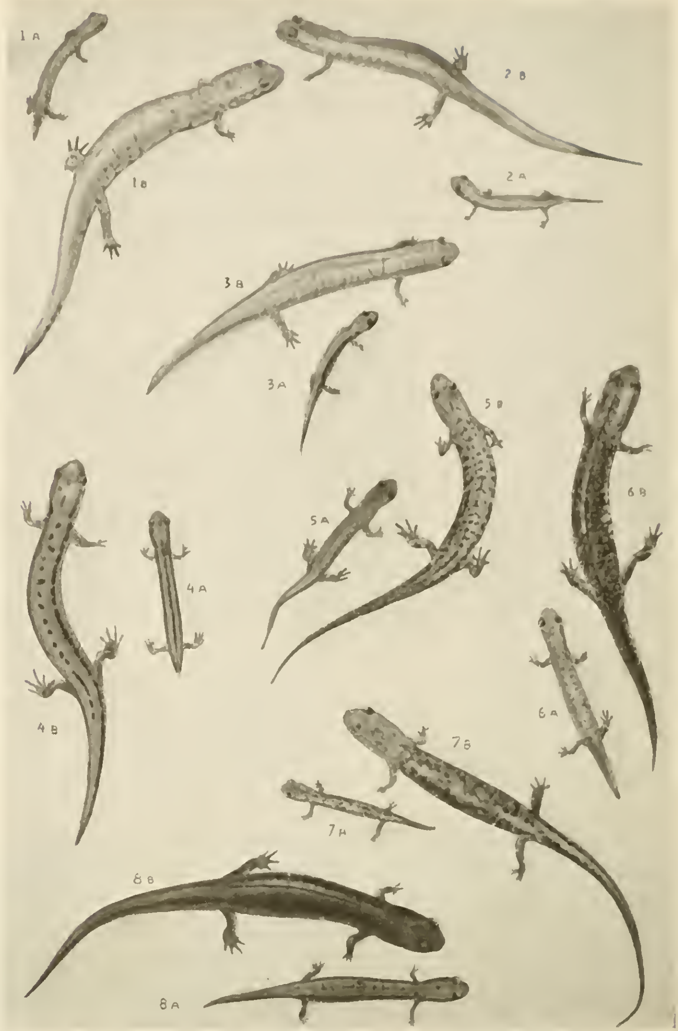
THE RESULT OF NATURAL SELECTION
A model in the Hall of Reptiles at the American Museum explaining diagrammatically why species tend to diverge from one another in time

be legitimate speculation but not without taking note that a very similar equipment in the defenseless *Chameleo oweni* apparently came into existence without a long series of intermediate stages acted upon by selection. Further, another chameleon of Africa, *C. cristatus*, has developed a great dorsal crest, a replica in miniature of the crest of the pelycosaur *Dimetrodon* and, like its model, supported by the greatly elongated neural processes of the vertebræ. A similar crest has evolved in an unrelated Central American basilisk, but here confined to the male. Iguanid lizards frequently fight by bluffing their rivals into thinking they are big and dangerous. Whether or not the dorsal crest is useful to *B. basiliscus* during courtship, it is found in only one or two species of the genus and hence probably did not come into existence gradually. Burrowing lizards would not be expected to develop great head or back spines, for such structures would be in their way. Nevertheless, the rhinoceros iguana develops three horns on the snout in both sexes and manages to dig long burrows. Thus, species get along with what heredity gives them and frequently they find some good use for these gifts.

THE ADAPTIVE COLOR CHANGE WHICH HAS NOT SUCCEEDED

In a large series of West Indian tree frogs, *Eleutherodactylus inoptatus*, a few were found with white color spots resembling lichen. Since the frog lives in tall trees and is the color of wood this variation would seem to make the coloration more concealing. However, this color variety has not yet established itself in a large percentage of the group

There are, of course, limitations to evolution imposed by nature; and it is only within these confines that biological forces are allowed to interplay. For example, butterflies frequently swarm near wet rocks on which they alight to drink. They never go to the pools as larger animals would do, for with their light weight they would fall a prey to the surface-tension of the surface film. Nor can butterflies get around this difficulty by growing as large as eagles. Insects, early in their evolution, developed a system of air tubes which carried oxygen directly to their tissues, and the blood concerned itself not with respiration but the transportation of food and waste products. With increase in bulk the problem of sending oxygen long distances in a fine tube becomes very difficult and probably would not be possible at all in the butterflies as large as eagles. Butterflies have proportionately very large wings and they beat them with rapidity. This is because their light weight gives them little momentum and they must devote considerable energy to lifting as well as to pushing themselves forward. A house fly vibrates its wings at a rate of more than nineteen thousand beats a minute, while the slow flap of a crow may be seen by anyone. There are mechanical laws which apply to living as well as to dead material, and species are able to evolve only within these limits.



THE MATERIAL FOR NATURAL SELECTION

All these color varieties of the salamander, *Desmognathus fuscus carolinensis*, were taken in a single stream bed near Durbin, West Virginia. Numbers 1–3 have a ground tone of bright yellow or salmon, while Number 7 is silvery. These color differences which appear to be hereditary, are already established at an early age. If a color variety develops a distinctive geographical range, it is usually considered a subspecies

Increase in size has both advantages and disadvantages. The weight of an animal increases with its volume, but the strength of the limb bones supporting the bulk varies with the cross-section. Hence, the increase in size in land animals conditions a disproportionate growth in width of the limbs until they reach the limit of ungainliness. Frequently the vertebrate animals living in the north or at the higher altitudes of mountains are of larger size than their relatives living in warmer climes. It would seem at first glance that this might be due to the struggle for food in a more rigorous environment, the more powerful individuals having survived. There are, however, subtle advantages of size. The loss of heat from the body of warm-blooded animals would be proportional to the surface. With increase in bulk there is proportionately less surface to the weight and hence greater conservation of heat. As the heat is produced by the combustion of food, a large mammal does not have to eat in proportion to its weight, as much food as a small one. Northern fish are frequently larger than their southern relatives, but this would seem to be due to the fact that cold slows up the processes of differentiation more than those of growth, and consequently fish in cold water would tend to grow longer and attain a larger size than their rapidly maturing relatives of the tropics. Size may be controlled in some species by environment. In cases of warm-blooded animals it would seem more likely that natural selection was favoring those individuals having mutations for increased size. Frequently single mutations have many effects on an animal's body. The mere fact that a species has a distinctive coloration is no evidence that this played any part in survival. Another expression of this factor, namely size, may have been the character selected.

There are other ways in which size may be correlated with environment. Large animals require more food than small ones. Where food is abundant, as in the case of most species feeding on vegetation, size would seem to be limited merely by mechanical factors of locomotion. On the other hand, insectivorous species would have difficulty in finding food to support a body much larger than a fox. There are, to be sure, a few insectivorous mammals larger than a fox, as for example the ant bear, *Orycteropus*. In these cases, however, the animal is extraordinarily modified for securing large amounts of very abundant kinds of insects. It would be inconceivable for elephants to live on insects, as the source of supply would be inadequate for their needs.

It has frequently been noted, especially in fish, amphibians and reptiles, that one species has been derived from another chiefly by arrested development. Something inside the animal prevents it from completing the development found in related forms. Still in addition to factors slowing up growth there may be others producing distinctive changes not found in the young of ancestral species.

CHROMOSOMES, THE BEARERS OF HEREDITARY CHARACTERS

These dark stained bodies which form the most conspicuous part of the nucleus of every animal and plant cell, carry the hereditary factors. (From a study by Foot and Strobell)

For instance, *Siren* is a large salamander which has gills, larval jaws, and rudimentary limbs. It might be considered a larva which has failed to differentiate beyond a very early stage found in the life of other salamanders. But *Siren* has certain peculiarities of its own, for example, the large Jacobson's organs with which it tests its food. New species are produced not by the addition of stages to more primitive species but by a modification of the processes of development of the former. This modification may mean a loss of growth, an extension of the growth period, but more usually it is the matter of a differential growth of certain parts. Such modifications are produced by genetic factors. Some may be adaptive in the sense that they permit the animal to meet new conditions of life, but others are merely arrested growth stages without such a significance.

When the differences between species is principally a matter of arrested development, it would seem possible by endocrine treatment to return the derived form to its ancestral state. The giant salamander of eastern United States, for example, may be considered a species which so far as many of its structures are concerned, ceased to differentiate beyond the early stages of metamorphosis. If *Cryptobranchus* could be induced to metamorphose, it would change first into *Megalobatrachus*, the genus including the giant salamanders of China and Japan, and then into a Hynobiid salamander. The distinctions between the genera *Cryptobranchus* and *Megalobatrachus*, and between the families Cryptobranchidæ and Hynobiidæ are essentially metamorphic differences. In the American Museum laboratories, as E. J. Farris and I showed, very young *Cryptobranchus* would metamorphose their skin into that of a typical land salamander when treated with thyroid extracts. There seemed to be some physiological block preventing this metamorphic change to include other tissues. The nature of this block has not yet been determined.

The glands of internal secretion have an important control over the processes of growth and differentiation. The growth of the skeleton, especially the long bones, is hastened by a secretion from the anterior lobe of the pituitary gland at the base of the brain. Giant rats and salamanders have been produced by treatment with pituitary substance. Still it has not yet been shown that the only difference between a giant and a dwarf species in nature is that the former has an hypertrophied pituitary gland. Whether or not this is demonstrated by future investigation, it must be remembered that the size of the gland in any species of animal is determined originally by developmental peculiarities produced by the action of the genes.

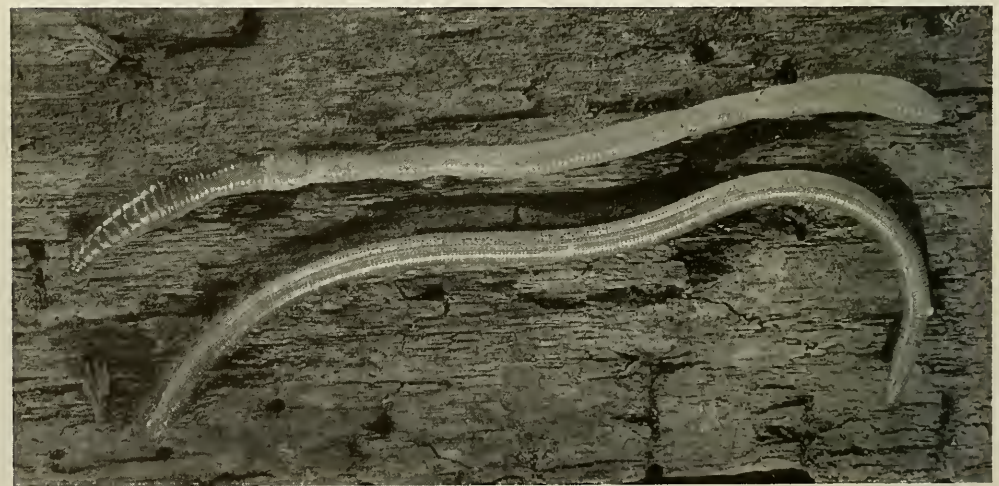
It is sometimes stated that all characters of animals must have some use, although our lack of knowledge concerning the habits of most species prevents us from defining these uses. If attention is focused on a particular set of characters such, for example, as the secondary sex characters, all possible uses of these structures may be worked out. Recently in our laboratory we discovered that the male plethodontid salamanders, the common species of the New York region, were equipped with special glands over the greater part of the body of the male, and these apparently served to hold the female's attention during courtship.

ISOLATION IN SPECIES FORMATION

Mutations produce physiological differences which determine the particular habitat in which each species can best live. These western toads have well marked habitat preferences. Isolation is the first step in the origin of a new species. (From a model in the Reptile Hall of the American Museum)

Further, some male plethodontid salamanders develop sharply pointed teeth in both jaws. A detailed study of many breeding pairs in the laboratory has failed to disclose the use of these elongated teeth. Mutations which afford greater efficiency in the process of reproduction would be saved by the selection process of nature and become part of the hereditary endowment of each sex. There is some reason to believe that the hedonic glands of these salamanders were evolved from the cheek glands of male newts which also play a rôle in courtship. However, other mutations may occur on the sex-determining chromosomes and be carried along by heredity because they are not detrimental to the species. Such a fact would explain the peculiar teeth of many plethodontids. Another distinctive feature of secondary sex characters is that characters found only in the male of one species may appear in both sexes in another. This is a common phenomenon in birds, lizards, frogs, and salamanders, and is one of the reasons for believing that many secondary sex characters do not have specific functions. An explanation for this shift is to be found in changes in the chromosomes, one of several possibilities producing the same result.

In brief, the study of species origin is today no longer a matter of speculation. By laboratory methods one may produce new types of animals and plants at will. The conditions producing new species in nature will, of course, vary with the type of environment and kind of species considered. The naturalist of the future will no longer have to guess as to the effect of the environment. By carefully planned experiments he will be able to demonstrate the part environment has played in the evolution of particular species. Evolution is today an experimental science.



WHICH IS WHICH?

The legless lizard, *Amphisbaena*, resembles the earth worm closely. Both burrow in the ground and have assumed a form efficient for locomotion underground. The lizard, lower figure, and the earth worm, represent a case of convergent evolution

EXTINCT ALASKAN SUPER-BISON WITH 53-INCH SPREAD OF HORNS (BELOW) COMPARED WITH AN UNUSUALLY LARGE AMERICAN BISON (ABOVE)

ALASKA'S FROZEN FAUNA

Alaska College and the American Museum of Natural History Join Forces for the Preservation and Study of Remains of the Mammals of the Frozen Tundra Brought to Light in Extensive Modern Gold Mining Operations

By CHILDS FRICK

Research Associate in Palæontology, American Museum

EIGHTY years before wondering Klondike miners drove pick or shovel into the skull of mammoth or super-bison, the discoverer of Kotzebue Sound had recorded the sight of elephant bones lying beneath an iced Alaskan cliff:

. . . At this news, we all went, provided with shovels and crows, to examine this phenomenon more closely, and soon arrived at a place where the bank rises almost perpendicularly out of the sea, to the height of a hundred feet; and then runs off, rising still higher. We saw masses of the purest ice, of the height of a hundred feet, which are under a cover of moss and grass. . . . An indisputable proof that what we saw was real ice, is the quantity of mammoth's teeth and bones, which were exposed to view by the melting, and among which I myself found a very fine tooth. We could not assign any reason for a strong smell, like that of burnt horn, which we perceived in this place. The covering of these mountains, on which the most luxuriant grass grows to a certain height, is only half a foot thick, and consists of a mixture of clay, sand, and earth.[1]*

Fired by similar accounts and tales of miners feeding their dogs on buried meat, the National and American Museums on four occasions have sent their representatives to Alaska in the hope of obtaining the frozen carcass of woolly mammoth or other ancient game such as have been found in Siberia.[2]

. . . Of all the fossil animals that have been ever discovered, the most remarkable is the entire carcass of a mammoth, with its flesh, skin, and hair still fresh and well preserved, which in the year 1803 fell from the frozen cliff of a peninsula in Siberia, near the mouth of the Lena.[3] Nearly five years elapsed between the period when this carcass was first observed by a Tungusian in the thawing cliff, in 1799, and the moment when it became entirely disengaged, and fell. . . . Here it lay two more years, till [a] great part of the flesh was devoured by wolves and bears; the skeleton was then collected by Mr. Adams and sent to Petersburg. Many of the ligaments were perfect, and also the head, with its integuments, weighing four hundred and fourteen pounds without the tusks, whose weight together was three hundred and sixty pounds. [A] great

*For footnote references, see Bibliography on Page 80

part of the skin of the body was preserved, and was covered with reddish wool and black hairs; about thirty-six pounds of hair were collected from the sand, into which it had been trampled by the bears. . . . One thing . . . is certain as to this mammoth, viz., that whether it was imbedded in a matrix of pure ice or of frozen earth, it must have been rapidly and totally enveloped in that matrix before its flesh had undergone decay, and that whatever may have been the climate of the coast of Siberia in antecedent periods, not only was it intensely cold within a few days after the mammoth perished, but it has also continued cold from that time to the present hour.[4]

In the vicinity of the same Kotzebue Sound the American Museum's expedition of 1907 actually obtained remains of a mammoth with parts of the flesh and long black hair attached. But previous to the stripping operations of the modern gold mining industry, Alaska offered little opportunity to fossil hunters who journeyed for over four thousand miles to be confronted with endless stretches of tundra, brush, and forest-covered plateaus and ridges, and who had to be content with the occasional yield of tumbled bluff or eroded river bank. The joint attempt of Alaska College and the American Museum of Natural History the present summer, to take advantage of the unusual opportunity afforded by the present vast stripping operations of the mining industry, was the outcome of correspondence between President Charles E. Bunnell of Alaska College, Mr. Neil W. Rice of the U. S. Smelting and Mining Company, and our museum. The field work was in charge of Mr. Peter Kaisen, for more than thirty years a member of the American Museum's department of vertebrate palæontology, who sailed from Seattle in late May and a week later entrained at Seward for the 475 mile journey to the College of Alaska at Fairbanks on the Tanana. Thanks to the hearty and friendly coöperation of Messrs. O. J.

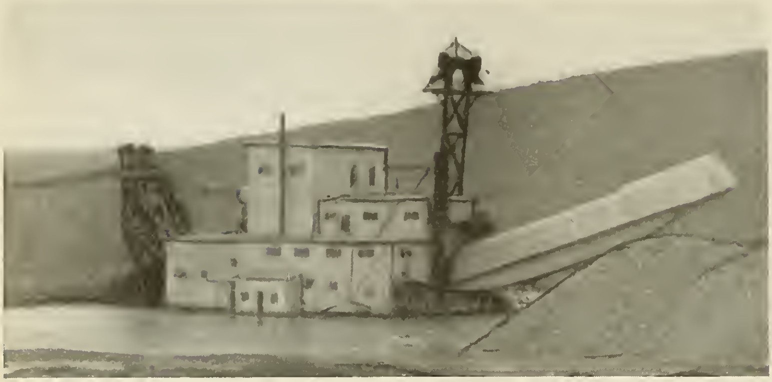
HYDRAULIC MINING
A powerful stream of water operating against a cliff removes the frozen muck foot by foot

A FROZEN CLIFF

What appears to be a rocky wall in this photograph, is in reality frozen muck interspersed with ice

Egelston and R. B. Erling, and the staff of the Fairbanks Exploration Company, the joint Museum and College party succeeded in harvesting during the four summer months some twenty-eight large cases of skulls, jaws, and bones — rare and important evidence on the prehistory of Alaska which otherwise would have been lost to science. The great percentage of this material, interestingly enough, came from three restricted areas, "bone pits," scattered between several widely separated operations of the Company, the remainder of the worked areas being, for the purposes of the bone hunter, nearly barren.

Placer gold, a derivative of anciently eroded quartz veins, occurs in the frozen gravels of former stream channels now buried at variable depth beneath later superincumbent and similarly frozen deposits. These latter over large areas consist of fine silts that represent the drained floors of former lakes, and here and there contain the bones of extinct animals. Now these residual silts, sometimes exceeding two hundred feet in thickness, are entirely masked from view beneath tundra, brush, and forest-grown flats save where exposed in cross section in the high banks of the deeper cuts of the present stream courses. To obtain the gold, the operators, by means of jets of water impinged from hydraulic giants, first remove the tundra and forest growth of the natural surface, and then the underlying and deeply frozen muck foot by foot as it thaws under the summer sun, from bank inward and from top downward. It is this wholesale stripping which affords such unusual opportunity for the location and securing of occasionally imbedded remains of the ancient fauna. Thus it is that the modern placer industry offers a realization of the bone digger's fondest dream—the magic waving aside of hills



GOLD MINING BY SUCTION DREDGE

A monster gold-mining dredge operating in an Alaskan valley

and uncovering of deep-laid strata over which, as along some beach at ebb tide, he may walk and garner a host of until now hidden forms. When once the higher lying deposits are reduced to the general drainage level, or when the gold-bearing gravels happen to lie but a few feet beneath the valley floor, the remaining residue is removed by impounded suction-dredges, without further preparation than the ever necessary thawing out of the solidly frozen ground. The fossil evidence of these lowest and therefore oldest layers of the ancient lake bottoms is unfortunately destroyed unseen as it is ground up within the maws of the dredges.

The percentage of the remains of animals preserved through natural burial is usually small and the opportunity of locating such burials, save in widely disintegrating hill land, such as in our western Bad Lands, is very slight. Success, no matter how strenuous the use of pick and shovel or of the horse- or tractor-drawn scoop, must always in a high degree be dependent on good fortune. An unusual example of such toil and unexpected reward was our six-weeks' investigation the past summer of a grassed-over hill land in northwestern Nebraska, where the outcrops of certain fossiliferous layers now and again have been hunted for the mineralized bones of the Sheridan fauna. (See table on p. 79.) Here our assistant, Mr. Falkenbach, had the good fortune, on excavating a 90×40 area to twenty-foot depth in search of further evidence as to the peculiar stilt-legged horse, to happen upon a beautifully preserved skull, jaws, and partial skeleton of the huge and rare so called Arctotherine "bear" (*H. simus nebrascensis* n. subsp.).

The vast operations in Alaska slush aside acres upon acres, while our chug-

CHARLES E. BUNNELL

President of Alaska College. The two mammoth tusks were procured by the American Museum and College of Alaska 1929 Expedition. They measure 11 feet 8 inches and 10 feet 10 inches in length

SKULLS OF MAMMOTH, SUPER-BISON, AND LION
The leader of the expedition, Peter Kaisen, is shown here with some of the important finds

chugging Nebraskan tractor scoops a few yards square. At one place the newly washed surface of former Alaskan accumulations exposes the eleven and one-half foot tusk of a mammoth and limb bone of a horse. Near by, at what was recently ten feet beneath a thickly tundra brush-grown plateau, stand undisturbed the broken stumps of an ancient forest. At another operation there is found the hind limb of a moose with hoof and some of the hair attached, and the skulls of a wolverine and badger, and again the wide-spread horns of an enormous bovine. And near the mouth of a gulch ten miles to the north in similar frozen muck, together with fine specimens of the same huge bison, at still deeper depth, to the general amazement of all, there appears the skull of a very African-like lion!

The great accumulation of fine and unstratified silts that, as already noted, line, over large areas, the present water courses of the interior plateau of western Alaska, indicate the former presence of extensive lakes and morasses and the endurance of long periods of quiescence. This northern area, strangely enough, is reported to have been largely unglaciated. The cold of the winters, however, has long been intense, and now the deepest deposits of the valleys are frozen to bed-rock. The freezing, which probably was effected earlier than the general elevation of the deposits, and the ensuing cutting of the present channels may have taken place subsequent to the engulfing of many of the included mammalian remains. Early reports of the occurrence of interstratified layers of ground ice and muck have

FOSSIL BEDS AT HAY SPRINGS, NEBRASKA
This photograph was taken before the work of stripping began. The picture at the right is of the same fossil beds

been shown at least in instances to be due to the formation of winter ice along seepage planes and in crevasses occasioned by the seasonal down-working and slipping of plateau edges and the masking and burial of this ice beneath falling vegetation.[5]

At various points, . . . beds of silt having the same appearance as those now being formed by the river have an altitude several hundred feet or more above the present stream, and are sometimes as much as 200 or 300 feet in thickness. . . . It has previously been suggested that the higher silts of the Yukon Flats were probably deposited in the bottom of a shallow lake, while the more recent ones were formed under lacustrine conditions in time of flood, and the step from one to the other condition is very slight. The elevated beds of pure silt . . . were formed at a period when lacustrine conditions prevailed for a comparatively long time; for they are often many feet thick, without any layers of vegetable matter or of coarse detritus . . . [Along the Yukon and in the vicinity of] the Five Finger Rapids, there is often a layer of river pebbles and sand, horizontally stratified, topping the silt beds and resting unconformably on them where they have been plicated. This layer is never more than a few feet thick, and is often entirely wanting. On top . . . is everywhere seen a thin layer of white, gritty volcanic ash, which ordinarily conforms to all the little irregularities in the surface . . . and is immediately overlain by several inches of vegetable loam . . . It may be said in general . . . that

A BANK OF FROZEN ALASKAN MUCK
Partly worn away by the hydraulic stripping operations

FOSSIL BEDS AT HAY SPRINGS, NEBRASKA
After the tedious work of stripping had been largely done. The picture at the left shows these beds before the work began

the accumulation of the silts began in shallow lakes and sluggish rivers on the emergence of the land from the sea after the maximum extension of the cordilleran glacier, and has continued on a progressively smaller scale up to the present day. . . . In the Upper Yukon region the silts seem to have been largely derived from material ground out of the rocks by glacial action . . . "[6]

Horses, while extinct in America before the coming of Columbus, in Pleistocene time ranged, together with species of the mammoth and mastodon, across the northern continents and extended southward into Florida and into Italy. (See table of surviving and extinct species on page 79). In the northern latitudes the mastodon seems to have been relatively rare — perhaps in habit he was largely solitary. Unlike the mammoth, he has left no immediate kin, his tusks were relatively short and straight, and his great, grinding molars "saw-toothed." The size and number of the mammoth herds that once thrived in the northland are beyond belief. As early as the time of Catherine the Great the recovery of tusks of the extinct mammoth had become an industry. Fifteen hundred pairs are recorded in a single year. The word "mammoth" itself is said to be of Tartar origin meaning "animal of the earth."

MAMMOTH TUSK AND HORSE LIMB-BONE
Lying as they were uncovered by the hydraulic stripping operations

The tusks are very long and greatly curved, the huge grinders lamelliform and the ears small—grinders and ears both being suggestive of the Indian elephant of today. While portions of hair and flesh of the Alaskan mammoth have been encountered, no complete or nearly complete carcass has ever been found. Our joint expedition of the past season secured, besides two large tusks, etc., limb bones, teeth, and three skulls. One of these skulls is practically complete, the slenderness of the single remaining tusk suggesting a female. A second skull is unique in indicating the long and easy life that these animals must at times have enjoyed—the individual specimen being of extremely old age, and without teeth or alveoli, the last great pair of grinders having been worn through and shed years past!

The ubiquitous skulls of the super-bison of Alaska indicate colossal herds and an ample supply of food. One cannot but wonder whether sections of these herds may have occasionally perished by extreme cold like the fifty wild yak seen by two missionaries in 1846 frozen in ice at the headwaters of the Yangtze-kiang River. It is inferred that the longest and widest spread horns of the thirty newly secured crania belonged to bulls, and the more moderate remaining specimens to cows. The horns of the super-bison of Alaska (*B. crassicornis* Rich.) greatly exceed in length those of the recent Plains species (*B. bison*) and of the relatively less massive-shouldered "Wisent" of Europe (*B. bonasus*). (The latter must be distinguished from the great wild ox, Aurochs (*B. primigenius*), which was apparently contemporaneous with *B. priscus* in the forests of Europe in Cæsar's time.) The more moderate sized of the Alaskan heads are approximated by specimens of the extinct European and Siberian bison. It is worthy of note that an almost equivalent range in spread of horn to that existing between the largest of the Alaskan forms and the recent bison of the Plains, occurs in the African buffalo (*Syncerus caffer*) as exemplified in comparison of its great southern and eastern with its smaller northwestern species. Horns somewhat similar to those of the larger Alaskan bulls are suggested by certain fragmentary specimens from the western plains deposits (the basis of a number of named species) — the greatest of these is the extraordinary Kansas type, *B. regius* Hay.

Of the six larger flesh-eating forms of Post-Oligocene time two, *Hyaenarctos* and *Amphicyon*, became extinct before the Pleistocene and today only two survive—the lion and the big brown bear. The strange and huge Arctotherine bear of Alaskan and more southern range, and the magnificent saber-toothed tiger (*Smilodon*)—as yet unrecognized in the northland—both became extinct previous to recent time. The lion and true bear have survived on opposite sides of the earth, the one would seem to have followed fat game herds to equatorial regions, while the other abided by the salmon streams. The big brown bear, differing widely from the Arctotherine "bear," much resembles the huge European cave bear (*U. spaelus*). The great American lion now for the first time shown to have been present in the Pleistocene of Alaska was already known from Mississippi and the tar-seeps of Rancho-la-Brea. Though in the ancient northland the tiger rather than the lion would be expected, on the basis of the former's present much more northern range, the skulls of the Alaskan lion (*Felis atrox alaskensis* n. sp.) and of the cave lion of Europe (*Felis spaelea*) are distinctly leonine rather than tigrine. Perhaps the shaggy mane of the African lion, like the woolly forequarters of the bison, are remnants of a former frigid habitat.

Alaska, the last stand of the giant

SURVIVING AND EXTINCT PLEISTOCENE MAMMALS	EXTINCT FORMS: Pre-tundra Fauna of Alaska-Yukon	EXTINCT FORMS: Sheridan Fauna of Nebraska
Carnivora		
ARCTOTHERE	*Arctodus yukonensis* Lambe[1]	*A. simus nebrascensis*, n. subsp.
Black and Grizzly Bears (*Ursus* and *Danis*)		
DIRE WOLF	*Aenocyon dirus alaskensis*, n. subsp.	*A. dirus nebrascensis*, n. subsp.
Wolf and Coyote (*Canis*)		
Fox (*Vulpes* and *Urocyon*)		
Badger (*Taxidea*)		
Skunk (*Mephitis* and *Spilogale*)		
Weasels and Otters (*Mustela, Lutra, Lutreola* and *Putorius*)		
Wolverine (*Gulo*)		
SABER-TOOTHED TIGER		*Smilodon nebrascensis* Matthew[2]
LION	*Felis atrox alaskensis*, n. subsp.[3]	
Bobcat		
Edentata		
GROUND SLOTHS		*Mylodon nebrascensis* (Brown) *Megalonyx* sp.
Artiodactyla		
CAMEL	*Camelops* race Gidley[4]	*C. kansanus* Leidy
TANUPOLAMA		*Tanupolama americana* (Wortman)
Antelope		*Antilocapra* sp.
CAPROMERYX		*Capromeryx furcifer* Matthew
Deer (*Odocoileus*)		
Bison	*Bison crassicornis* Rich.[5]	*B. ferox* Marsh
Peccary		*Platygonus* sp.
Caribou (*Rangifer*)		
Moose (*Alces*)		
Big Horn Sheep (*Ovis*)		
Rocky Mountain Goat (*Oreamnos*)		
Musk-ox (*Ovibus*)		
SYMBOS	*Symbos tyrelli* Osgood, and *Bootherium sargenti* Gidley	
Perissodactyla		
HORSE	*Equus alaskae* Hay[6]	*E. excelsus* Leidy *E. calobatus nebrascensis*, n. subsp.
Proboscidea		
ELEPHANT	*Mammonteus* (*E.*) *primigenius* (Blum.)[8]	*Archidiskodon* (*E.*) *imperator* Leidy
MASTODON	*Mastodon americanus* refd.[7] Kerr	*M. americanus*
Shrews, etc. (*Insectivora*) various species		
Bats (*Chiroptera*) various species		
Rodents (*Rodentia*) various species		

1

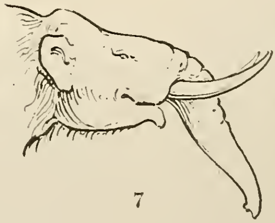

3


2


4


5


6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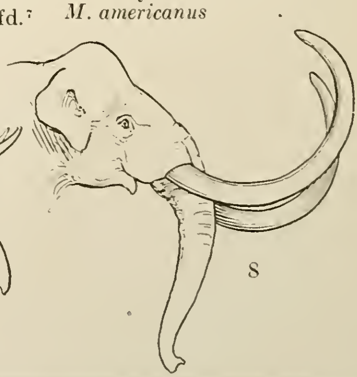
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PRELIMINARY LIST

Surviving Pleistocene and (capitalized in first column) *extinct* Pleistocene mammals of Alaska-Yukon and Nebraska areas, with scaled heads of certain of the extinct genera moose and of the big brown bear, was once the host to other giants now long since passed on. Certain owners of these frozen bones, the objects of our search, perhaps in measure contemporaneous with the reindeer fauna and cave man of southern Europe, may at times have afforded sport to Alaskans yet unknown. Arrowheads, one reported to have come from bedrock twenty feet below the recent surface, suggest at least, as President Bunnell writes, the contemporaneous presence of some early hunter. The ground once broken, what fields Alaska opens to Quaternary research—the buried bones and forests of mammalian and plant denizens of prehistoric time, whose minutest details frozen carcasses and vegetation yet may reveal; and the thick enveloping mucks and sands in far-flung strands, superficial of today and deep laid of ages gone, that yet, with interstratified clays in possible reconstructed sequence from earliest glacial era, may correlate and index the passage of mammals, plants, and time.

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THE LION OF INDIA

An Account of the Vernay-Faunthorpe Expedition to India, December, 1928, to March, 1929

By ARTHUR S. VERNAY

IT is not remarkable, that in the minds of people of today, the lion is almost invariably associated with Africa.

The Asiatic lion, never numerous, is gradually becoming extinct. Dr. W. T. Blanford in *The Fauna of British India*, 1888–91, stated that it was common in Mesopotamia and part of southwestern Persia, but the information I received while in Syria, Mesopotamia, and Persia, was that the lion is extinct all through these countries. Possibly a few may still be found on the borders of the Tigris and the impenetrable thickets and reeded swamps bordering on the Euphrates, on the Zagros Mountains, and the thickly forested ranges near Shiraz, but this is unlikely since none have been recorded for many years.

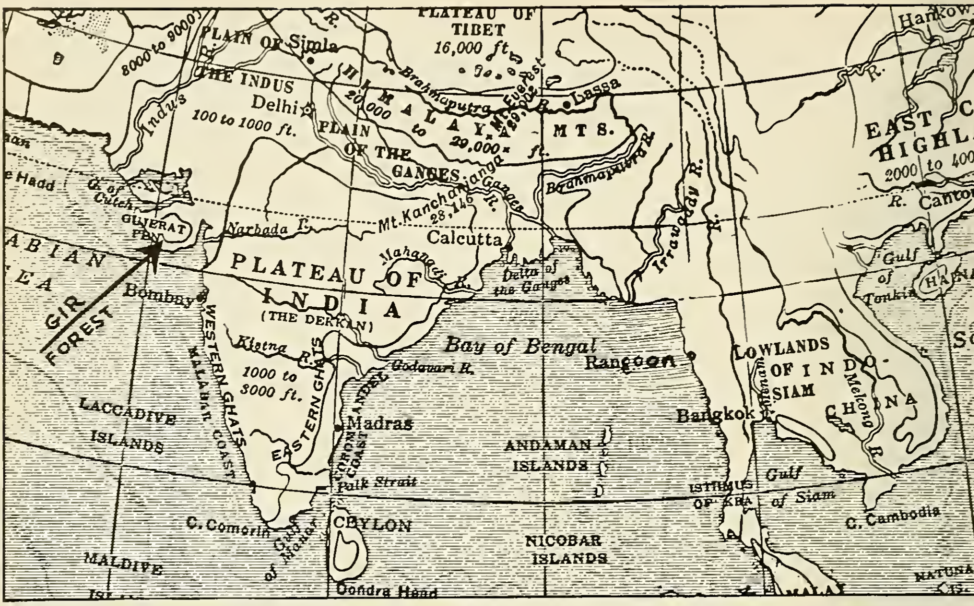
I believe, therefore, that we can assume that the lion in this part of the world is almost, if not entirely, extinct, and it is only in the Province of Kathiawar, a small peninsula northwest of Bombay, that the true Asiatic lion can still be found. Even there it exists only in the Gir Forest, an area of four hundred square miles in the State of Junagadh.

Junagadh is the chief state of the Province of Kathiawar, and is under the rule of His Highness Sir Mahabat Khan Nawab, Nawab being the Mohammedan equivalent of Maharajah in Hindoo.

It is only a question of time before the lion will disappear even from this district, although at present it is closely protected. The number, which is roughly estimated at 200, is not increasing. The inevitable diminution of the forest, in spite of the restrictions against cutting, and the possibility of disease owing to the confined area, mean ultimate extermination.

The Indian lion is an interesting subject. In the first place, even in India there are few sportsmen who have ever seen one, still fewer who have ever had the opportunity of shooting one, and mounted specimens are not to be found either in England or America. The American Museum of Natural History has one skin of an animal which was shot several years ago by Lord Lamington, but this is not fit for mounting. In the Prince of Wales Museum in Bombay there is an immature male, not in any way a representative specimen, and the Bombay Natural History Society hopes that the Nawab of Junagadh will give the Society permission to obtain one, particularly as it is for an Indian Museum. The two mentioned comprised all the museum specimens up to a few months ago, when we obtained a pair for the American Museum.

They are royal game, jealously guarded, and quite rightly so. If one speaks of the Indian lion to a sportsman in India, one generally receives the reply, "Oh, you mean the maneless lion." Another remark is, "There are no true Indian lions. Those that are here were imported from Africa 30 to 40 years ago." This is quite a reasonable supposition, as a small number were imported into Gwalior about that time, but after a few years they became a pest, killing not only the cattle of the natives, but also the natives themselves, so the African lions were all eventually shot out. Also, the tigers of Gwalior are famous, and as tigers will not permit lions to remain in their terri-



SHOWING THE LOCATION OF THE GIR FOREST

In the limited district marked by the Gir Forest, which is situated in Kathiawar, are to be found the only lions that are native to India. Formerly their range was much wider, but today they are very much restricted and it is highly probable that their total extinction is a matter of comparatively little time

tory, they must have helped to kill off the lions. But more of this later. In the meanwhile, the true Asiatic lion lived and still lives in the Gir Forest, which is about three hundred miles from Gwalior and an entirely different type of jungle.

The lions used in the arenas of Rome were African lions. The Biblical lion, the lion of Daniel, it is believed was a true Asiatic lion. We will not speak of the Macedonian lion; let us begin by admitting the existence of the lion at one time in Syria, trace it down the Tigris and Euphrates Rivers through Persia, where a few may possibly exist today, to the oak-clad ranges near Shiraz.

Unquestionably, in ancient times lions were numerous throughout Syria, Mesopotamia, and Persia. The Syrians frequently used the lion motif as a frieze decoration, and at Persepolis, thirty miles northeast of Shiraz, where the magnificent ruins of the palace of Darius the Great may still be seen, the lion as a decorative architectural motif was constantly used. In the embrasures of some of the great doors of Persepolis the winged lions were magnificently carved. The feathers of their great wings are almost as sharp today as when they were cut more than two thousand years ago.

We have traced the lion to Persia, now let us follow its course through to India and disprove the theory that the Indian lion is an African lion imported either by the Maharajah of Gwalior or by some previous eastern potentate.

We have not far to go in order to get into India where, as I have said, the true Asiatic lion exists at the present time. From Shiraz, keeping due east to Kerman across the Shurgaz Desert to the border of Persia and Baluchistan, southeast, a matter of twenty-four hours by train, we find ourselves on the border of the country where the Indian lion lives today. I was told, while in Duzdab, the frontier town on the Baluch-Persian border, that the lion existed in Afghanistan seventy-five years ago. This is mere hearsay, but it sounds quite reasonable. In order to make the situation a little clearer let us find Karachi on the map, a familiar name. The State of Junagadh is within a day of Karachi.

In earlier times, the lion, as records show, was comparatively common in India as far down as the Central Provinces. At the beginning of the Nineteenth Century it was found in the northwest of the Central Provinces, and Doctor Spry, in his *Modern India*, states that, when he was at Saugay in the Central Provinces, there was brought to him the skin of a full-grown male lion which had been killed by natives. This was in 1837, and from 1837 to 1864, there appear frequent references to lions in these Provinces, but at no time is it recorded that lions were common, although possibly they were there in considerable numbers at one time. In the old sporting books there is mention of a lioness in 1834. We hear of them again in Saugay from 1857 to 1864. The native shikaris spoke of having seen a tiger without stripes. After 1864 it appears the lions were driven out, possibly because the jungle became unsuitable. Again, it may be that the extermination of the lion throughout this part of India is due to the tiger. This is Mr. A. Dunbar Brander's opinion and he is one of the great authorities on Indian game.

It is a well-known fact that in combat the tiger invariably defeats the lion. So far as I can ascertain, there is only one instance on record of a lion's beating a tiger, and this happened in a circus where they were confined in adjoining cages. The animals broke through the partition and engaged in mortal combat, the lion being the victor; but this cannot be used

A TYPICAL VIEW IN THE GIR FOREST

Though taken in India, this view is also typical of those districts of Tanganyika Territory and Kenya Colony, in Africa, where lions abound. Thus it is obvious that the lions still to be found in India and those of Africa inhabit similar country as a criterion. The caged lion or tiger is a poor creature in comparison to these animals in their natural habitat. In this particular instance, the tiger might not have been in good condition, and the lion freshly brought in.

The tiger is not only more cunning than the lion, but is also a heavier animal. Sir John Hewitt, late Governor of the United Provinces, who is a great expert on tigers, says that a good specimen measuring around ten feet will average from 500 to 510 pounds.

While I was hunting last year with the Heir Apparent of Bikenir, who had just returned from shooting in Gwalior, he informed me that he had shot a tiger measuring 10 feet 3 inches, and weighing 620 pounds. The animal was taken to a small station where there was a weighing machine, and the Maharajah Kumar himself witnessed the weighing, and checked the weight; but there is this to be said, that the weighing occurred several hours after the animal had been killed. In any event this is quite abnormal, and 450 to 500 pounds is the usual weight of big tigers.

I have never had the opportunity to weigh lions in Africa, and the old lion we shot weighed approximately 410 pounds, as near as we could weigh it by the scales we had in camp. Mr. James L. Clark, who is very well informed on the lion of Africa, told me that a big African lion weighs about 450 pounds and averages in length about 9 feet to 9 feet 3 inches.

We can safely say that a big tiger measuring roughly 9 feet 6 inches would weigh about 475 pounds; a ten-foot tiger is not uncommon, consequently there would be greater length, greater weight in favor of the tiger, and greater cunning as compared with the lion. The fact that the tiger does not exist in the Province of Kathiwar, consequently may be one of the reasons why the lion's final stronghold is in the State of Junagadh.

From my observation, there is apparently no important difference between the Indian and the African lion. It is a curious fact that the Indian lion for some reason appears to carry less mane than the African lion, although in captivity the Indian species develops a good mane. It is generally supposed that this is because of the great quantity of acacia and thorn bush which is found in the Gir. This does not appear to me to be correct, as the country of the Gir, although thorny, is by no means as thorny as many parts of Africa, especially Angola where, on the banks of the Cunene River in dense thorn country far worse than the Gir, I shot a lion with an enormous mane. Mr. Dunbar Brander thinks the cause may be interbreeding, owing to the limited area. The black-maned lion has never been seen in India, the manes there being tawny, running to a very light yellow.

The male African lion has what is called a thorn in the end of his tail—a sharp bony point, of conical shape, about 3/16 inch at the base and about the same length; consequently one of the first things we did was to find out if the male Indian lion had the same kind of thorn. It was there. Why this thorn should exist in the male is an interesting problem. It may be used for scratching purposes, as the lion frequently switches his tail over his back. Again, if the lion lashed his tail, this small point could inflict a certain amount of damage.

In discussing the Vernay-Faunthorpe collection, Prof. Henry Fairfield Osborn on several occasions emphasized the fact that one of the most important desiderata was a good specimen of the Indian lion. Some of the other groups, such as the water buffalo, the elephant, the tsine in Burma, and the elusive wild dog in India, presented difficulties, but here was one the obtaining of which seemed almost unsurmountable.

PANCHAN, THE EXPEDITION SKINNER
This expert has followed Mr. Vernay's expeditions all about India and probably has skinned more different species of Indian animals than any other man. He holds the skull of a lion in his nand

The late Colonel Faunthorpe was most persistent and indefatigable in arriving at his objective, which was to obtain from His Highness the Nawab of Junagahd permission to shoot one specimen. We were asking a great favor. For three years Colonel Faunthorpe continued his efforts. Every avenue of approach was tried without avail and it seemed almost hopeless until we obtained the help of Major F. B. N. Tinley of the 20th Deccan Horse, then Chief Secretary in Junagadh. The first discussion with Major Tinley was in London. He said that on his return to India he would find out what could be done. Eventually, through his assistance, the Nawab gave us permission to shoot a male and female. There was joy in the land. We anticipated this *shikar* with the keenest pleasure. It was the culminating point in the formation of our collection, with one exception, and that is the small one-horned rhinoceros, which we hope to obtain in the course of time. Already two expeditions have been made for it. However, that is another story.

Colonel Faunthorpe and I many times discussed our plans. Every preparation was made to insure success, and the Nawab gave orders that everything possible should be done in order that we might secure these specimens for the American Museum of Natural History. The time chosen was February, 1929, and Colonel Faunthorpe and I journeyed from Bombay to Rajkot, on the border of Junagadh. There motors met us and we were taken to the capital, Junagadh, and later on in the day proceeded to camp at a place called Sasan, which is on the fringe of the Gir Forest. Major Tinley accompanied us as our host, and a better one we could not have wished for. We settled down in a camp which had been built for the Viceroy, Lord Irwin, who had planned to shoot there last year, but owing to his having to return to Delhi, his shoot was abandoned. We therefore had the pleasure of using this luxurious camp.

A FINE SPECIMEN OF INDIAN LION
So similar to the lions of Africa was this animal that, had he been found in Tanganyika Territory, no one would have questioned him as a native African beast

During the first few days luck was against us; no news came in. We hunted without avail. We beat here and there, but it was useless beating unless we had some definite news that the lion had been tracked and the spot where he was taking his daily siesta located. We were somewhat worried, as we had been told we might expect to get one the first day or two. On the fifth day news came that lions had been seen in a certain part of the country. We beat for them, sat up for them, but nothing happened.

But I am getting ahead of my story; we must speak of the country. It is extremely interesting and reminds one very much of certain parts of Africa, especially Angola. The greater part of the jungle is covered with stunted dwarf teak, bamboo, and thorny barbul (*Acacia Arabica*), and a beautiful tree, Sterculia, called by the natives "the naked tree." This is a large deciduous tree with whitish green-gray bark, whose gleaming trunks are a great feature of the Gir Forest. Coupled with this is the "flame of the forest," a gorgeous tree with large spreading branches covered with great brilliant vermillion blossoms. The twisted and stunted teak trees, the various acacias, the Sterculia, the great splashes of vermillion, and the low carranda bushes and wendy trees make a jungle of great beauty, while the ground is covered with dry leaves of the teak, dry grass, and withered shrubs. The soil is thin, with frequent outcrops of rock, and quantities of quartz crystals.

Leopard, hyæna, pig, sambur, four-horned antelope, chinkara, and lion, as well as a few black buck are found there. All these creatures were seen with the exception of panther and black buck, although we did hear a panther "sawing" late one evening. There are plenty of cattle for lions and panthers to feed on apart from sambur and four-horned antelope. The lions sometimes stroll into the adjoining Baroda territory, principally during the rains, in order to get into higher country, but they return to the Gir after the rains. As I have said, the estimated number of lions in the Gir forest at the present time is about 200. There are no bears as the feeding is unsuitable. In 1900 two were let loose in the Gir but did not survive the effects of swallowing wild fruits. There are no jungle fowl or spur fowl, but partridge are plentiful.

The average rainfall is about twenty inches, and from May to October the climate is extremely unhealthful. The region is a veritable death trap, full of malaria and very bad water. Undesirable citizens of Junagadh are generally sent there and are made forest guards or Gir police, as a penalty for their misdeeds.

This brings us to the shikaris (the native hunters), camp followers, and so on, who were with us. They appeared to be a very fine set of men, physically, and were wonderful trackers and shikaris. I have seldom seen better. Several of the men were supposed to have committed murder, and by their appearance the supposition seemed correct, but we were told the crime could not be definitely proved so the sentence was suspended to a period in service in the Gir. They were a motley crowd, but one could not help admiring their courage. They were good natured under the difficult conditions that faced them. Some of them had been badly mauled by lions and one of their number had been killed two years before.

The Gir buffaloes are the finest I have ever seen in any part of India. They are water buffalo and almost as fine as the wild species. If, while being hunted, a wounded lion should hide himself in an inaccessible place, some of the Gir buffaloes are put on his trail, and I am told it is an astonishing sight. They become infuriated and hunt him out, and unless he can escape, they will trample and gore him to death.

On our arrival at Camp Sasan we saw how complete the organization was.

AN INDIAN LIONESS

It is widely supposed that the Indian lion is maneless, but this is far from correct. The female is, of course, without a mane, as is the case in Africa, but the male obtained by the expedition had a fine, well developed mane

Everything possible had been done to insure success. We had brought with us our skinner from the border of Nepal, one named Panchan, a Tharu, who had been with Colonel Faunthorpe and me for the last seven years. I venture to state that no man in India has ever skinned a greater variety of Indian game than Panchan: many tigers, the great one-horned rhinoceros, the Sumatran rhinoceros, the tsine and thamin of Burma, elephants, sambur, and most of the Indian deer family, birds, porcupines, rats; he is trained to the last degree, and his skill is shown by the fact that we have in no instance lost a skin from the many specimens we have collected.

So our general equipment was perfect. All we needed was the lions. The method of hunting the Indian lion is not very exciting, except for the fact of seeing the animals, but we were fortunate in having a little episode which gave more amusement to the incident. His Highness, the Nawab, has forbidden anyone to shoot on foot since the tragic accident which befell Captain Carnegy, who while shooting with Lord Lamington was killed following a wounded lion. The shikaris go out, locate a lion by following the tracks; then *machans* (platforms) are put in trees, and the lions are, if possible, beaten up to the machans. It is not, as I have said, a particularly interesting way of shooting. Nevertheless, that is not the point. We wanted a lion and lioness and we had come many thousands of miles to get them. As I have said before, during the first few days nothing happened. We had seen one lioness or an immature male late in the evening, as we were passing down a jungle road in a motor car from where a beat had taken place. On the fourth day news came that a big lion had been seen. The shikaris were on his tracks. They had followed him for hours and could not leave him until he lay down for his siesta. The shikaris, who were posted certain distances apart, sent runners into camp, and in the meanwhile the machans were put up and the men placed in position. In the course of two or three hours the beat was ready to begin. In this particular instance, the only suitable place found for the machans was a jungle path about four feet across, with thick jungle on either side. A rather difficult position, for the lion could slip across this narrow path and it might be impossible to get a shot. We could hear the beaters a mile or so away, shouting, beating gongs; they came nearer and nearer; a noise was heard in the bushes, it came nearer and an old lion quickly appeared and was shot as he emerged from the jungle, a fine old full-maned lion, measuring 9 feet 1 inch. There was great excitement among the natives. They all gathered round, and we were told it was the biggest lion that had been shot in the Gir Forest in many years. Judging by the various photographs shown us of lions that had been shot during a period of twenty years, this was by far the finest specimen, especially as to mane.

We had permission to shoot a lioness. As one has only a few seconds in which to decide, it is very difficult to tell whether the animal being hunted is a female or a small male, on account of the absence of mane. However, we had to take the chance. A day or two passed by. We had been beating various parts of the jungle without success, until one afternoon, as we were returning to camp from a fruitless beat, motoring along a jungle road, we turned a corner; and there twenty yards ahead were nine lions. They quickly dispersed. None apparently was maned. The temptation was too great. Faunthorpe and I ran from the cars, separated, and went into the jungle. Fifty yards ahead on my left, in scrub jungle, I saw trotting what I believed to be a big lioness. I fired, and hit rather far back in the ribs. The animal went by in Faunthorpe's direction. He fired and hit rather high in the shoulder. She still carried on. We began to stalk, whereupon the head shikari and several others accompanied by Major Tinley ran toward us and asked us not to go on. It was against orders. The shikaris would lose their positions. As we were intensely anxious to secure the animal, we went on for a few yards, and saw the lioness disappear into a nullah. We had to stop, however, and we decided that it was impossible for the animal to live long after the two shots it had received, and that it was only a question of waiting until morning when it would be found dead. It was not a pleasant thought to have to leave this animal, as in the event of its dying, a hyæna or some other denizen of the jungle might destroy it. However, nothing else was to be done. We returned to camp. Major Tinley insisted it was a small lion but Faunthorpe and I felt confident it was a lioness. In any event it was an anxious period. In the morning the shikaris went out and found the animal dead within twenty yards of where we had stopped stalking, with its head resting on the top of the nullah, forepaws advanced ready for a charge. There was joy in the camp. A lion and lioness had now been secured, both perfect specimens.

The skinning was watched with the greatest care. The skeleton was carefully preserved, and the skin finally packed up ready to be sent to New York. Our object was accomplished. The skins were in perfect condition, not a hair missing. We took them back with us on the train to Bombay and then proceeded to prepare them for their journey to New York. When sending skins long distances from hot climates, it is important to treat the hair side of the skin with some kind of poison or turpentine. We always used turpentine. This kills a very voracious beetle, called the Dermestes beetle, which bores into the skin and, if left undisturbed for any period of time, will entirely destroy the skins.

The limited area in which these lions live is slowly becoming more limited, and ultimately the lions of India will become extinct. The lions of the Zagros Mountains, of the Euphrates and Tigris will also have disappeared, but thanks to the generosity of His Highness the Nawab, the American Museum of Natural History will have specimens. Not only the skins will be on view at the Museum but also the skeletons of the lions which roamed through Asia—the lion of Daniel—the lion of Junagadh, all one and the same thing, are now in the Museum workshops.

I have spoken of the time it took to obtain permission to shoot these specimens—more than three years—and had it not been for Colonel Faunthorpe, I believe this permission could never have been obtained. He persistently followed every possible trail that could lead to the objective which eventually brought him in touch with Major Tinley. It was a great effort and the last he made for the American Museum of Natural History. On December 1st last, he passed on, but the lions will remain in the Museum as a memory to him—a splendid sportsman and a very gallant gentleman.

WILD LIFE IN DOMINICA

A Brief Outline of the Many Interesting Species Revealed to the Members Of Two Short Expeditions

By PAUL GRISWOLD HOWES
Curator of Natural History, the Bruce Museum, Greenwich, Connecticut

PHOTOGRAPHS BY THE AUTHOR

WHEN we think of the rich and wonderful fauna and flora of South America, or even such richly endowed islands as Trinidad, which lies close to the mainland, Dominica and the other small islands of the Antilles are of course comparatively barren.

It is true, however, that Dominica is richer by far than most of them and, notwithstanding her isolation, she has gathered and mothered the seeds of a flora at least, that is unsurpassed for its beauty and luxuriant growth. She is lofty, too, with massive, crumpled lava mountains that pierce the clouds and gather enormous quantities of rain. In the sunlight after a deluge, she steams and breathes off the humid vapors and perfumes of life and growth. Her forests gleam in golden light, and hundreds of hidden streams rush their liquid treasure to the myriad roots that bind her rocks and lava-soil together.

Unlike the islands to the north, she is near enough to the source of hurricane disturbances to miss their maximum fury. She has suffered wounds at their hands but not very serious ones, for her high mountains have protected her, and therein lies the secret of her greater wealth of animal life.

Again, to the north whole islands have been ravaged and swept by these terrible hurricanes, which have taken immense toll of the living inhabitants. On many of the other islands there is not a single bird, for instance, that could be called abundant. This is true also of islands such as St. Vincent to the south. It is Dominica's high mountains that have conserved her wild life.

In the mountains, particularly at an altitude around 1800 feet, birds are abundant, and although there are only fifty-seven varieties, some of which are seen only as migrants, their voices are heard on every side echoing through the forests and clearings. Birds are very fortunate in Dominica. Few of them except the pigeons and doves and parrots are ever killed for food by the natives; their natural enemies are an unimportant factor because of their scarcity, while food and shelter are both abundant and admirably suited to their needs.

Life was everywhere if one really searched for it, and my simple discoveries amazed some of our Dominican friends. In the water held by bromeliads were quite a number of *Amoeba radiosa*. In one plant there were large numbers of them and a single species of diatom. *Amoeba* also occurred upon dead leaves in a drain at the side of the Imperial Road. In such places I also found other Protozoa—beautiful microscopic *Difflugia* encased in faceted suits of brilliant crystalline substances, emerald green *Euglena*, *Chænia*, and countless *Paramœcium*.

Everyone who has visited the American tropics is familiar with the Cecropia tree, *Cecropia palmata*. It is very common in Dominica. In studying this species and examining the strange, divided interior, it was found that in every tenth or twelfth or perhaps fifteenth division a quantity of water is held captive. This water, enclosed deep within the stem of the tree, supports animal life. Vials of the fluid taken from various trees and examined under the microscope proved to be housing four forms of Protozoa!

In a running brooklet I collected a brown species of flatworm. The worms are found on dead leaves and are much like the common *Planaria agilis* which is studied in every biology class. At the sides of the headlike anterior end, are processes like "ears" which are held upright and waved about as the animal progresses, as though of use as special sense organs. The two pits or eye spots in the head are oval, and a black, eyelike spot lies in the bottom of each.

These *Turbellaria* were very active day and night, and were strong enough to push their way about under a cover glass and finally escape from the weight unaided. As their chosen haunts undoubtedly dry up at times, they must encyst until the dry periods are over. In the economy of the brooklet they were used as food by larval *Aeschnid* dragon flies.

The earthworms are very abundant in Dominican soil. They are very active creatures, in many cases wriggling about with great rapidity when uncovered.

While digging in a bank in the heavy forest, I uncovered a perfectly round object three millimeters in diameter, which I took to be the egg of a small *Anolis* lizard. I placed it in a properly prepared vial to develop, and in three weeks it commenced to exhibit an orange coloring. A few days later this color had given way to a delicate pink, and red

THE OPOSSUM OF DOMINICA
This animal is often found in the orange groves, where it comes to eat the fallen fruit and particularly the seeds of both oranges and grapefruit

A GROUP OF FROG'S EGGS
The eggs of *Eleutherodactylus* are as clear as crystal, and their development may be watched by means of a binocular microscope. This picture shows the eggs greatly enlarged

A LAND SNAIL
Amphicyclotus amethystinus (Guppy) peculiar to Dominica, so far as is known has never been figured before

veins could be seen through the soft, thin shell. Four days later a perfect eighteen millimeter earthworm emerged from this egg. It commenced feeding at once in the earth within the vial and lived very well for some time.

To me the round form of the clitellum and the fact that it produced only one individual seemed a very interesting point.

Another strange earthworm protrudes a long, fleshy, viscid apparatus when disturbed. I found one of these progressing over a stone. When touched, it flashed out this odd device like the lash of a long whip. Very rapidly it came back along the worm's body, waved about behind it, and was then withdrawn again. The whip was as long as the body of the creature itself, but I could not ascertain whether it was solely for protection or also for gathering food from the protection of its burrow.

Molluscs are numerous and easily found, but only sixteen land forms and two from fresh-water streams were found on our two expeditions. In addition there are of course many marine forms found along the coast.

Amphicyclotus amethystinus (Guppy) is peculiar to the island and has never been figured heretofore, but the species of greatest interest to me is a little enlongated creature called *Subulina octona* Brug. I first found it commonly in the uplifted strata about one hundred feet above the present shore line. Here the dead shells were plentiful, associated with coral, marine shells, sand, and fragments of spiny lobsters, for all the world as though the species had once been a marine form. Later, the same species was found alive and quite commonly as a true land form 1800 feet in the mountains. I understand that this snail was never a marine form, but why so many of them in the uplift above Roseau?

ANOTHER VIEW OF THE LAND SNAIL
(See opposite page)
Sixteen species of land snail and two from fresh water were found by the expedition members

Among the crustaceans, both the land crab, *Pseudothelphusa dentata* (Latreille) and the shrimp, *Atya occidentalis* Newport, occur, and are very good to eat. We frequently set minnow traps baited with salt fish, in any convenient stream

A FROG READY TO HATCH
Frogs of the *Eleutherodactylus* group have no free tadpole state, but hatch directly from the eggs as perfectly formed frogs. Very greatly enlarged

near our headquarters, and into these the shrimps would go with all haste. They are very tasty and a welcome change from the everyday food. At other times we would catch a mess of them by scraping the undersides of half submerged bowlders with a butterfly net, and cook them in a tin while we worked in the stream. Thrown into hot erbswurst, they are unsurpassed, and many a meal we had thus, fresh from the mountain water.

The land crabs are very good also, but as they feed upon some very bitter form of vegetation, it is necessary to pen them up for a week or two before they are used. They live in the streams as much as upon the land, and we even found them on the plateau at Milton far from any water. The specimens here would turn immediately upon our approach and give battle, with wild and awkward claws waving about in a most ridiculous manner.

They have been reported as migrating in vast numbers at one time of the year, to breed in the sea. As is so often the case in Dominica, no one, if actually pinned down, can tell you just when this occurs, and the fact that we found very tiny ones under stones along the rivers is strong evidence that they are born near by.

We found only one species of fish in most of the small mountain streams, a goby, *Sicydium punctatum* Perugia, that feeds entirely upon algæ which it browses from the rocks. In the larger rivers there are mullet and a few other species, and although there are plenty of shrimps and snails also, the mullet will not eat them, but will bite well on avacado pear.

The goby mentioned is fitted with a suction disc upon its belly which enables it to cling to the rocks when the rivers are high. As these streams, when simply rain carriers, often dry up, I tried an interesting experiment to test the resisting power of this fish.

In a small glass box I placed a few algæ-covered stones and some of the stream water from which I had collected the fishes. One or two specimens were then placed in

AN ANOLIS LIZARD

These little reptiles live in the deep forests along the streams. They swim with ease and great rapidity

A DOMINICAN GECKO
This weird looking creature (*Thecodactylus rapicaudus*) lives in the houses and comes out at night to catch the moths attracted by the lights. Note the creature's strange feet, perfected for clinging upside down

the box at a time, without plants of any kind except the algæ.

As the oxygen became partly exhausted, the fishes would jerk themselves up the side of the glass box by means of their suction discs and, here, with their heads entirely out of water, they would remain for a time breathing atmospheric air over their moist gills until revived, when they would return to the foul water again.

When the streams dry up, the fishes evidently burrow into the damp pebbles and sand and there await the return of the water after the next rain, meanwhile breathing the same air that we do.

Perhaps the most interesting creatures of all in Dominica are the little frogs of the *Eleutherodactylus* group. These are the ones that pass through no free tadpole state as most of their relations do, but hatch directly from the eggs as minute but perfectly formed frogs.

On our first expedition to the island, I was fortunate in finding two batches of eggs which were strung out upon the wet forest floor near our headquarters. The eggs are very large for so small a creature, but it must be remembered that the amount of food matter which they contain must be sufficient. to supply the budding frog, from the time of the first appearance of the embryo until the finished creature steps into the world beyond its egg shell. In Dominica, it would seem that this is a perfect case of adaptation, for despite the enormous annual precipitation in the frogs' habitat, there are no natural pools in the forests, because of the steepness of everything and the resulting rapid drainage, while the rivers are either too violent or lacking in sufficient food material.

The eggs of these frogs are as clear as crystal and the whole development may

AN OPOSSUM ON A TREE FERN
This species looks very much like the Virginia 'possum. It is relished as food by the natives

The only frog on the island that we were able to find is the large *Leptodactylus, follax,* called "Crapaud" locally. This is used to a great extent for food. They are caught and penned up, and strange as it may seem, they thrive on a diet of "French grass" which is nothing more nor less than the day flower, *Commelina Virginica.*

Reptiles are numerous in Dominica, but nothing poisonous occurs, even though Martinique, which is within sight on clear days, supports numbers of the deadly fer-de-lance. It is remarkable that this species has been unable to reach Dominica by way of the sloops which carry produce between the islands.

A beautiful snake is commonly found, which is one of the most docile creatures imaginable. It is harmless and cannot be induced to bite. This is *Leimadophis juliæ*, a species which inhabits the country from about 650 feet up to 1850 feet, and possibly higher. It, however, loses its docility as it gets older and then fights violently when captured.

We captured several Antillean boa-constrictors (*Constrictor orophias*) and successfully brought them home alive. They are extremely vicious and will inflict a bad wound if great care is not exercised in handling them. None of them ever became quiet or reconciled and finally all of them died of a malady which filled their jaw muscles with pus, causing their mouths to swell and shutting off their air supply. They actually died of strangulation.

They occur up to ten or eleven feet, but our largest was seven feet four inches in length. All of the boas were collected around 1800 feet in the moun-

be watched by means of the binocular microscope. For anyone who is interested in the study of glands in relation to growth and metamorphosis, here is indeed an ideal subject.

On our second trip in 1929, we found the eggs again almost on the same date that the first ones were obtained, and by coincidence, within a few yards of this site. The frogs occur from sea level to the tops of the mountains.

tains and none of them were found in the forest itself.

Of the fifty-seven birds a few stand out particularly in my memories of this wonderful island. As I awoke from a sound sleep after my first night in the mountains, the full, rich song of the Dominican wren, *Thryothorus rufescens* floated in to me.

The singer sat outside my window, and there from his lichen-coated orange branch poured forth his melody to the rising sun beyond Diablotin. I have never heard a more beautiful song from the throat of any wren. Near by in a cover of ferns and dewy weeds, his mate spoke her approval in simple language, which sounded much like the chatter-talk of our wrens in America. Later I found this bird's song to be remarkably varied, and it was some time before I could recognize the variations as coming from the same species.

The mountain whistler, *Myiadestes dominicanus*, is a characteristic inhabitant of the high forests and mountain gorges. It does not appear to go below 1000 feet, but in the forests about our headquarters at 1800 feet it was seen on nearly every walk.

Its calls and songs vary greatly. Sometimes one hears a series of gorgeously clear, ascending notes, which echo through the green halls, as sweet and liquid as those from a silver flute. Again, the notes will be less perfect, even discordant and slightly out of key, but pleasing nevertheless. I like to hear the whistler best when all else is silent and no wind stirs and its voice issues from some deep and distant wooded canyon just at evening. It is then that its song fits into the environment as at no other time. It makes one feel the joy of the open and the tonic of a mountain world. One feels in addition, that here is the ideal setting of Nature, something, I believe, that everyone pictures more or less vaguely in his mind. When one finds the perfect setting and the perfect bird inhabitant together, the resulting song seems somehow to be just what one has hoped to hear.

A BLOSSOM OF THE DAY FLOWER
(*Commelina Virginica*)
This flower is an article of diet of the Dominican frog

(*Above*)

DOMINICAN SOIL FORMS RAPIDLY

Lichens at work upon the rocks preparing soil for the higher plants. Altitude 1800 feet

(*Left*)

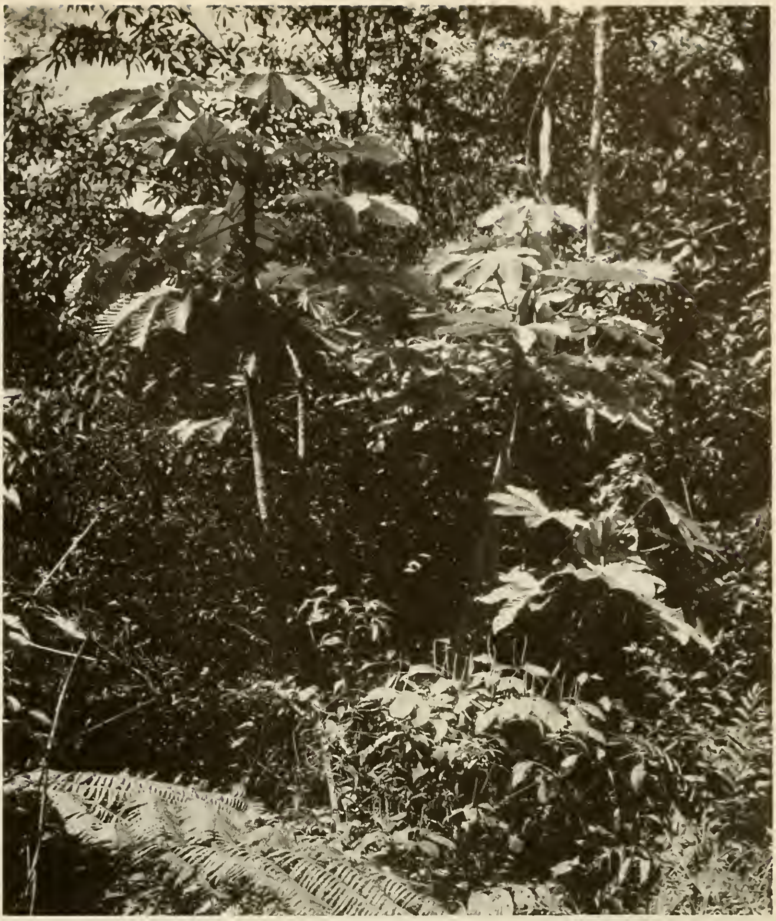
STOUTLY ARMED PIN TREES

The protecting spikes that protrude along the trunks of these trees are very sharp and remarkably strong

(*Right*)

CECROPIA TREES

The stems of *Cecropia palmata* are hollow and divided into compartments, some of which contain water and microscopic animal life



(*Below*)

FERNS OF DOMINICA

Exquisite fern life such as this grows everywhere along the mountain roads that wind through the big forests

There is only one other bird that has ever impressed me just as this "siffleur" has done, and that is a mythical one that trills strange melody from behind the scenes at the opera. There is no earthly bird song like it, yet this bit of tin with a drop of water in it and the mountain whistler fascinate me and excite my imagination in the same way.

I was able to call the whistlers at times by imitating their call notes. They would assemble in the branches above, answering and peering in astonishment at me or venting their angry feelings upon one another. In the heat of the argument they would suddenly realize that it was all a fake and, finding themselves trespassers upon one another's chosen territory, would fly off in all directions with strange squeaks, stifled whistles, and snapping mandibles.

Mammals are not well represented in Dominica, as one would naturally suspect, but there are a few of considerable interest.

The black rat, *Rattus rattus rattus*, and the house mouse, *Mus musculus*, and rat, *Rattus rattus alexandrinus*, have been introduced as usual. There is one 'possum, *Didelphis marsupialis insularis*, greatly sought after by the natives and its flesh is often dried and smoked for future use.

Agouti roam the forests also, but are not common, as they are on the mainland of South America. They are called "mountain rabbit," and are relished as food by whites and blacks alike. A wild pig is also found and sometimes descends from its mountain abodes to do much damage in the gardens of the natives. This is not a peccary but simply a domestic variety that escaped long ago and has become wild in the forests.

Bats are of course the dominant form of mammal life. Being winged, they have easily reached the island, and here is a field in which there is doubtless still considerable work to be done.

A CAVE BAT
(*Myotis dominicensis*)
These small creatures live in the foulest fissures of the volcanic island. The two button-like processes to the left of the animal's nose appear to be connected with glands under the skin, which may have something to do with their success in such habitats

A HANDFUL OF CAVE BATS

These specimens came from a cave known locally as "The Stinking Hole." Note how small this species is

We saw nine species on our two expeditions, but only six were actually obtained. The huge, reddish furred fruit bat of the coast, another big species that was seen nightly about our headquarters, and what is doubtless the same form of fish bat one finds skimming the water at Trinidad in search of minnows, were not secured despite all our efforts.

The species collected were, *Molossus major*, *Monophyllus luciæ*, *Tadarida antillularum*, *Natalus stramineus*, another species of *Natalus* with a yellowish brown coat, and the tiny cave bat, *Myotis dominicensis*.

High in the hills above our headquarters is a strange funnel-like hole in the mountain which we called the "Stinking Hole." Here, in a deep cleft that one must enter from the top of a rise in the forest, and thirty-five feet below the surface, is another still narrower crack that leads into the earth. Some distance within the second crack the earth drops away into darkness with the floor deep below, and from here no one knows where the cave leads to. It breathes a foul air in one's face that is warm and sickening, like the breath of a huge living monster, while water drips and runs down continually upon the investigator over shiny black volcanic stones that stud the sides of the cavern.

Far within, it is dry and hot, and has become the abode of swarms of the little cave bats, which in some unaccountable manner are able to withstand the foul fumes. We collected many specimens by means of a butterfly net, but were soon forced to retreat to the upper air, as the gases from the interior of this cave made us feel sick and dizzy.

In 1929 we made a trip to the Glo Manioc cave, from which much guano has been taken by the natives in the past and which we had always been anxious to visit.

This cave is situated west of the Layou River and about 200 feet up in the cliffs, one half mile west of the old abandoned plantation known as Glo Manioc. One may walk down the bed of the river upon the huge bowlders and cross over when the entrance to the cave comes into view as a carved, arched doorway leading into the gray wall of the cliff.

We climbed up a deserted and heavily grown path left by the guano gatherers and descended afterward by another and better route to a small river which empties into the Layou.

As we neared the entrance to the cave, a distinct odor of sulphur was noted, but at no other time either within or outside the cave was this noticeable; there is doubtless a small vent near by, as these are not uncommon in Dominica.

The opening to the cave is seventy-five feet in width and ten feet high. It is partly blocked by great chunks of porous lava which have either been loosened from the vaulted roof of the chamber or heaved up from below when this great mouth was still breathing forth sulphur and gas and boiling stuff from the interior of the island. The cave runs back for some distance and slopes steeply to the rear, where more large fragments of lava are heaped together, in places forming smaller caves within the mother cave.

The floor is of rocks and lava and disintegrating material, quite dry and even dusty in many places despite the water which seeps through the roof and drops to the floor from the ends of little stalactites. Unfortunately the specimens were lost and no analysis can be made unless another trip to the cave is made.

THE BAT CAVE AT GLO MANIOC
The viewpoint of this picture is from the small river that runs into the Greater Layou near by

The rocks lying upon the floor are beautifully tinted by one-celled algæ, those nearest the entrance being brilliant green, while the ones upon the rocks farther in from the source of light are duller in color and other rocks are tinted with reds and browns. The green algæ contain chlorophyll and therefore manufacture their own food materials. Naturally they grow best close to a brilliant light source.

There were very few bats in the cave. We found one mass of them quite near the entrance, from which I caught fifty or sixty in my net. These I allowed to escape, expecting to get plenty of others later on, but to our surprise this was the only colony in the cave. There was very little guano upon the floor, and it is my opinion that the natives finally drove the main colony away and that this single small group is the nucleus of a new colony.

All of the bats here were *Myotis dominicensis*, the little cave bat, and the same as we found in the Stinking Hole in 1926, but the specimens from Glo Manioc showed a slightly smaller wing spread, although of the same sex (male) as the ones from that foul cave.

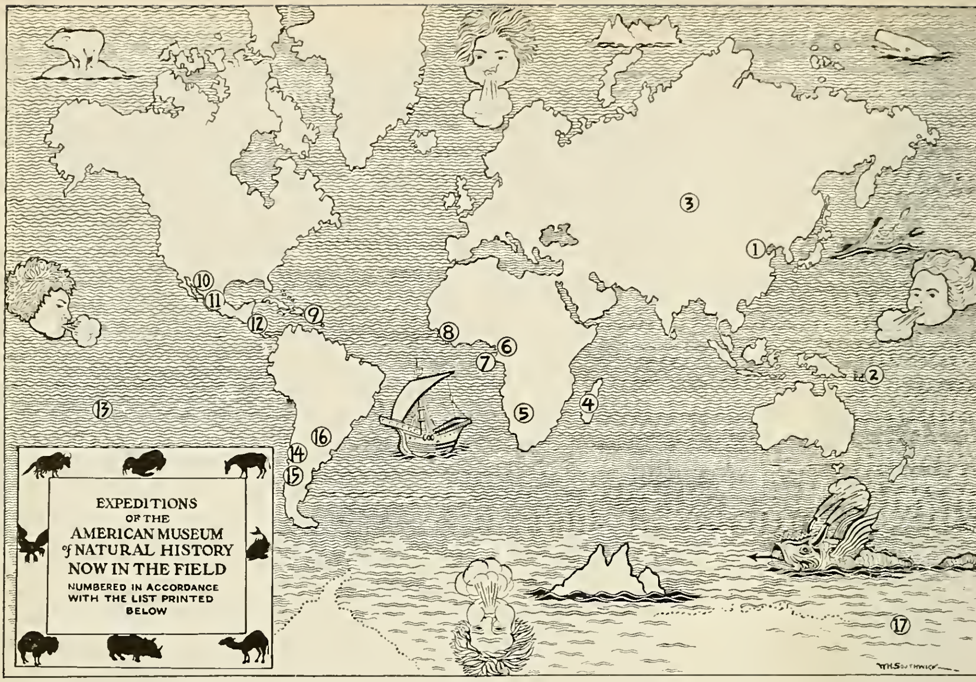
MR. CUMMINGS AT THE ENTRANCE TO A BAT CAVE
Tiny stalactites were hanging from the roof of the chamber, and beautiful algæ grew upon the rocks inside

A remarkable observation made in the present cave was the fact that the Dominican wren, *Thryothorus rufescens* was frequenting the guano deposits under the roosting place of the bats for the purpose of obtaining bits of undigested insects from the droppings. Under the microscope these droppings were found to be rich in such food matter, and the wrens have found this out to their advantage. The maggots which collect in the guano are another source of food.

After the bat colony had been disturbed, a small cloud of bat flies went whirling about within the cave, but these disappeared with the bats and did not return.

In 1926 we secured the rare and desirable *Natalus stramineus*, a pale, delicate bat with a very peculiar profile. This was the only one seen, but in 1929 a bat flew into the house which proved to be another species of *Natalus* with a greater wing spread and fur of a different color.

Thus it will be seen that there are still very interesting things awaiting the investigator in Dominica, and that our two intensive expeditions have not exhausted the possibilities.



1. Central Asiatic; 2. Whitney South Sea, Solomon Islands, for birds; 3. Morden-Graves, Turkestan, for mammals; 4. Madagascar, for birds, mammals, and fossils; 5. Vernay, to Africa, for mammals; 6. Columbia University-American Museum, to Africa, for anatomical study; 7. Thorne-Correia, Gulf of Guinea, for birds; 8. Murphy, to Liberia, for birds; 9. Heilprin-Hassler, Haiti, for reptiles; 10. Frick-Rak, New Mexico, for fossils; Frick-Falkenbach, Nebraska, for fossils; 11. Vaillant, Valley of Mexico, archæological study; 12. Chapman, Barro Colorado, for bird study; Legendre-Carter, to Eastern Panama, for birds and mammals; 13. Shapiro, Polynesia, physical anthropology; 14. Olsen, South America, archæological reconnaissance; 15. Ottley-Anthony, South America, biological reconnaissance; 16. Naumburg-Kaempfer, Southeastern Brazil, for birds; 17. Byrd, Antarctic

AMERICAN MUSEUM EXPEDITIONS

Edited by A. KATHERINE BERGER

It is the purpose of this department to keep readers of Natural History *informed as to the latest news of Museum expeditions in the field at the time the magazine goes to press. In many instances, however, the sources of information are so distant that it is not possible to include up-to-date data*

WORD from the Columbia University-American Museum Expedition to Africa indicates that all its members are in fine health and spirits, and that they expect to be back in New York about the middle of February.

The November–December number of Natural History noted the taking of the first big gorilla by Leader Harry C. Raven, after an exciting charge from the animal. The following extracts from letters received by President Osborn describe the most recent activities of the expedition.

Chabinda, in the Mountains
West of Lake Kivu

Shortly after Raven had returned here to camp with his big male No. 1, we all had an opportunity to spend two hours late in the afternoon and three hours the next morning spying through the bushes on a party of gorillas which were literally within hearing of camp. Many interesting observations have been made as to their habits, but unfortunately no opportunity to get motion or still pictures of the living animals presented itself. At this time Raven shot and killed a second adult which he took to be a large female but which turned out to be a male. Professor McGregor and others took many cinema and still pictures of this specimen, showing many important details, also excellent casts of the bust, hands and feet. It was necessary to remove the contents of the digestive tract, so that we all had an opportunity to see the enormous quantity of ingested food, the very man-like vermiform appendix, and numerous tapeworms and other internal parasites.

Some ten days ago Raven took Gorilla No. 1 on a long journey by auto-truck to Uvira, where he left him, pending shipment via Dar-es-Salaam. Now that we are sure the second one will not go bad on the way home, we will shortly take him with us for shipment along with No. 1. We are sending both to be stored temporarily in the refrigerating room at P. and S.

Since then we have made many excursions to get photos of the living gorillas, but have not as yet succeeded as they live in very dense brush. At present Raven and Engle are on a side trip to a high mountain about six hours' journey from here, where it is reported gorillas inhabit the bamboo forest, where photography may be more possible. Meanwhile McGregor and I are guarding camp and making local excursions whenever the rain permits.

P. S. Sept. 15th. Raven and Engle returned some days ago from their strenuous trip to Mt. Cahusi. They found apparently ideal country for gorillas there, with fine bamboo forests and original or open forest not so much choked with underbrush as this is; but *no traces* of gorillas. However, they shot several monkeys, including one with a vertical white band on his nose, which may be the very rare *Rhinos-*

tigma. Meanwhile I have been making almost daily excursions in this vicinity, searching for recent traces of gorillas, but the elephants which were here a couple of weeks ago have left a labyrinth of trails and trampled the gorillas' favorite nesting places, so that the Mambuti hunters tell us they think the gorillas have all moved away to the south and west. And now we must begin immediately to move camp, so as to take up our long journey to the West Coast.

The movie and still photos are being developed and stored away as fast as possible. They are nearly all in excellent shape, so that by the end of the trip we should have a great deal of material for lectures and illustrations.

CONGO RIVER, 1 DAY'S RUN ABOVE COQUILHATVILLE.

We had to leave the Kivu region about September 20 and have been traveling or waiting for boats or trains ever since, except for a week's side trip from Stanleyville, after chimpanzees. This side trip to Benalia, 85 miles north of Stanleyville was intensely interesting and yielded many pictures of the natives. Raven worked until he was worn out hunting chimpanzees in a locality where they are often abundant, but luck was against him and we had to leave with only one instead of four. However, we may still possibly get them elsewhere.

AT THE PORT OF DUALA, FRENCH CAMEROON, November 7, 1929.

We are waiting to go ashore into the French Cameroons for the last part of our African journey and our thoughts naturally turn toward home. We had a singularly interesting trip across Africa, mostly by steamboat, leaving the mountains of the Kivu September 20. What a gorgeous panorama of mountain and lake, primal forest, river jungles, the mighty Congo itself, for many weeks past! I have kept a record of crude sketches of these scenes and have studied the topography and geology as far as possible, so that I have seen a section across Africa from the east coast to the west coast. And with what delight I have studied the intensely human "indigenes," truly our black cousins, and more akin to me at least than the cold blooded Mongolians. How many memories of walks in native villages we shall treasure and what an immense range of variation in details, with underlying racial characters, have passed before us. Just when one is ready to say "Well, this is the *most perfect* gorilloid human nose of all," another still more perfect will appear.

During the long waits for boats and trains we have made side trips whenever possible, which have yielded to Mc Gregor, a great store of cinema records.

This afternoon we shall reach Duala, and plan to go by train or camion eastward to Yaounde, where the Governor resides. After making arrangements with him, we shall probably go southeastward toward the Gabon, east of Eblowa, where gorillas are said to be numerous. But in Africa one can rarely learn in advance the precise local conditions so our detailed plans may be modified to suit. But we shall make every effort to be back here in Duala in time for the Dec. 19th boat for Bordeaux, or at latest the one leaving here Dec. 30, in time to get us home before February 1.

ALTHOUGH, owing to the regrettable attitude of the Chinese toward research, the Central Asiatic Expedition was unable to continue its field work in 1929, Dr. Roy Chapman Andrews has remained in Peking working upon the narrative volume of the expedition, "The Conquest of Asia." It is hoped that conditions will so change that the expedition can continue its work in 1930.

The other men of the expedition have returned to America and are devoting their time to studying the collections obtained. The manuscript for Volume IV on the Permian of Mongolia is practically ready for the printer, and will be published in 1930. Prof. Henry Fairfield Osborn and Mr. Walter Granger are engaged in the study of the palæontological material, the results of which will appear in Volumes VI and VII. Profs. Charles P. Berkey, Frederick K. Morris, and Leslie E. Spock have the manuscript nearly completed for Volume III, which is a continuation of Volume II on the Geology of Mongolia.

THE Morden-Graves North Asiatic Expedition has been successful in obtaining six skins and five skeletons of the rare saiga antelope (*Saiga tartarica*) from the Steppes of Russian Turkestan, together with specimens of plants and other accessories for the construction of an exhibition group at the American Museum. This will be the only habitat group in America of the saiga.

The saiga and the *Jerboa alactaga* are the sole survivors of the Ice Age fauna that invaded Europe from the cold steppes of Asia with the woolly mammoth. The saiga once abounded in Central Asia, but is now rapidly becoming extinct, due to its relentless pursuit by the Chinese who believe that the horns of the saiga possess medicinal properties.

The difficulties encountered in obtaining the antelope were far greater than had been anticipated. Much of the time the members of the expedition were without proper food, and the water, even when boiled, was very bad. The winds sweeping across the steppes were so fierce that tents could not be used at night, and the party was without shelter whenever it was not possible to stop at the native huts.

Under these conditions Mr. Morden spent ten days in the saddle, pursuing the saiga. The strain told greatly upon his health; for two weeks he carried on and covered about two hundred and fifty miles, trying to shake off the results of the hardships suffered. Finally, a cablegram was received at the Museum early in December announcing that Mr. Morden's illness necessitated his immediately abandoning his plans to go to Siberia, and that he had gone from Moscow to Paris for treatment. He hoped to rejoin the expedition again in January.

In the meantime Mr. George Goodwin of the American Museum's department of mammalogy went to meet Mr. George Graves, who took charge of the expedition in Mr. Morden's absence.

Mr. Morden has already secured for the Asiatic Hall of the American Museum a splendid collection of the *Ovis poli* of Mongolia and the Thianshan ibex.

AT the end of December Arthur S. Vernay sailed from New York for England on his way to Cape Town to begin his expedition to the Kalhari Dessert. The main object of the expedition is the collecting of specimens of large mammals. These are to be divided between the Field Museum of Natural History and the American Museum. Mr. Rudyerd Boulton, who is to be a member of the party, and who is now collecting for the Carnegie Museum in southern Rodesia, will collect birds for the Carnegie Museum and the American Museum. At Cape Town Mr. Vernay will be joined by Herbert Lang who has been making preparations for the trip.

The party will proceed by motor truck from the railroad toward the region about Lake Ngami, where work will be carried on for about four months.

ON Christmas Day, a cable was received from Curator Harold E. Anthony, and Mr. Gilbert Ottley stating that they were in Puente Inca, Argentina, and that by January 1 they would reach Santiago, Chile. Mr. Anthony and Mr. Ottley are making a reconnaissance of South America with the object of collecting at the type localities as many species of mammals as is possible. They will return up the east coast of South America and are expected to arrive in New York during the month of April.

THE Byrd Antarctic Expedition.—On the occasion of Commander Byrd's dramatic flight on November 28 and 29 from Little America to the South Pole, President Osborn and the members of the scientific staff of the American Museum sent the following congratulatory radiogram to the intrepid leader of the Byrd-Antarctic Expedition:

December 3, 1929.

To Commander Richard E. Byrd,
Little America.

The members of the staff of the American Museum of Natural History send united congratulations to yourself and your associates upon the completion of the triumphant flight to the South Pole.

From our own field experience in many lands and seas, we have a clear appreciation of the patient and faultless planning necessary for such monumental achievement. We hail, therefore, the perfect climax of your campaign and extol the judgment, courage and teamplay that made it possible.

Your flight writes the opening page in a new history of science on the vast Antarctic Continent. We do not forget, moreover, that you and your consecrated fellow-workers are extending knowledge day by day and building through the laborious routine of duty, the foundation for your brilliant exploration by air. You have justified the confidence of your countrymen, and to the fulfillment of all your plans our hopes are with you.

Henry Fairfield Osborn
President

A few days later President Osborn received the following reply by radio, which was forwarded by the *New York Times:*

Little America, December 10

For Henry Fairfield Osborn
President, American Museum of Natural History.

Your radio has delighted us. It is most generous and more encouraging than you can perhaps realize since we have tried so hard to produce real scientific results. A message like yours from such a distinguished scientist as yourself makes us feel that our efforts have not been in vain. Please accept my deep appreciation and warm regards.

Richard Byrd

LATEST advices from the Whitney South Sea Expedition state that all its members are well and are expecting to be through with bird collecting in the Solomon Islands by March, including Malaita, where no naturalist has ever collected before. The next objective will be the Japanese Mandate Islands to the northward.

A VERY creditable piece of bird collecting has been done by the Thorne-Correia Expedition which has been visiting two Spanish and two Portuguese islands in the Gulf of Guinea. Word from Mr. Correia, early in December, said that he was on his way to Annobon, one of the Spanish islands. On Fernando Po, the other Spanish island, there is a great scarcity of water from the upper part of the forest zone to the highlands. Mr. Correia is negotiating with the governor of the islands for men to cut trails and carry water to the top so that this region can be explored by the expedition.

Mr. Thorne has extended his contribution so that there will be sufficient funds to complete the task in the Camaroon Mountains on the African mainland, thus for the first time making possible a valuable and adequate series of the birds of these islands, with excellent photographs and notes.

THE Tanganyika Expedition.—Messrs. J. Sterling Rockefeller and Charles G. B. Murphy, accompanied by Allan L. Moses as preparator, started from Dar-es-Salaam in August, 1928, on an expedition intended largely to contribute specimens to the bird collections of the American Museum. Recent cables inform us that they have traversed the continent from the East Coast to the lower Congo River, and that Messrs. Rockefeller and Moses plan to return directly to New York.

Mr. Murphy, in company with Mr. R. H. Drinkwater, is proceeding to Liberia with the aim of securing further specimens of birds from a region as yet almost unrepresented in our collection.

The expedition was named the Tanganyika Expedition because its efforts were to be directed largely in the vicinity of that great lake. Some six months were spent in Tanganyika Territory, partly in hunting, partly in collecting birds. Next the party proceeded to Marungu, a highland country on the southwest side of Lake Tanganyika. The mountains here rise to over 6000 feet, being largely grass-covered, but clothed on their lower slopes with savanna woods, or extensive groves of trees with grass growing almost everywhere beneath

In 1883 the region was traversed rapidly by the talented ornithologist Dr. R. Böhm, and nearly all that was known of its birds came from Böhm's notebooks, for he succumbed to fever the following year in the Katanga. Although a few collections of birds were made by others along the shore of Lake Tanganyika, the fauna of the highlands remained imperfectly known.

Our Tanganyika Expedition therefore devoted its entire efforts for three and a half months to a survey of bird-life in these highlands, which they crossed twice, going south to the Rhodesian border. The resulting collection numbered 597 specimens and amply fulfilled our hopes. A number of species were secured which had not previously been known to occur within the boundaries of the Belgian Congo, and when the collection has been studied more closely it will reveal a great deal more about the avifauna of this southeast corner of the Congo, and its relation with eastern Africa. Together with their collection, Messrs. Rockefeller and Murphy have sent back a very complete report of the topography and vegetation of the country, and a field-catalogue with many notes on the birds observed.

After shipping their collections to America by way of the east coast, the party turned northward to the valley of the Ruzizi River, flowing from Lake Kivu. To the west of this valley runs a mountain ridge some 10,000 feet high, where very few birds have ever been collected, save by the Austrian explorer, Rudolf Grauer.

On these mountains they again began collecting, and after crossing the ridge they entered the southeastern angle of the great Congo forest, reaching Kindu on the Lualaba River. They report having made another excellent collection of birds between Kindu and the Ruzizi Valley, in which numerous rarities will surely be found when it reaches the Museum.

Mr. H. C. Raven writes that at Uvira he had the good fortune to encounter Mr. Murphy, whose happy features were wreathed in a generous black beard. This was just before the Tanganyika Expedition started from the Ruzizi for Itula and Kindu. At last reports, the party was in good health and had come down the Congo River to Matadi.

THE Straus-Nyasaland Expedition.—Mr. and Mrs. Rudyerd Boulton have completed four months of ornithological work in the vicinity of Lake Nyasa, made possible by the generosity of Mrs. Oscar Straus. Early in 1929 they accompanied Mrs. Straus and Mr. Edward Schafer, Jr., on their journey up the Nile and through Uganda and Kenya Colony.

From Nairobi Mrs. Straus turned homeward, the Boultons proceeding by steamer from Mombasa to Beira. Thence they gained Lake Nyasa, and began collecting on Mt. Rungwe, north of the lake. A number of other localities were subsequently visited, so that Nyasaland will no longer be without representation in the American Museum's bird collections. The country is of great interest because of its diversified nature, the separate mountain districts offering homes to many peculiar birds. The Boulton collection is awaited therefore with pleasant expectations.

THE greater part of 1928 and 1929 was spent by Mr. F. G. Carnochan and Mr. G. H. Russell, of New City, N. Y. in Tanganyika Territory, Kenya Colony, and Ruanda, studying the natives, their medicinal herbs, and especially the snake-societies among the Wanyamwezi. Mr. Carnochan, deeply interested also in the animal life of the region, remembered that he could help the American Museum by securing specimens, and thus brought together a considerable collection of mammals, birds, and reptiles. On his return he very kindly donated to the American Museum 379 skins of birds, as well as many mammals and some herpetological specimens.

AFTER an extended trip to Cuba, Arizona, and Utah, Barnum Brown returned to the American Museum December 20. His expedition to Arizona and Utah was under the auspices of the Museum of the University of Pennsylvania. One party of the expedition, directed by Dr. J. A. Mason, excavated in the Pueblo ruins on Navajo Mountain in Southern Utah.

Mr. Brown's party, accompanied by Gilbert E. Gable, investigated Triassic dinosaur tracks on the Navajo Reservation, uncovering 300 tracks representing four distinct species at one spot in the Painted Desert on the Little Colorado River near Cameron.

The most important results of the expedition was the discovery of two skeletons of Jurassic dinosaurs in Utah—a *Brontosaurus* and a new genus of carnivorous dinosaur. Both skeletons were examined and re-covered to await future excavation by an American Museum expedition.

ON December 29, Mr. Walter W. Holmes, field associate in palæontology, left the American Museum to continue explorations in the Pleistocene deposits of southern Florida during the winter.

ON January 2 Mr. Ronald Olsen left New York to make an archæological reconnaissance in Ecuador, Peru, and Bolivia. The major portion of his time will be spent in Peru. Mr. Olsen will study cross sections of the Andean region in several places, starting from southern Peru in the Lake Titicaca region. The purpose of his trip will not be for collections, but rather to study the refuse heaps to establish the sequence of cultures, which, in those countries of South America have never been clearly established. Much of the ancient culture has been attributed to the Inca period, which in reality was only four or five centuries in duration. The material in the Museum would indicate much older civilizations.

THE Angelo-Heilprin Expedition to Santo Domingo.—Mr. William G. Hassler is visiting Santo Domingo on a grant from the Angelo-Heilprin exploration fund. He is collecting and infiltrating reptiles and amphibians in the field. The process of infiltrating whole specimens with paraffin was recently worked out in the department of herpetology and experimental biology at the American Museum. It consists essentially in replacing by paraffin the water in an animal's tissues. The animal is posed in its natural surroundings with all of its tissues intact, then it is run through a series of baths which make the entire specimen a permanent preparation. This is the first time that any expedition has gone into the field to prepare specimens by the new infiltration method.

Incidental to the work, Mr. Hassler has been collecting specimens for the Museum departments, especially for herpetology and experimental biology. The development of lizards is being studied in the Museum laboratories, so Mr. Hassler made an effort shortly after his arrival at Santo Domingo to collect numbers of lizard eggs to be shipped alive to the Museum laboratories. Mr. Hassler writes,

> The first day after I arrived I told the native boys I wished lizard eggs and they brought in over 250 at once. Most of these were eggs of *Sphaerodactylus*, although some eggs of the larger species of geckos were included. The second night when John, my guide, and I returned from exploring, we were surrounded by a howling mob of boys, each with a handful of eggs. When the excitement was over I found that I had some 700 additional eggs, and there was a large percentage of big gecko eggs. I closed the egg market at once for an indefinite period.

In the course of the next few weeks Mr. Hassler shipped to the Museum a large series of living tree snakes, forest lizards, and various burrowing species of lizards and snakes. The *Amphisbaena* and *Sphaerodactylus* lizards illustrating the article "What Produces Species?" in this issue of NATURAL HISTORY, were collected by Mr. Hassler. The living specimens are being studied in the laboratories of experimental biology and are yielding important life history data.

ON December 12, Dr. Frank M. Chapman left for Barro Colorado, Canal Zone, where he will be until April, continuing his research and photography work.

THE Heilprin-Yucatan Expedition.—Mr. Robert T. Hatt, of the department of mammalogy, and Mrs. Hatt (Marcelle Roigneau), of the department of comparative anatomy, at the American Museum, returned on December 22 from their expedition to Yucatan. The first few weeks were spent at the ruined Maya city of Chichen-Itza where mammals and reptiles were collected. Following this, Mr. and Mrs. Hatt explored a large number of caves in Yucatan's low mountains, for the remains of extinct animals. Fossils were obtained in every site excavated, though numbers were small and none of them were of great antiquity. This expedition was supported by a grant from the Angelo Heilprin Fund. Doctor Heilprin himself was greatly interested in the geology of Yucatan and has written on this subject.

A THREE-months' leave of absence has been granted to Mr. Francis L. Jaques of the American Museum's department of preparation in order to permit him to study bird life and do extensive sketching along the shores of the Gulf of Mexico and up the Atlantic coast.

NOTES

JOHN CHAMPION FAUNTHORPE

ON December 1, last, there died at Lucknow, India, from pneumonia, one of the great benefactors of the American Museum.

Col. J. C. Faunthorpe, former Commissioner of Lucknow, originated the idea of the now famous Vernay-Faunthorpe collection of Asiatic mammals that is being mounted for exhibition in the great Asiatic Hall of the American Museum. This hall will be opened to the public in the autumn of 1930. It was hoped that all the Maharajahs and leading officials of India who had assisted in the securing of the collections could be present with Colonel Faunthorpe at that time.

It had been the dream of Colonel Faunthorpe's life to make this collection absolutely complete, and, backed by the enthusiasm and generosity of Arthur S. Vernay, he planned expedition after expedition to East India and Burma. On some of these Mr. Vernay accompanied Colonel Faunthorpe, while others were carried out by Mr. Vernay alone.

Colonel Faunthorpe was born in 1872, and was graduated from the famous Balliol College, Oxford. He was appointed Commissioner of the Lucknow Division in 1920. This same year, while visiting President Osborn at the American Museum of Natural History, he observed that the collection of Asiatic mammals was not of great value. Shortly afterward Colonel Faunthorpe wrote a letter to President Osborn offering to arrange for a representative collection, at least of the wild animals of the plains.

That offer was followed in November, 1921, after considerable correspondence, by a letter from Mr. Vernay saying that Colonel Faunthorpe had broached this plan to him, and that he would be very glad to join in the undertaking. This was the beginning of the Vernay-Faunthorpe expeditions that have resulted in securing for the American Museum the finest collection of Asiatic mammals in the world.

Colonel Faunthorpe was *persona grata* with, and knew all the chief officials in India. Through his personal friendship he was able to enlist the interest and coöperation of the Maharajahs of several of the great provinces. This led to the American Museum's expedition into Mysore for wild elephants and for the great Indian rhinoceros from Nepal. With this beginning Colonel Faunthorpe devoted himself continuously, in companionship with Mr. Vernay, to assembling the Asiatic collection.

Colonel Faunthorpe was typical of the race of quiet Englishmen who accomplish so much in all parts of the world. He was a man of very few words, and what he did was done in the quietest possible manner. He had a fine sense of humor, was an excellent naturalist, and a keen observer of the habits of wild game. The last great achievement of Colonel Faunthorpe and Mr. Vernay was the collection of the animals for the Indian lion group. Permission to secure specimens of this fast disappearing race of lions, was exceedingly difficult to obtain, and for three years Colonel Faunthorpe persistently endeavored, through every possible channel, to secure this great privilege, that the American Museum collection might be completed. How he finally succeeded is told in this issue of NATURAL HISTORY, by Mr. Vernay, in the article entitled "The Lion of India."

It is the hope of President Osborn and the American Museum that a volume may be published commemorative of the manner in which the Vernay-Faunthorpe collection of Asiatic mammals was made a reality.

ASTRONOMY

THE astronomy radio broadcasts under the auspices of the Amateur Astronomers Association on the Saturday afternoons of December from 5:30 to 5:45, which were made possible through the courtesy of WOR, elicited so many letters of approval on the part of the vast unseen audiences, that WOR decided to continue the broadcasting during January and February.

On January 4, Mr. David Pickering talked on "The Romance of Variable Stars." "Star Lore and Astronomy of the North American Indian" was the subject of Mr. Stansbury Hagar's talk on January 11. Dr. E. E. Free discussed "Einstein and the Stars" on January 18, and Dr. Palmer H. Graham told about "Comets and Meteors" on January 25.

The radio program for February follows:

February 1. Capt. Robert A. Bartlett. "Navigation by the Stars, in the Polar Seas."

February 8. Mr. Oliver P. Medsger. "The Moon."

February 15. Rev. John A. Ingham. "The Earth as a Timekeeper."

February 22. Mr. William Henry. "The Sun and Sunspots."

ON January 8 another record audience enjoyed the second showing of the remarkable motion pictures on the Einstein Theory of Relativity.

This repetition program had been arranged in response to the numerous requests that came pouring in to the president and secretary of the Amateur Astronomers Association after the November 6 projection of the pictures. On that occasion more than 3000 people flocked to the Museum, necessitating two showings of the pictures during the evening.

A lecture illustrated by motion pictures and slides on "Ether Drift and Relativity," by Prof. Dayton C. Miller of the Case School of Applied Science, Cleveland, followed on January 22. This lecture was the same as that given at the Royal Institution, London, and many universities here.

During February and March the speakers scheduled are:

February 5, Dr. Willis I. Milham, Professor of Astronomy, Williams College, "Time and Timekeepers." (Illustrated.)

February 19, Dr. Harlan T. Stetson, of Perkins Observatory, Ohio Wesleyan University, "Eclipse Hunting." (Illustrated by motion pictures and slides.)

March 5, Dr. E. E. Free, "Mars." (Illustrated.)
March 19, "Dr. Ernest W. Brown" of Yale University, "Time and Tide." (Illustrated.)

CONSERVATION

BIRD Refuge Established in Montana.—By recent Executive order, President Hoover has set aside, as a refuge and breeding ground for birds, a 12,234-acre tract at Benton Lake, in Cascade and Chouteau Counties, Montana, near the city of Great Falls. The new reservation will be known as the Benton Lake Bird Refuge and will be administered by the Bureau of Biological Survey of the United States Department of Agriculture.

EXPERIMENTAL BIOLOGY

COLOR Change in Lizards.—Prof. Charles E. Hadley of the New Jersey College for Women has recently been carrying on in the laboratory of experimental biology of the American Museum, various investigations concerning the mechanism of color change in lizards. Light, temperature, moisture, and several internal factors control the expansion and contraction of the pigment cells in the skin of lizards. Professor Hadley is determining which mechanisms play the chief rôle in the species under his observation. The laboratories of experimental biology afford facilities to competent investigators who have need of living material in pursuing their investigations.

AMERICAN MUSEUM BROADCASTS

UNDER the auspices of the department of public information of the American Museum of Natural History a series of radio talks was arranged for in October, to be broadcast by Station WRNY at 5 P.M., on the first and third Sundays of each month. A page of illustrations chosen by the head of the department giving the broadcast, appears in the *Herald-Tribune* on the same day, and is accompanied by an announcement that a talk upon the pictures will be given in the afternoon.

This is a form of publicity new to the Museum, and has met with a degree of success far beyond that originally hoped for. The curators have given generously of their time in the choosing of pictures and the preparation of talks, and have bent their energies enthusiastically to the work, with the result that every effort has been made, both by the *Herald-Tribune* and Station WRNY to advertise the programs. The great number of letters received is ample evidence of the popularity of these programs. Thus far the following have given talks: Mr. Barnum Brown, Mr. James L. Clark, Dr. Clyde Fisher, Dr. G. K. Noble, Dr. Roy W. Miner, Dr. Robert Cushman Murphy. Dr. Margaret Mead, Mr. T. Donald Carter, Mr. Herbert P. Whitlock, and Mr. C. M. Breeder, Jr.

So great has been the appreciation of these talks that Station WRNY asked for, and has been granted, a series of Saturday morning talks at 11:30 each week. This series was inaugurated by Mr. James L. Clark on Saturday morning, December 28.

In addition Station WJZ began broadcasting on January 6 a series of weekly Monday afternoon talks at 5:30 P.M. The first three of these were given by Mr. Herbert P. Whitlock, on precious and semi-precious stones.

A series of radio talks given over WNYC at 5:45 P.M. were arranged for in November, December, and January, as follows:

Nov. 19, Dr. Sherwood, "The Museum and School Service."

Dec. 3, Mr. Carr, "American Museum Nature Trails at Bear Mountain."

Dec. 17, Mr. Mann, "Indoor Nature Trails."

Dec. 31, Mr. Carr, "An Animal Engineer: The Beaver."

Jan. 14, Dr. Smith, "Museum Jungle Life."

Jan. 28, Dr. Fisher, "Origin of the Earth."

Morning talks, given for the benefit of high schools, were broadcast from the Museum on January 7 and 24, at 11 A.M. Slides were shown at the schools to illustrate the talks, and a duplicate set of the slides was used simultaneously at the Museum by the speaker. It is hoped that these morning talks will prove of sufficient value to the schools, to warrant their continuation through the school year.

HONORS

THE degree of Doctor of Laws was recently conferred by Indiana University on Dr. Clark Wissler, curator-in-chief of the division of anthropology, American Museum. President W. L. Bryan in conferring the degree said in part:

> I think of you when you were a student of psychology here. You have so wrought that your name is known on every coast where there is a university or where there are scholarly men.
>
> You have won elsewhere high honors including the highest—membership in the National Academy of Science.
>
> Therefore, upon you, Clark Wissler, your University now confers the degree Doctor of Laws.

MEETINGS OF SOCIETIES

THE Société Géologique de France was founded March 17, 1830, and is planning to celebrate its centenary by a general assembly of geologists in Paris on Monday, June 30, 1930, to which delegates will be invited from all parts of the world. Among its long list of distinguished presidents the Society numbers Cordier, Alexandre Brongniart, Constant Prévost, Dufrénoy, Elie de Beaumont, Alcide d'Orbigny, Daubrée

Albert Gaudry, Hébert, De Lapparent, Mallard, Marcel Bertrand, Michel-Lévy, Munier-Chalmas, Emile Haug. It is now under the presidency of Dr. Pierre Termier, a member of the ancient Academy of Sciences in Paris. Meanwhile, a jubilee volume is being prepared to which contributions have been invited of geologists and palæontologists representative of various geological societies and academies. As Senior Geologist of the United States Geological Survey and Gaudry Medallist of the Société Géologique de France, Prof. H. F. Osborn is contributing to the jubilee volume a memoir entitled "Ancient Vertebrate Life of Central Asia. Discoveries of the Central Asiatic Expeditions of the American Museum of Natural History in the Years 1921–1929."

THE Section of Biology of the New York Academy of Sciences held its annual demonstration in Education Hall of the American Museum on Monday evening, December 9. Forty-one investigators presented demonstrations which ranged from the structure and functions of single-celled animals to the anatomy of man. The demonstrations were examples of current research work being carried on in Columbia University, New York University, College of the City of New York, Rockefeller Institute, Flower Hospital, and other institutions of the city. Nine of the demonstrations were presented by American Museum biologists, who reported the results of the original investigations on the physiology and embryology of salamanders, embryology of fishes and lizards, the habits of insects and salamanders, the adaptive modifications of worms, and evolutionary problems in birds. The Museum members taking part in the program were: Doctors Lutz, Miner, Murphy, Gudger, Noble, Mr. Brady and Misses Richards and Teale.

SCIENCE OF MAN

OUR research associate, Dr. Robert Broom, in a recent letter, gives his opinion of *Australopithecus*.

I was rather surprised to find that the scientific world has apparently quietly dismissed any claims the Taungs Anthropoid Ape might have to be near the point of the origin of Man, and that the general opinion seems to be that it is only a Chimpanzee. Holding, as I do, that *Australopithecus* is not a Chimpanzee, and that it is an Anthropoid Ape very much nearer to the form which gave rise to Man than either the Chimpanzee or the Gorilla, and that it is thus by far the most important fossil ever discovered, I feel I must do what little I can to prevent a final decision which I am convinced is wrong. In *Australopithecus* the incisors are not directed forwards as in the Gorilla and Chimpanzee, but almost downwards as in Man. The canine is relatively small, and in shape much nearer to that of Man than the canines of any of the living Apes. *Australopithecus* was a cliff and plains-frequenting being like the Baboon of today. We can be quite certain that it was not a forest animal from the geological structure of the rocks and caves at Taungs, and from the fossil-remains associated with it. And as it was, we have good reason to believe, from a cliff and plains-living pro-Gorilla that mankind arose, I think there is much to be said in favour of *Australopithecus* being very near to the origin of the human stem and possibly even being the very ancestor.

NEW BOOKS

Carl Akeley's Africa. By Mary L. Jobe Akeley. Dodd, Mead & Co., N. Y. City. 1929.

AS the steam-shovels dig alongside the American Museum, Carl Akeley's vision of an African Hall is coming true. This great dreamer spared no efforts to give his plans solid form; and before the walls have begun to rise, many of his masterpieces stand ready to take their places in the new building, and the work is being carried forward by a staff of experts trained in the Akeley school.

The story of Akeley's life, as related in his *Brightest Africa*, is fittingly completed in Mrs. Mary L. Jobe Akeley's recent book, *Carl Akeley's Africa*. The African Hall had become a certainty, the men were trained who would complete its exhibits, but their leader could not relax. Another expedition would assure a proper setting for the Gorilla Group and obtain material for other examples of the splendor of mammalian life in eastern Africa.

This—to the world's sorrow—was his last adventure, ending so tragically, yet so magnificently. The story is recorded in full by Mrs. Akeley's loving pen, with a depth of feeling that is best appreciated by those of us who saw the Akeleys at their devoted and strenuous task in Africa. The pace was a hard one, it began to tell on Akeley; but when the time came to turn toward the sanctuary which his own efforts had gained for the Kivu gorillas, there was no slackening. Nothing could weaken the urge to revisit the most glorious spot in all Africa.

We may wish he had spared himself a little, that he had not purposely chosen the very worst season because of its opportunities for distant views in Leigh's painting of the scenery. But we can only be thrilled by the indomitable courage that carried him upward into the cold and misty home of the mountain gorillas.

Mrs. Akeley's book is steeped in the love of Africa so familiar to naturalists who have worked there. How fortunate that, as her husband's biographer, she served also as his able assistant throughout this last long trek. For my part, her book gives me the illusion of being with the party as they toiled up the forested slopes into the romantic retreat of our friends the gorillas. It reawakens the sadness I experienced as I knelt beside Carl Akeley's grave; and I can bear witness to the loving care bestowed on the last resting place of a pioneer in a noble cause. It will be a shrine visited by many a naturalist in years to come.—J. P. CHAPIN.

AUTHORS IN THIS ISSUE

The cover design for this issue of Natural History is from a painting by **Arthur A. Jansson**, of the American Museum's department of preparation. The giant panda is one of the rarest of animals, and so far as any records go, the first one ever seen alive by white men was the specimen obtained by Kermit and Theodore Roosevelt for the Field Museum of Chicago. Skins of these animals have occasionally been brought out by natives or by missionaries or travelers who had obtained them through natives, and the American Museum has such a skin. Accurate pictures of the animal, however, are almost unknown, and Mr. Jansson's painting, based on Mr. Kermit Roosevelt's photographs and on other data including a smaller painting by Carl Rungius, is a highly unusual and very valuable representation of this raccoon bear of the borders of Tibet.

Kermit Roosevelt, the author of "In Search of the Giant Panda" has long been interested in exploration. In 1909–10 he accompanied his father, Theodore Roosevelt, on a hunting trip in Africa; and in 1914 on an exploration trip on the "River of Doubt" in Brazil. Since then he and his brother Theodore have together organized and carried out several scientific expeditions. During the course of these they collected for the Field Museum in Chicago, specimens of the Thian-shan ibex and Littledale sheep with world-record horns: they also collected *Ovis poli* in Turkestan for the Field Museum.

Both **Gertrude Sanford** and **Sidney Legendre** have interesting records as sportsmen, Miss Sanford having hunted in Tanganyika and Mr. Legendre having collected tigers in Indo China previous to the Abyssinian expedition. The need of the American Museum for specimens of nyala for a habitat group proved a stimulus to them to secure the necessary material. The first installment of their story of this trip appears in this issue of Natural History under the title "In Quest of the Queen of Sheba's Antelope."

It has been very largely due to the generosity of **Arthur S. Vernay** that an Indian hall is being established as a part of the American Museum. During the winter seasons of the past nine years, he has, with Col. J. C. Faunthorpe, collected specimens of the fauna of India, all of which he presented to the American Museum. To secure specimens of the almost extinct Indian lion has always been his great ambition, but it was only after three years of constant effort that permission to collect them was finally granted. In his article "The Lion of India," Mr. Vernay describes his experiences in obtaining this rare prize.

G. Kingsley Noble is curator of the department of herpetology and experimental biology of the American Museum. The problem of the origin of species is being attacked experimentally in many laboratories and Dr. Noble writes in his article "What Produces Species?" on the subject from the viewpoint both of the laboratory and field man. Almost every naturalist who studies animals in the field has been confronted with the question, How do species arise? Geneticists have apparently answered this question and Doctor Noble shows how the data of the geneticist agrees fully with that of the field naturalist.

Clark Wissler, curator-in-chief of the department of anthropology at the American Museum and author of "The Universal Appeal of the American Indian" in this issue, is already well-known to the readers of Natural History through his many contributions to its pages. Doctor Wissler has devoted the greater part of his life to the study of man, and has become internationally known as an authority on the American Indian, particularly the Indians of the Plains. His latest book, *An Introduction to Social Anthropology* is just off the press.

Leonard W. Kephart, the author of "The Grass Trails of East Africa" has been in the Bureau of Plant Industry at Washington, D. C., for sixteen years, during most of which time he has been studying the culture and use of forage crops in the United States. When in 1927, it was decided to send an expedition to East Africa, he went and thus became the first grass seed collector for the United States Government. During recent years the policy of the Bureau has been to send out specialists for certain kinds of plants rather than to send general collectors as was the custom some years ago. In this way more than a dozen Department men have become plant explorers since the war.

Facts concerning other authors have appeared in former issues of Natural History

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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 number 11467

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THE NEW SCHOOL SERVICE BUILDING, with the increased facilities it offers, makes it possible to augment greatly the Museum's work not only in New York City schools but also throughout the country. Fourteen million contacts were made during 1928 with boys and girls in the public schools of New York and the vicinity alone. Inquiries from all over the United States, and even from many foreign countries, are constantly coming to the School Service Department. Information is supplied to, and thousands of lantern slides are prepared at cost for distant educational institutions, and the American Museum, because of this and other phases of its work, can properly be considered not a local, but a national—even an international—institution. Through its loan collections, or "traveling museums," which are circulated locally, 557 schools were reached last year, and 2,282,192 direct contacts were made with the pupils. More than a million lantern slides were lent to the New York City schools, and 4,851 reels of the Museum's motion pictures were shown in 223 public schools and other educational institutions in Greater New York, reaching 1,576,249 children.

COLLEGE AND UNIVERSITY SERVICE. The President and the Curator of Public Education have extended and intensified the courses of college and university instruction. Among the institutions with which the Museum is coöperating are Columbia University, New York University, College of the City of New York, Hunter College, Rutgers College, University of Vermont, Lafayette College, and Yale University.

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

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

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

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

EXPEDITIONS from the American Museum are constantly in the field, gathering information in many odd corners of the world. During 1929 thirty expeditions visited scores of different spots in North, South, and Central America, Europe, Asia, Africa, and Polynesia, and nearly as many are now in the field continuing last year's work or beginning new studies.

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

THE AMERICAN MUSEUM OF NATURAL HISTORY
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1930

The Journal of The American Museum of Natural History

HAWTHORNE DANIEL
Editor

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Associate Editor

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ENTRANCE AND EXIT TO CAÑON DEL MUERTO, ARIZONA

This elongated box cañon, twenty miles long, affords an intermittent stream, which has eroded a channel bounded by walls eight hundred feet high, from which project enormous pinnacles, buttresses, and towers of light-red, cross-bedded de Chelly sandstone. In niches eroded in the cañon wall stand nineteen ruins, which were built 1060–1284 A.D. by an ancient race that has held the attention of explorers and archæologists since their discovery by J. H. Simpson in 1850.

See "Land Erosion" Page 131

VOLUME XXX

NATURAL HISTORY

NUMBER TWO

MARCH-APRIL, 1930

MELANESIAN MIDDLEMEN

A Description of the Trading People of the Admiralty Islands Who Have Built Up an Elaborate System of Primitive Markets and Who Make Long Overseas Trading Voyages in Their Slender Out-rigger Canoes.

By MARGARET MEAD

Assistant Curator of Ethnology, American Museum

RESULTS OF FIELD WORK DONE IN 1928–29 AS A FELLOW OF THE SOCIAL SCIENCE RESEARCH COUNCIL

TWO days' voyage from the Bismarck Archipelago lie the Admiralty Islands, an archipelago formed of one large island sixty miles long and a cluster of smaller ones, some of them fifty miles from the Great Admiralty, but none out of sight of its mountain peaks. The Great Admiralty is steep and mountainous; its red volcanic soil makes poor gardening and worse traveling. After a rain the surface of the island turns to mud; the thin, emaciated land people splash about from one small settlement to another, muddy and miserable. The inhabitants of the Great Admiralty are called collectively the Usiai—a word meaning "inland" in the sea people's tongue. They are divided into many small groups whose languages are relatively unintelligible to one another, and their customs differ considerably one from another. They are united by a common agricultural way of life and a common hatred of the more aggressive sea people, who in turn despise them. Timid, underfed, often bandy-legged, fearful of the sea, the general contempt in which they are held seems to give them a certain awkwardness of aspect,—the uncertainty and clumsiness of gesture which so often characterize the lighter-skinned, smaller-bodied "man-o-bush" in Melanesia. The poor soil and steep slopes make subsistence difficult, and the Usiai live in very small scattered communities of ten people and five dogs, only coming together for ceremonial occasions. Yet in these infrequent ceremonies is found more rank and style than in the festivities of the scornful sea people.

On the small islands, and in a few settlements on peninsulas and along the coast where there is firm land instead of the more frequent quaggy ring of mangrove swamps, live the peoples who are known as Matankor, the "eye of the land." Here, again, the sea people have classified together a number of groups of people speaking different languages and having different customs. To the sea people they all present the common characteristics of living on the land but

"BONNETING" THE ROOF OF A NEW HOUSE
The small boy is merely playing, for children do no important work in Manus. They are expert, however, at climbing house roofs and palm trees

near enough to the sea to know something of fishing, venturing upon the sea without giving to others shameful and ludicrous signs of fear. These Matankor groups are sometimes spread over half a dozen villages, on one or more islands; occasionally an offshoot of a village on the south of the archipelago will be found far to the north, speaking the same language and presenting the same cultural picture.

The Usiai and the Matankor are by far the most numerous peoples. Yet the archipelago is best known, is named from, and takes its color from a group of some two thousand people, who boldly proclaim themselves "Manus true," or "the soda water [salt-water] boys." Darker, heavier, firmer of purpose, the "Manus true" have no real hold upon the land of the Admiralties. Their stout pile dwellings are clustered like long-legged birds in the wide lagoons along one part of the south coast of the Great Admiralty, and in the shelter of a few precipitous islands. Their only lanes are bits of volcanic outcrop from the reef or small platforms laboriously constructed from coral rubble. On these barren bits of soil there is only a handful of greenery, a few trees from which the children pick fruit for spinning tops, a few bushes which flaunt the cerise hibiscus. The Manus village is a preserve staked out in water—its streets are waterways, its unoccupied house sites, or once inhabited suburbs marked only by a few rotting stakes against which the unwary paddler barks his canoe.

Viewed materially, these sea people are helpless denizens of the muddy lagoons, without lands or forests, without gardens, without fresh water, without wood to build their canoes and houses, without sago leaves to thatch their houses. They have not the fiber for making fish nets, the clay for making pots, nor the bark for making mats and carrying bags. They belong to a race to whom the stimulus of betel chewing is almost more necessary than food itself, but they have neither betel trees, nor pepper plants, the leaves of which are chewed with the betel.

Of their need, of their complete dependence, they have built up a system of trade which is so efficient, so far spread in its ramifications, that they have made themseves the richest, the most dominant people in the southern part of the archipelago. (For the North I cannot speak, for I have not been there in person.) It is words from their language which creep into the lingua franca of the territory; the other peoples use Manus words to describe themselves.

The Manus have one industry—fishing—at which they are particularly adept. They know how to count the phases of the moon and predict the huge run of spawning fish into the lagoon. Here several canoes of beaters drive the fish into a half circle of two-man nets. Sometimes a thousand large fish are taken at a catch. Torch-light fishing and many types of weirs and baskets are also in continuous use. Their skill in fishing is the basis of their hold over the miserable, poorly nourished bush people. For fish and shell fish, the Usiai trade them sago, taro, taro leaf greens, fibrous bark for thread and rope making, betel nut, pepper leaves, bags, leaves for mats, gourd lime containers, gum for caulking their canoes; dishes, oil containers and funnels of basket work smeared with gum; sago leaf thatch. For turtles, or special large supplies of fish, they receive

A CANOE OF COCONUTS FROM RAMBUTCHON
These coconuts will be arranged in piles on the small islets, and will be used for a feast which will end a widow's ten months' mourning period

SCARIFIED IN THE FASHION OF THE MATANKOR
This Mok girl bears on her chest an elaborate representation of the lizard, which has been raised by rubbing open cuts with lime

The procedure is varied a little for different Manus groups. The people whose houses cluster in the shadow of the distant island of Buke depend upon their pots for their trade with the land people, and fish principally for their own purposes. Twice a week broad-beamed canoes laden to the gunwales leave the island which, away on the northern horizon, looks little bigger than the clam shell from which it took its name, and make their way up the narrow tortuous rivers into the Usiai country. Scowling, hating this journey into the hostile, sorcery-ridden interior, seeing lurking demons in the tangled swamps, voracious mythical snakes in the stagnant waters, vaguely connecting the fevers which overtake them in their safe salt-water village with the evils of the mainland (where mosquitoes abound), the Manus boatmen punt their freighted canoes up the stream, where they exchange their pots with a silent, hostile people.

wood for house building and for the construction of their large canoes. All the necessities of life are based upon this daily interchange which goes on between bush people and sea people. Regular markets are held to which the Manus men repair early in the morning with their canoes heavy from the chilly night's arduous fishing. The market places are held at different points along the shore to give different groups a chance to bring their wares. In the old days, a lattice work was built across a stream, and silent bargaining between men armed to the teeth was concluded by floating taro downstream and flinging the purchasing fish upstream.

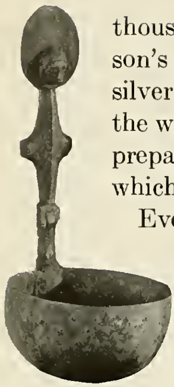
The Manus people who live under the lee of the island of Mok, and speak with a soft dialect which the Manus of the great island lagoon comprehend but ridicule good-humoredly, are more fortunate. Their daily traffic is not with the furtive hostile Usiai, whose eye is ever on driving a sharp bargain, whose trade manners are atrocious, and workmanship poor. Instead, the Mok people trade with two Matankor groups, on the islands of Balowan and Lou. They are wont to boast of their Balowan customers, of their beauty, their good nature and trustfulness,—while the Usiai demand immediate payment, the Balowan man will trust one a good three days. From Balowan they obtain yams—"mammies"—their staple carbohydrate food, betel nut, pepper leaves, and beautiful wood work, carved bowls, carved ladles, delicately wrought betel spatulas. From Lou come obsidian glass for knives, carving tools, and spear heads, painted gum oil containers, carved dancing poles, decorated lime gourds, more wood work, and most of the fish nets used by the Manus people. From Lou and Balowan and the further island of Rambutchon, where a colony of Manus natives dwell near the Matankor colonies of the land, come the coconuts and coconut oil used by the entire group.

Within the tribe wealth changes hands most frequently in the ceremonial payments between families. Beginning with the betrothal in early childhood, there is a periodic exchange of valuables between the family of the bride and the family of the groom. The groom's kin give shell money and dogs' teeth which the bride's kin repay in various types of foods—many of which must be obtained from other tribes.

At betrothal, puberty, ear piercing, marriage, birth—these payments are made in the form of great festival displays. The dates of the feasts are announced several weeks in advance by a system of signals on the slit gong. When the set rhythmical prelude resounds through the village, people stop their work, children pause in their play to wait for the count. The prelude ceases, a single beat is given, the listeners count "one." A formal spacing tattoo follows, then another isolated beat. The listeners count "two," and so on up to ten or twenty or thirty. Thus the whole community is informed that Nane or Paleao or Talikai plans to give away many

MANUS MAN WEARING THE WAR CHARMS MADE BY THE PEOPLE OF PAK

When a man is slow in going into battle, the charm scratches his back and urges him to bravery



A SOUP LADLE FROM BALOWAN
When soup is given to guests at a feast, the bowl and ladle are presented to them also

thousands of dogs' teeth for a son's betrothal or his wife's silver wedding. Everyone in the wide family circle sets about preparing for the feast, part of which will be carried overseas.

Every feast has its reverberations in the markets, and upon inter-tribal trading also depend some of the large accumulations of wealth. So the man who is a successful turtle fisherman will sell his turtles for many dogs' teeth and thus add to his store against a payment for his son's bride. When the payment is made, it will be taken perhaps to Mok, to the father of the bride.

THE MARINERS OF THE NEXT GENERATION
The youngsters are already proficient in handling their own small canoes

Among the villages of the Manus people there is much intermarriage, and each new betrothal or marriage means endless visiting to and fro between the in-laws. On each of these visits, some of the products of the local markets are carried back and forth. One day a Bunei canoe would return from visiting Buke connections. The pot-laden canoe would stop in Pere, and some of the pots would be exchanged for the products of the local Usiai market. Another day a Mok canoe would sail in laden with fresh coconuts from Balowan, to be exchanged for sago bought in the Usiai market. When a baby is born in Buke, its relatives in Pere make the journey from Buke to Pere to help with the birth feasts, and carry a load of property each way. When a great marriage feast is made in Balowan, the carvers set to work to make ex ra bowls to be given away at the ceremony: the recipients trade some of them to Mok men who then carry them far and wide.

So upon this double system of local markets between different peoples and a long distance voyaging between villages of the same people, a perfect exchange is maintained. All of the carrying is done by the Manus people, or very occasionally by a group of the Matankor in Manus canoes. Where relations are very friendly—as between Mok and Balowan—the Manus build canoes of Balowan wood which are regarded as partly Balowan property. But in general the Matankors depend upon the Manos to do their carrying. Toward the Usiai the Manus are less lenient. It is understood that the sea is their province—the Usiai merely skulk up and down their narrow rivers and in and out

USIAI CARVED BOWL
Note the conventionalized crocodile handles

the tangles of the mangrove swamps. If a settlement boasts of one water-logged canoe hidden in the bush, it is lucky. The Manus come to them with their produce from fishing and trading—and they wait with their laden women folk for the master traders to arrive. Manners are not of the best at the market. If there has been a shortage of fish for several days, the Usiai fall over one another in a scramble to get it. Or the Usiai will develop sudden caprices and bring no rope fiber for weeks—the first to appear commanding high bidding.

At first blush this sounds like an economic system based entirely on barter among a people too primitive to have developed the idea of a currency. But this is not the case. The Admiralty Islanders have a currency which satisfies all the requirements of a good money base—it is rare, it is capable of increase only at great labor cost. It has another value besides its use as currency, it is small and extremely divisible—a respectable enough list of orthodox requirements to please any economist. This currency is of two sorts—shell money which closely resembles wampum, and even more closely the strings of shell beads used at present in the Southwestern United States—and dogs' teeth. The shell money is manufactured with great patience and expenditure of labor by the people of Ponam on the north coast. Strung on durable native fiber, it is used both as necklaces, wrapped about arms and legs, or woven into aprons which form part of the bride's dowry. The strings can be cut up into units of any size, but the measure of a man's outspread arms is the customary unit. Dogs' teeth form the more usual currency for small objects—a lime gourd will be worth two dogs' teeth, or a lime spatula five or six. The dogs' teeth have very fine designs incised upon them, they are bored at one end, and when strung, serve as collars and belts. In units of fifty or a hundred to a string they are used in marriage payments.

There are many fixed obligations which must always be met with shell

A CHERISHED WAR CHARM

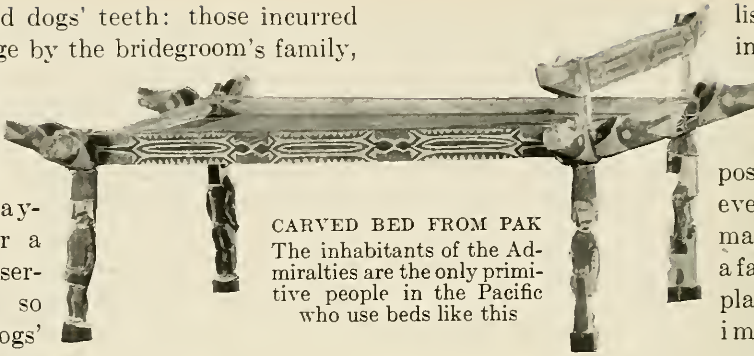
This has been kept in the owner's family for several generations

PERFECTLY BALANCED ON THE NARROW GUNWALE

This child of four is quite at home in a canoe

A BIRD BOWL FROM BALOWAN

It is carved in the likeness of a wild duck



CARVED BED FROM PAK
The inhabitants of the Admiralties are the only primitive people in the Pacific who use beds like this

money and dogs' teeth: those incurred at marriage by the bridegroom's family, payment for a bit of magic knowledge, payment for a magical service, and so on. The dogs' teeth are taken, four from each dog, at its death—a slow rate of increase, had not the early traders imported large quantities of teeth from China and Turkey. This inflation of the currency, now stopped by government order, had the usual effect. Prices rose, a pot formerly worth one dog's tooth now sold for ten. As the importation ceased definitely, a financial equilibrium was again established. The inflation of the currency makes it possible, however, for a man to make a far finer display on the important occasion, for instance, of his payment for a wife.

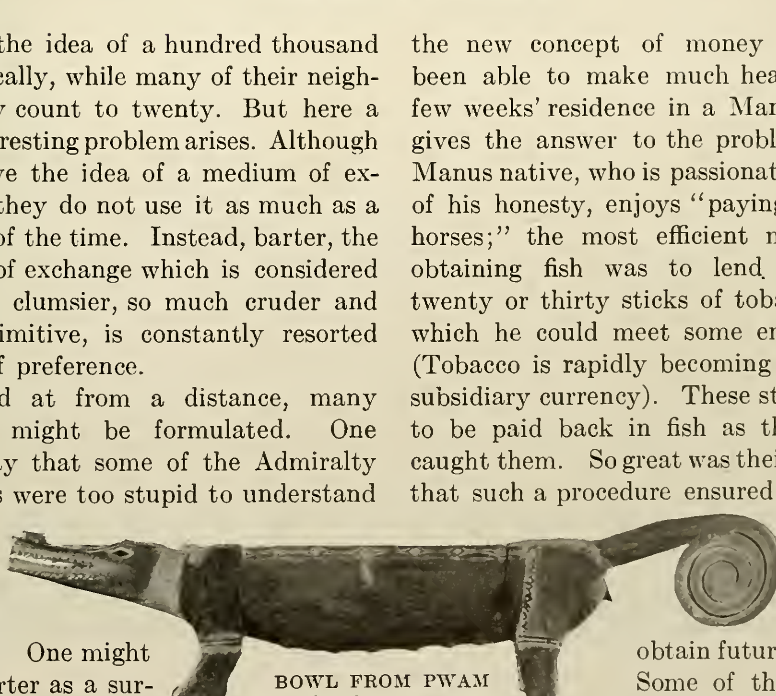
The value of every object sold or exchanged in the Admiralty Islands can be expressed in terms of dogs' teeth or shell money—a large dog's tooth is worth ten taro, ten coconuts, forty betel nuts, one bundle of bark fiber, and the like. The idea of a common medium of exchange is perfectly clear to the native mind—incidentally they are able to

DISMANTLING A HOUSE AFTER A DEATH
The thatch is loaded on canoes and paddled to another site, where the house will be rebuilt and the skull of the recently dead set up within as a guardian

UNLOADING THE SAGO LEAF THATCH
It is stored temporarily on the foundation piles of another house until the framework of the old house is set up on the new site

express the idea of a hundred thousand linguistically, while many of their neighbors only count to twenty. But here a very interesting problem arises. Although they have the idea of a medium of exchange, they do not use it as much as a quarter of the time. Instead, barter, the method of exchange which is considered so much clumsier, so much cruder and more primitive, is constantly resorted to out of preference.

Looked at from a distance, many theories might be formulated. One might say that some of the Admiralty Islanders were too stupid to understand money, so the others deferred to them. One might claim barter as a survival against which the new concept of money had not been able to make much headway. A few weeks' residence in a Manus village gives the answer to the problem. The Manus native, who is passionately proud of his honesty, enjoys "paying for dead horses;" the most efficient method of obtaining fish was to lend a native twenty or thirty sticks of tobacco with which he could meet some emergency. (Tobacco is rapidly becoming a sort of subsidiary currency). These sticks were to be paid back in fish as the native caught them. So great was their honesty that such a procedure ensured more fish than trusting to any desire to obtain future tobacco. Some of these debts would be outstanding



BOWL FROM PWAM
The head represents a crocodile, the tail a pig

PERE, A VILLAGE OF THE SEA PEOPLE
The houses, built on stilts in the shallow reef-bound lagoon, look like clusters of long-legged birds

A GROUP OF USIAI TRADERS
They are seated on the veranda of a Manus relative, where they have come to collect contributions for a great death feast

A GROUP OF RELATIVES BOUND FOR A FEAST

The cooked taro in the feast bowl is decorated with artificial flowers made of coconut meat

A MANUS CHILD'S PLAYGROUND

The streets are waterways, and in the cool shadows under the houses the children play, sheltered from the sun

THE REMAINS OF A CEREMONIAL DIET
A Manus girl holding up the remains of fish she has eaten during a month's taboo period. Her brothers caught the fish, and her father's sisters ceremonially ate all the fish heads in order to ensure her health

wishing to pay his debt in money or tobacco was turned away with a command to bring fish and fish only.

This is merely a tiny modern sample of conditions all over the archipelago. Each group of villagers are specialists—raising or making only part of the materials necessary for life. No one is dependent upon money for existence—although there are occasional individuals who only engage in activities for which they receive shell money or dogs' teeth. Such a one was Pataliyan, a widower, a returned work boy who had brought with him powerful charms from the New Guinea mainland. Wifeless and childless, he had few needs which he could not satisfy by contributing some of his payments for magic to the household where he lived. But had he been the head of a family, charged with the business of regularly providing for a household, his wealth would not have availed. It was only because his needs were slight and unimmediate that he could live so. He turned over a sum of money to his sister, for instance, and she used it to further some marriage scheme for her nephew. The nephew in turn fished for his aunt. Part of the fish went into Pataliyan's bowl, another part bought taro at the market. But the sister could not have taken the dogs' teeth to the market and

quite a while—a native would have bad luck in fishing, or many pressing obligations to meet. Then some of those especially scrupulous ones, restive under the debt, would try to pay it back with tobacco or money. We were immediately plunged into the barter psychology. Our money box contained a whole "fuse," as the natives call five pounds in shillings from its likeness to a dynamiting fuse. In the cedar wood boxes with the musical burglar alarm lock were sixteen pounds of tobacco, but in the "house cook" there was only canned meat. The native bought taro with them except under most unusual conditions. Competing with her for the taro would have been fishermen from whose hands hung whole strings of fresh glistening fish. The Usiai wants fish, he can never get enough fish, his children at home are hungry. If he sells his day's load of taro for dogs' teeth, he must go home empty handed, unless he can buy fish with the dog's teeth. But all the fishermen have come for taro or sago, or betel nuts, or bark fiber. One is giving a feast and must have an extra supply of betel nut, another must have fiber to mend his net. If he takes the dogs' teeth he stands the chance of being turned down by the Usiais who have the perishable product which he wants.

So dogs' teeth and shell money often go begging in the market. It is only the rich man who has many resources—many young people pledged to work for him daily—who can afford to snap up the money which the unsuccessful fisherman or bad gardener brings to market.

The conclusion is obvious. Where it is possible to store wealth, to accumulate against future needs, money is used, but in the hand to mouth existence of the people's daily life, barter is far more efficient. The need for proteins by the land people, of carbohydrates by the sea people, is far more pressing than either's need for money, which will command some vague, less defined good in the future. Every one is close to the subsistence level for food and so food is bartered against food. Bowls, lime gourds, lime spatulas, bags, mats, thatch, spears, fish nets, are bought and sold for money. These represent the less essential objects of wealth. But Mok people hungry for sago, sail to the mainland with a canoe load of coconuts which they will sell for sago and for sago only,

BALOWAN WOMAN CARRYING WATER
Empty coconut shells are used for carrying water, and are swung at each end of a shoulder pole, thus leaving the woman's head free for other loads

A CARVED FIGURE FROM RAMBUTCHON

This figure, which was brought from Rambutchon by traders, shows the characteristic elongated ear lobes and carvings, and the picturesque headdress of that island

(*Right*)

A BRIDE'S APRON OF SHELL MONEY

A bride wears two of these and they form part of her dowry

(*Below*)

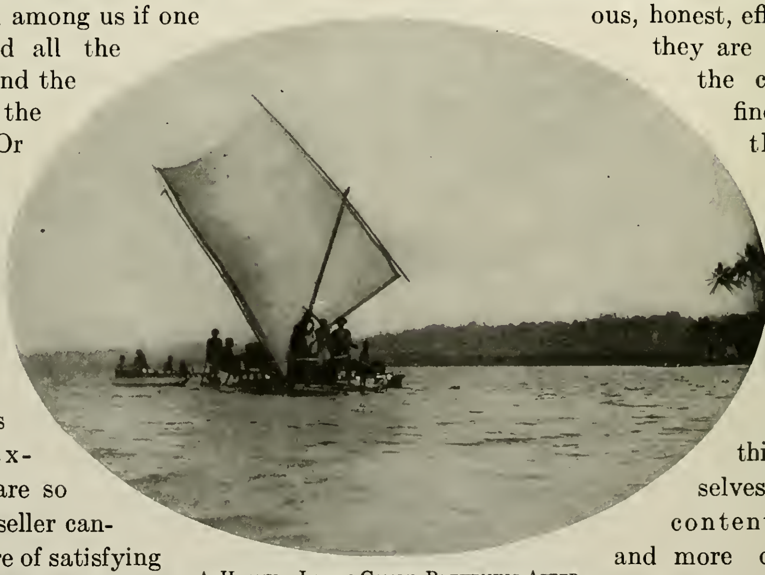
USIAI CARVED BOWL

This example bears a single pair of conventionalized crocodile handles, as contrasted with the double set carved on the bowl shown at the bottom of page 120

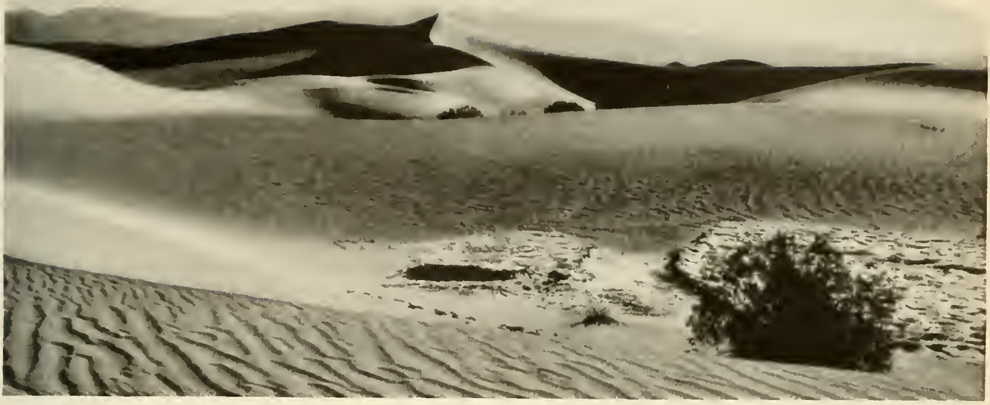
sure of a sale, among people hungry for coconut meat to sweeten their monotonous sago diet. When such a canoe entered the village, our tobacco and shillings were useless. We had first to buy sago and then trade the packages of sago for the coconuts. The hungry Mok people were taking no chances. Similarly, in Balowan where sago is scarce, one package of sago will command ten mud hen eggs! The price of the sago in currency brings only three. Thus the Balowan people coerce those who would trade with them into bringing particular products to their shores.

There is one quaint example of this tendency outside the realm of food proper. While the land people grow the betel nut and the pepper leaf, the sea people burn and refine the coral lime with which the betel and pepper leaf are chewed. In the market the same sized fish will command ten taro or forty betel nut. But a cup of lime commands eighty betel nut, but only four taro. Betel chewing need is matched against betel chewing need, to coerce the sea people into providing enough lime for the land peoples. This would be paralleled among us if one group had all the tobacco and the other all the matches. Or a barter in rare stamps might be comparable, where the things to be exchanged are so rare the seller cannot be sure of satisfying his desires for money.

So the old psychology of barter lives side by side with a sophisticated appreciation of money among these people who have made such a business of trade. The sea dwellers, landless with only fishing and their knowledge of navigation to depend upon, have built for themselves a solid place in the Admiralty Island world. Lords of the sea, arbitrators of the market—the land people and the island people both rely upon them. In the attics of their large commodious houses are many dozens of pots, on their shelves are carved wooden bowls, under their arms are decorated lime gourds, with daintily carved lime spatulas projecting from the openings. Their brides are laden with aprons of shell money and strands of shell money and dogs' teeth. Their dancers stand on carved dancing poles from Lou, with combs from Balowan in their hair, spears from Lou in their hands, shell money from Ponam around their waists. Their tireless, wet, chilly vigil at all-night fishing, the dangerous oversea voyages in narrow outrigger canoes, have been rewarded well. They are a brave and enterprising people, industrious, honest, efficient, but they are traders to the core. The finest art of the archipelago passes through their hands, but they make no beautiful things themselves; they are content to buy, and more content to sell—at a profit.



A Heavily Laden Canoe Returning After a Long Trip Overseas In Bad Weather



Photograph by Ewing Galloway

A SAND DUNE IN DEATH VALLEY, CALIFORNIA

LAND EROSION

How the Surface of the Earth is Being Worn Away by the Action of Wind, Water, Glaciers, and the Other Atmospheric Agents which Cause the Decay of Rocks

By CHESTER A. REEDS
Curator of Geology, American Museum of Natural History

WHEN land appears above the level of the sea, its surface is subjected to the agents of erosion. Aided by gravity these agents sculpture the surface of the land into a complex series of forms which are not only beautiful to behold, since they vary greatly in character and in magnitude, but are of interest in that they have an economic bearing on the fertility of the land. The waves of the sea and of lakes also constitute a factor in that they are slowly changing the outlines of the land. Man should also be considered, for his activities are producing conditions of abnormal erosion.

Erosion is a continuous process and, while it affects only the surface features of the land, it is engaged in modifying, lowering, and removing the materials of higher elevations to lower ones and in eventually transporting them to the oceans.

It is such a slow and orderly process that it is not readily apparent to most men, yet, since it affects all land areas, which cover about 50,000,000 square miles of the earth's surface, it is a prodigious force capable of removing mountains. In fact, many a plain, plateau, and mountain, and even numerous mountain ranges, have been removed by this process during the long eras of geologic time.

Erosion affects the land in various ways. Numerous atmospheric agents, like rain, snow, frost, changes in temperature, et cetera, attack the minerals of which the rocks are composed, causing some of them to go into solution, altering others and separating out the more resisting kinds like quartz to form a mantle rock or regolith, the uppermost layer of which is known as soil. The more powerful agents, like wind, running water, and ice, pick up the decayed rock fragments and transport them from one place to another.

Since the processes of decay and removal are continued from year to year, it is well to consider briefly the principal kinds of rock affected, as well as the work of the more active agents. It should be noted that soft rocks yield more readily to erosion than hard ones.

The rocks of the land are of many kinds. They differ from one another in hardness, in strength, in color, in texture, in composition, in age, and in origin. The more common rocks, however, may be grouped into three great classes, namely: sedimentary, igneous, and metamorphic.

Sedimentary rocks are composed of the materials of older rocks, which have been broken up into fragments and transported to different places and deposited. They are not unlike the sands, gravels, and muds now being laid down in rivers, lakes, and seas. These when consolidated will form sandstones, conglomerates, and shale, the three common kinds of mechanically laid sediments. They are generally arranged in beds or layers called strata which vary in thickness from several inches to a few feet. The strata are oftentimes horizontally disposed, but at other times they are tilted or folded due to subsequent movements within the earth.

The familiar limestone rock is a stratified rock, but the mineral matter of which it is composed was derived chiefly from the shells secreted by marine invertebrate animals. Even this shell-material comes from the older rocks, for the lime-bearing minerals were dissolved and taken in solution to the sea. In the absence of life, chemical deposits may be formed. The more important sedimentary rocks of chemical and organic origin are limestone, chert, gypsum, salt, iron ore, peat,

Photograph by Ewing Galloway

A WEATHERED SANDSTONE FORMATION, KANAB CAÑON, SOUTHERN UTAH

This view presents in cross-section the fore-set beds of an ancient delta deposit consisting of sand. The normal inclination of the strata in the fore-set beds of a river delta are still in evidence, although the erosion by wind and rain water has developed numerous parallel gullies and irregular depressions in the consolidated deposit. The soil layer is but scantily represented

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THE DEVIL'S TOWER, WYOMING

A volcanic plug of andesitic porphyry, which cooled below the surface of the ground. The surrounding stratified rock which once covered the Tower, being softer, has been eroded away to a comparatively low level

lignite, and coal. These deposits may be separately formed or intermingled, producing a great variety of rocks. Such rocks contain fossils, various records of the earth's history, and point to notable changes in its surface.

Igneous rocks are those which have cooled and consolidated from a molten or hot liquid state. They arise from unknown depths in the interior of the earth and are commonly associated with the eruptions of volcanoes. The liquid rock may be called a magma or lava. All sorts of igneous rocks are formed by the solidification of magmas. They are usually massive and homogeneous in character and generally of the non-stratified type. They are non-fossiliferous and vary in texture from the noncrystalline or glassy phase to the coarsely crystalline state as noted in coarse-grained granite. The degree of crystallinity is dependent upon the rate of cooling; the large imperfect crystals of granite were formed from a slow-cooling magma. When a molten mass of igneous rock consolidates below the surface of the earth, it is called *intrusive;* if poured out on the surface it is known as *extrusive.* There are many types of rock in each group.

Explosive action may or may not accompany the outpouring of lavas. It often occurs during volcanic eruptions, causing ejections of dust, ash, and larger fragments. These materials, when consolidated in or near the cone of a volcano, constitute breccias, agglomerates, and tuffs. When igneous rocks decay, and they all do, the decayed particles at the surface may be blown or washed away to form beds of sedimentary rock.

Metamorphic rocks constitute a large group of rocks which have been notably altered from a previous state. Either sedimentary or igneous rocks may be changed into metamorphic rocks by great pressure, by the action of underground water in modifying the composition of the rock, or by heat which sometimes assists the mineral matter to recrystallize, forming new minerals. Such changes trans-

Photograph by Ewing Galloway

THE DEVIL'S POST PILE, CALIFORNIA

Columnar structure developed by shrinkage and jointing in an intrusive basaltic rock. The structure is the same as that of the Giants Causeway in Ireland, the Devil's Tower in Wyoming, and the Palisades of the Hudson in New Jersey and New York

form sandstone into quartzite, limestone into marble, shales into slates, granites into gneisses, and modify other rocks in various ways.

All large masses of rock, whether sedimentary, igneous, or metamorphic, expand and contract due to changes in temperature. These changes produce cracks or joints which traverse the rocks and break them up into blocks of various sizes. These joints and blocks may be noted in every quarry or in rock-cuts along the highways. The joints may be vertical, horizontal, inclined, close together, or far apart. The columnar structure in basalt, an igneous rock, is due to close jointing developed by shrinkage of the upper surface of a cooling mass of intruded lava, along lines that radiate from various points at angles of 120 degrees, forming shrinkage lines, which intersect to form columns pentagonal or hexagonal in outline. The joints found in rocks not only permit the agents of erosion to pass below the surface of the ground, but they provide greater contact surfaces for these agents to work upon in bringing about the decay of the rock.

The erosion of rocks is also effected chemically by the interactions between the elements of the air and those of the earth. The air contains oxygen; the rocks contain iron in various forms. When oxygen unites with iron, it forms an oxide of iron. When water enters into the combination, it appears as iron-rust, that is, as hydrated oxide of iron. This oxidation of the iron leads to the slow crumbling of the rocks containing it. Other minerals in the rocks may be oxidized and hydrated to such an extent that the rocks will disintegrate. Carbonic acid gas (CO_2) is another constituent of the air which actively enters into combination with various elements in the rocks, such as lime and copper, to form carbonates. The result is a tendency to still further break up the original composition of the rock. Nitric acid also affects rocks in a similar but minor way. All of these chemical changes are phases of the general process of *weathering*, which includes most of the natural processes by which rock at or near the surface is caused to crumble. Much of the soil and subsoil of the earth have been produced by them. Soils which have been developed out of the underlying rocks in this manner are known as residual soils. When the rocks are broken up by these processes of weathering, their particles are more readily transported by wind, water, and ice. Soils formed from transported material are known as transported soils.

In many regions the water in the soil freezes during the winter. While the ground is frozen, the wind and running water do not carry the soil away but the expansion which takes place when water is converted into ice, about one-tenth of its volume, causes a breaking up of the rock particles composing the soil and a widening of the joints between the underlying blocks of rock. This process of rock-breaking is most important where there is abundant moisture, and where the changes of temperature above and below the freezing point of water are frequent, that is, in middle latitudes, or in mountainous regions which have the temperature of middle latitudes.

During the summer months and in places where large areas of bare rock surfaces are exposed, the rock becomes heated by day and cooled by night. Where the daily changes in temperature are great, the surface of the rock becomes very hot during the day, but not for great depths, since rock is a poor conductor of heat. This differential heating of the rock causes exfoliation, that is, expansion and flaking off of the outer surface. At night time, when the reverse process sets in, the outer surface cools more rapidly than the inner and causes an unequal shrinkage of the rocks, resulting in a peeling off of the outer portions.

By DeCou from Ewing Galloway

ELLERY LAKE ON TIOGA ROAD, NEAR TIOGA PASS, CALIFORNIA

A fine example of a talus slope developed by the weathering of granite appears across the lake. Tioga Road connects Yosemite National Park with Lake Tahoe in the high Sierra Nevada Mountains

THE CAÑON OF THE
YELLOWSTONE RIVER, WYOMING
The banks of this youthful V-shaped valley present a series of the most gorgeous color formations in the world

© *By E. W. Newman, Publishers Photo Service*

This expansion and contraction of rock by alternate heating and cooling are very common phenomena and may be noticed in cities where sidewalks buckle and break. The lower surfaces of steep cliffs and mountains are covered with rock débris of varying sizes known as talus which has been loosened from the higher levels by alternate freezing and thawing, expansion and contraction of the rock, and moved to lower levels by gravity. This process of rock breaking is a phase of weathering.

Plants penetrate the soil, loosening it, and thereby assist water to get below the surface. Roots frequently find lodgment in cracks and with continued growth they act like wedges and thus assist in forcing the rock asunder.

The rock material loosened by the various processes of weathering is sometimes called the *mantle rock*, since it covers the solid rock which lies below. It is also known by the terms *rock waste* and *regolith*. It may vary in thickness from a few inches to many feet. The upper surface of the mantle rock is commonly known as the soil layer, since it contains humus and supports the plants that grow therein. It may vary in color and be either clayey and compact or sandy and porous. Beneath the soil layer is the *subsoil* which is usually of a different color and has a greater density than the soil layer. If the soil layer is suddenly removed, it will be noticed that the subsoil does not readily support vegetation. Beneath the subsoil occurs rock in process of decay.

Wind is a potent agent in removing particles of rock already loosened and in blowing sand and dust against rock surfaces, producing a sand-blast effect which not only abrades but in time wears away even the hardest kind of rock. This is particularly true of arid and desert regions where there is little or no rainfall and where vegetation is scanty or lacking. The sandy soil being loose is readily picked up by the wind and either driven against the exposed rock surfaces or drifted into dunes. Since the wind picks up only dry sand, the work of the wind is not so apparent in humid regions as in arid ones. In moist areas where rainfall promotes the growth of vegetation, bare rock surfaces are rare, and the soil is protected by a mat of plant life. Being shorn of its tools, the wind does little abrasive work.

Where rocks are of unequal hardness and there is no cover of vegetation, the softer rock will be worn away by wind action more rapidly than the harder one. Should the soft formation be capped by a layer of hard rock, mushroom-like columns of weird designs may be produced. Such forms are of common occurrence in Monument Park, Colorado, and in the southwestern portion of the United States.

In the desert the movement of sand and dust by the wind is almost incessant. Much of this material is also carried out of the deserts by the winds and allowed to settle elsewhere. Thus the surface of the desert is being slowly modified as well as lowered. During desert storms, sand and dust amounting to more than a hundred thousand tons per cubic mile of air may be lifted and transported. As soon as the velocity of the wind decreases, the heaviest particles will settle to the ground, but the finer particles will float for hundreds of miles from their source and give rise to the thick deposits of loess such as that found in China, central Europe, and the Mississippi valley states. The ancient cities of northern Africa, the Euphrates valley, and western Asia have been covered for the most part by windborne dust and sand

The water of streams is the most important single agent modifying the land surface. According to the late Sir John

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THE NEEDLE'S EYE, BLACK HILLS, SOUTH DAKOTA

Note the large slab of rock beneath the man's left hand, which has been freed from the main mass by the alternate expansion and contraction of the rock induced by daily changes in temperature

© By Hileman, Ewing Galloway

MORNING GLORY LAKES, GLACIER NATIONAL PARK

Two lakes now occupy these glacial cirques, large amphitheater-like depressions with steep back walls, which were eroded by small horsehoe-shaped glaciers known as "cliff glaciers"

Murray, about 29,347 cubic miles of rain-water fall upon the land surfaces of the earth every year. About one-third of this amount evaporates, a large amount soaks into the ground, and about one-quarter runs off. These proportions are modified in various regions by climatic conditions, the porosity of the surface rocks, ruggedness and steepness of slope of the landscape, et cetera. A considerable amount of the water which soaks into the ground eventually enters the streams in the form of seeps and springs. Rivers also receive contributions from ponds, lakes, snow-fields, and glaciers.

The rivers in the aggregate deliver to the sea about 6,524 cubic miles of water annually. When it is considered that the average height of the land above the sea is nearly a half mile, and that this large amount of water must descend slopes which aggregate about a half mile in height, it is seen that great energy will be developed. The water of the rivers has the same amount of energy that it would have if it fell vertically. This great force is expended in cutting away the sides and bottoms of the valleys and in modifying the surface of the land. Whether the region under consideration be one of mountains, plateaus, or plains, rivers act in very much the same way in each type of region, hence, what is true of river action in one area is true of that in another.

It has been observed that streams are more numerous in regions where rainfall is abundant than in those areas where it is scarce; that many small streams are revived with each fall of rain or melting snow; that streams are swollen after rains, especially after heavy rains; that, in arid or semi-arid regions, small streams flow only after heavy rains or during rainy periods unless they are fed by springs, lakes, or melting snow and ice. It is thus apparent that rivers are dependent cn atmospheric precipitation for their supply of water.

The familiar rain-wash is the beginning of stream erosion. As the water begins to flow down the slopes of the land, it picks up and carries with it particles of soil and weathered rock. Presently it forms a rill, or perhaps a gully, leading to older gullies or valleys, increasing its load all the while as it progresses toward the flowing stream which it enters. The water which flows down freshly plowed slopes is usually very muddy, while that which runs over grass or forest-covered slopes carries away little soil, since the roots of the vegetation hold it. The removal of forests from hill and mountain slopes and the subsequent cultivation of the soil often lead to the complete removal of the soil, as in many of the abandoned farms of the southern Appalachian Mountains.

Where the run-off is concentrated into streamlets, little gullies are oftentimes made by a single shower. Older gullies formed by previous rains may be lengthened headward and their valleys cut deeper. This is especially noticeable in soft formations in semi-arid regions such as in western South Dakota, or in arid regions, where "cloud bursts" are not uncommon.

During the winter and spring months the rivers of the land are apt to be in flood following heavy rains and the melting of winter snows. At such times the waters are usually muddy, due to the removal of rocky waste from the weathered surface of the land. In addition to the mud which the streams carry in suspension, they may roll sand, gravel, and bowlders along their bottoms. The sediment carried by a stream, whether in suspension or at the bottom, is its load. The fine sediment, and the sand, gravel, and bowlders, constitute the tools which a stream uses in cutting its channel deeper and in widening its valley. The finer

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ONE OF NATURE'S CATHEDRALS, BAD LANDS, SOUTH DAKOTA

Through many hundreds of years these horizontally stratified beds of a weak formation have been exposed to the agents of erosion. Many a fantastic spire in varied colors has been carved out of the deposits which contain the bones of prehistoric creatures. To look upon this weird landscape under the various lights of day or a moonlight night gives one the impression that he is indeed back in a Spirit Land of prehistoric days. The Bad Lands are a warning to the nation and to those farmers and herdsmen who do not pretend to conserve the inherited soil of the ages from the daily forages of the agents of erosion

Photograph by Ewing Galloway

THE MOST AWE-INSPIRING VIEW IN AMERICA

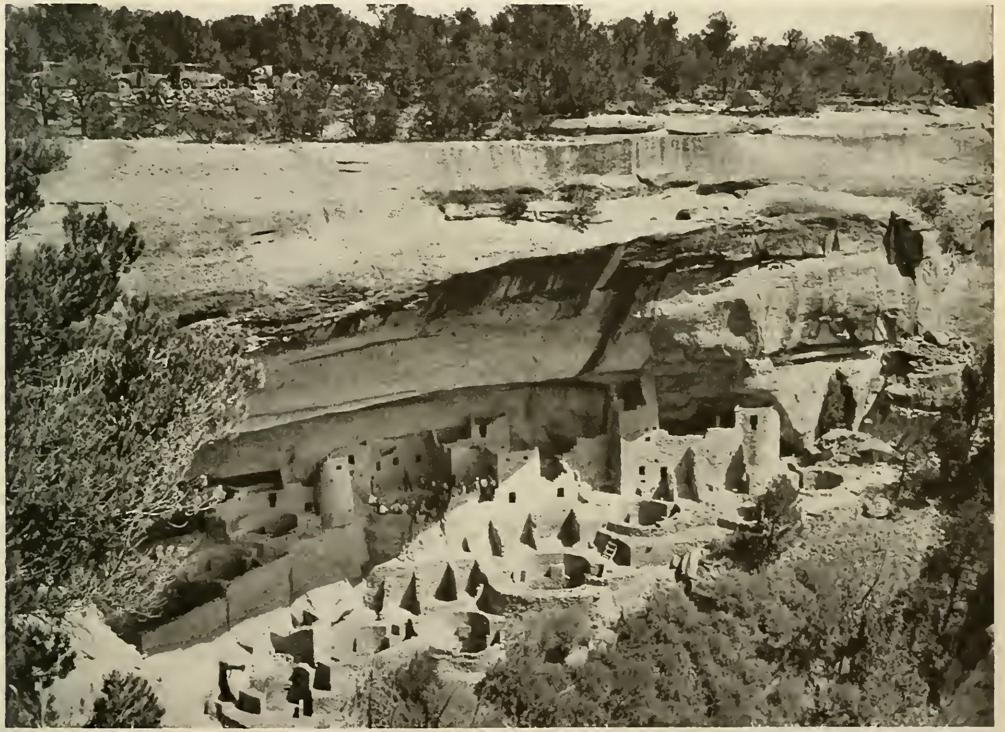
The Grand Cañon of Arizona as seen in sunset light from Pima Point, with the Colorado River winding through the gorge a mile below. The inner, outer, and some tributary gorges are in evidence below the plateau surface which appears in the background. This is the most stupendous example of river erosion in the world

material, which is nearly three times as heavy as water, is kept in suspension by the minor upward currents in the main stream. The greater the volume of water and the greater the velocity of the streams, the greater the load of sediment the river can carry. The carrying power of streams varies as the sixth power of the velocity, hence, when rivers are in flood, they are able to move large bowlders. Streams, however, carry a much greater weight of fine material than of coarse, since the fine material can be spread more widely and taxes the stream's energy less. Swift streams flow in channels which have steep gradients; as the valleys are deepened, the gradients become less and the streams flow more slowly. Cañons like the Colorado and the Yellowstone are being made deeper, since their stream gradients are still steep. Such valleys are never found in plains. Valleys of such depth are found only in plateaus and mountains. The depth to which a valley may be eroded is determined by the height of the land and the elevation of the body of water into which its river flows. The volume of water carried by a river may be so great that it is able to cut its channel below sea level, as the Mississippi has done from Baton Rouge to the Gulf, where it maintains a channel about one hundred feet below sea level.

The erosional history of a stream may be judged from the character of the valley along its course. Where the valley is V-shaped and narrow, with waterfalls in evidence, and its tributaries short, it is still youthful. Where the valley is moderately wide, its slopes gentle, and its tributaries long, it is said to be a mature valley. Where the valley is wide and has a broad, flat, flood plain and a low gradient, it is an old valley. A stream also exhibits a similar history. In youth it is swift and impetuous, unless it flows through a low-lying country. In maturity it is steadier in its flow and habits. In old age it meanders across its wide flood plain. Streams may be rejuvenated, however, throughout their entire length or for a part of their course, by an uplift of the land. Then we see them hastening on their way, following all the old bends and meanders in their course as they cut their channels deeper. A new cycle of erosion has begun and there is much work for the stream to do to keep its channel open across a rising land.

As a stream passes from the youthful to the mature stage, it may widen its valley by (1) under-cutting its bank as it swings from one side of its channel to the other; (2) by rain-wash on the adjacent slopes slowly wearing back the hillsides; (3) by loose material slowly creeping down the hillside toward the river under the action of gravity aided by other forces such as changes in temperature and viscosity of the material when wet; (4) by slumping of the loose material from higher to lower levels when soaked with water; (5) by the action of animals in burrowing and walking near steep slopes; (6) by the overturning of trees on valley slopes; (7) by the action of the wind in carrying away the smaller particles when dry and loose; and (8) by the development of talus slopes. The limit to which a valley may be widened is determined by the distance to the divides between the stream under consideration and that of the adjacent streams.

While widening its valley, a stream may also cut down its channel to a low

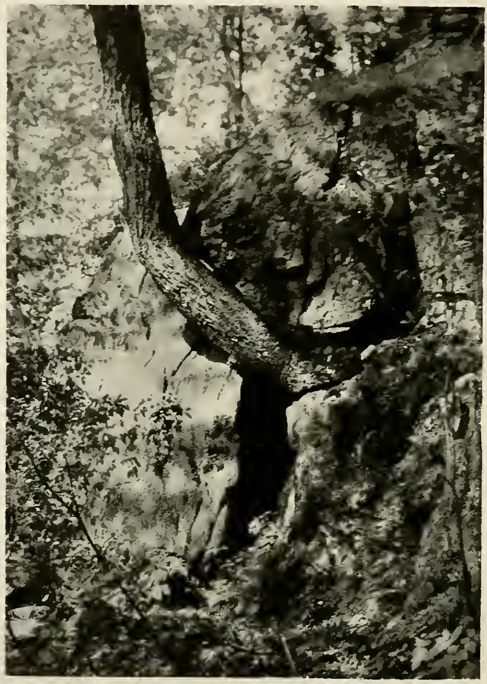


Photograph by Ewing Galloway

A MEDIÆVAL CLIFF CASTLE, MESA VERDE, COLORADO

This famous relic of ancient Indian civilization is in southwestern Colorado. The recent study by Dr. A. E. Douglass of tree rings found in the roof timbers and their correlation with the known tree ring chronology show that these buildings were erected 1073-1262 A.D. The erosion of the cliff recess and cañon began many thousands of years ago gradient, at least for a portion of its course, and develop marginal flats or flood plains which usually appear a few feet above the water in the main channel of the stream and considerably below the surface of the bordering upland.

Since all lands are being lowered by erosion, it is of interest to know how fast they are being worn away. It has been estimated that the Mississippi River, for example, carries to the Gulf of Mexico more than 400,000,000 tons or 7,500,000,000 cubic feet of sediment each year, or more than 1,000,000 tons a day. This would afford enough material to cover one square mile to a depth of 268 feet. All of the rivers of the earth are probably carrying to the sea about forty times as much sediment as that carried by the Mississippi.



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A TREE GROWING IN THE CRACK OF A ROCK

As the tree grows larger, the roots act as a wedge which splits open the rock

There is still another factor to be considered. The rain-water which enters the soil to form the ground-water, found in wells and which issues from hillsides as seeps or springs, dissolves various mineral matter in the rocks before it enters the rivers and lakes of the land. This dissolved matter carried by streams is invisible, yet it has been estimated from numerous chemical analyses that it amounts to nearly 2,753,000,000 short tons for the rivers of the United States and about 5,000,000,000 tons for all the rivers of the world. These totals for dissolved matter amount to about one third as much as the sediments carried by the rivers.

When the mechanically transported sediments and the dissolved matter carried in solution by streams are totaled, it may be observed that the rate at which the surface of the Mississippi basin is being eroded is about one foot in 3500 years. This may represent the approximate rate at which the lands of the earth are being lowered by erosion at the present time by natural processes.

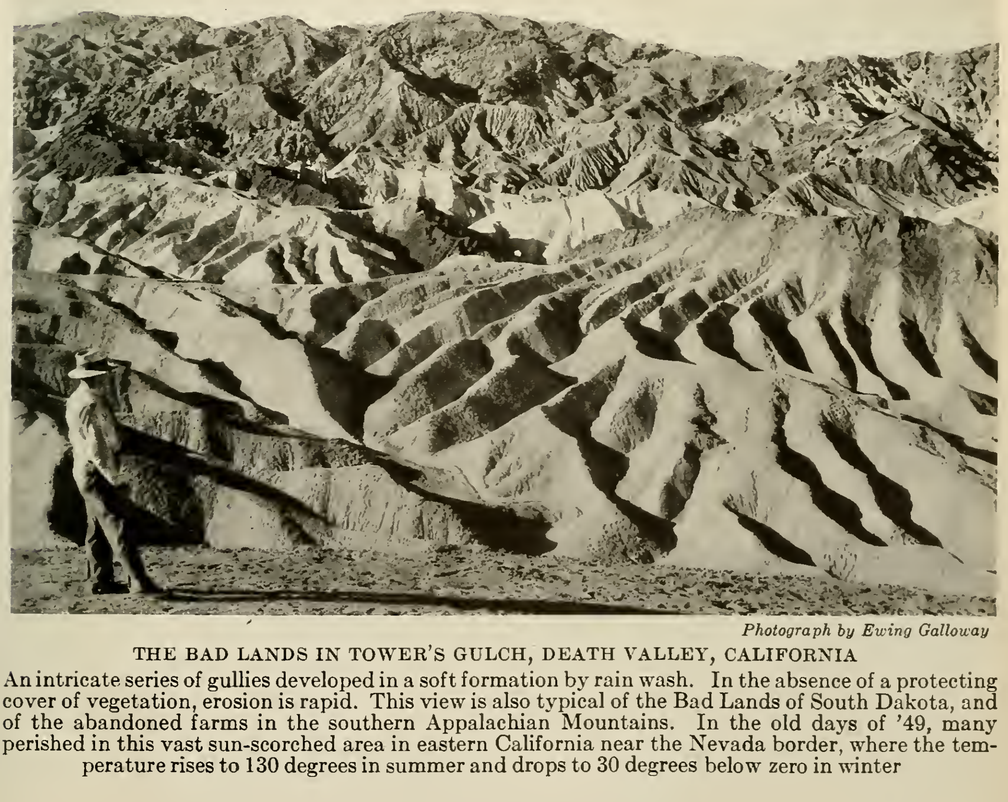
Glaciers not only erode the surface over which they pass, but they carry and eventually deposit the material which they acquire in transit. Soil, stones, and large blocks of rock may freeze into the bottom of a glacier and be carried along as it slowly moves forward. The stones, which have been frozen into the bottom of the mass of ice, serve as tools for grating away the soil layer and projecting masses of rock as the glacier advances. The effects of glacial action are thus (1) the removal of loose rock débris from the surface, (2) the wearing down of protruding masses of rock which it overrides.

In a plains region an ice sheet may move across or along valleys and over considerable hills without being diverted from its course. Where it moves across a valley it tends to fill it up with rock débris and abrade its margins, but where it

Photograph by Ewing Galloway

BRYCE CAÑON IN SOUTHERN UTAH

It is a vast maze of colorful monoliths some of them 200 feet high, and thousands of people go there each month to behold its overwhelming beauty. The district is now a national park



Photograph by Ewing Galloway

THE BAD LANDS IN TOWER'S GULCH, DEATH VALLEY, CALIFORNIA

An intricate series of gullies developed in a soft formation by rain wash. In the absence of a protecting cover of vegetation, erosion is rapid. This view is also typical of the Bad Lands of South Dakota, and of the abandoned farms in the southern Appalachian Mountains. In the old days of '49, many perished in this vast sun-scorched area in eastern California near the Nevada border, where the temperature rises to 130 degrees in summer and drops to 30 degrees below zero in winter

RAINBOW NATURAL BRIDGE IN SOUTHEASTERN UTAH

Known to the Indians as Nonnezoshi. This peculiar natural wonder, which is more than 300 feet high, was formed thousands of years ago when the stream which now flows beneath the arch flowed at a higher level and followed an ox-bow meander around the western end of the rock mass. The neck of the meander lay on opposite sides of the bridge, and as the stream continued to undercut its banks and these points, it eventually developed a hole in the rock. Then the stream abandoned the meander and took the short cut through the hole. During the ages which followed, the stream has cut its bed to lower levels, the sandstone rock of the bridge has exfoliated along the outer surface, and this, with wind erosion, has tended to lengthen and narrow the arch

Photograph by Ewing Galloway

follows a valley it scours it out. In mountainous regions, however, previously existing valleys determine the direction of movement of glaciers. These valleys are widened and deepened and made smoother by the passage of the glaciers; in fact, they are transformed from V-shaped into U-shaped valleys. Tributary valleys bearing smaller glaciers are not eroded so deeply as the main valley; hence they form hanging valleys. The glaciers of hanging valleys have a steep descent near their heads, which affords a site for great erosion. As the head of the glacier works its way back farther and farther into the mountain, it develops a horseshoe-shaped depression with a steep back wall about its head and sides known as a cirque. Cirques are of common occurrence in the Alps of Europe and in the Bighorn, Uinta, and Sierra Nevada mountains of the United States. These huge amphitheaters are oftentimes excavated in solid rock, and, after the cliff glaciers which occupied them have disappeared, the rock basins may become the sites of charming little lakes which add beauty to the mountain scenery.

In addition to the large amount of eroded material which is carried in the basal portion of a glacier, some rock débris may be carried at higher levels in the ice and also on the top of the glacier. The material carried on the surface of a glacier may be derived from steep mountain slopes by avalanches, or as talus from adjacent cliffs, or as wind-blown dust. Marginal accumulations of rock débris are known as lateral moraines. Where two or more glaciers unite, lateral moraines may be brought to a medial position and united, forming medial moraines. The thick accumulation of rock débris at the end of a valley glacier or at the margin of an ice-sheet is called a terminal moraine. As a glacier or ice-sheet melts away, all the rock material which it carried is left strewn over the surface of the ground and is known as a ground moraine. The rock débris left by the ice is commonly known as glacial drift. New England and New York State and the states to the westward were extensively glaciated at various times during the Pleistocene epoch, or Glacial period. The southern limit of glaciation, which is marked by a huge terminal moraine, extends from Montauk Point, Long Island, westward, across Staten Island, and then west-northwest across the United States to the Pacific Ocean near Seattle, Washington. Glacial drift deposits are commonly recognized as a heterogeneous mixture of irregularly shaped bowlders, gravel, pebbles, sand, and clay. The amount of glacial drift material in North America and Europe is so enormous that no accurate estimate of it has ever been made.

In addition to the erosional effects produced by wind, rivers, and glaciers, the waves of the sea and of the many inland lakes are continually modifying their shorelines. The changes produced during a year are slight in comparison with those developed during a decade or a century. While the waves modify the outlines of the land rather than its relief, they do effective erosional work in the shallow water near shore. They form reentrants in the weaker formations and

Photograph by Ewing Galloway

A DOUBLE OX-BOW MEANDER, TROUT CREEK, YELLOWSTONE NATIONAL PARK

These meanders have been developed on the delta plain of Trout Creek between Lake Junction and Cañon Junction near the entrance of the stream to Yellowstone River

Photograph by Ewing Galloway

AIRPLANE VIEW OF NIAGARA FALLS, NEW YORK

The Niagara River, which connects Lake Erie with Lake Ontario, is clearly outlined above and below the Falls. Although the river has cut a gorge seven miles long below the Falls during the last 25,000 years, it has much work to do before the Falls recede up stream to where they will become rapids

Photograph by Ewing Galloway

A VIEW IN THE ENDLESS CAVERNS, VIRGINIA

It took untold millennia for the underground waters to erode this cave in the limestone rock. The beautiful rock stalactites and stalagmites which were deposited later were formed by minute particles of calcium in the water that dripped for centuries from the roof of the cave. The two men in the picture have gained permission to saw off one of the stalactites for the Milwaukee Museum

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A RURAL LANDSCAPE OF THE RIVER LEE, IRELAND

A slightly meandering stream with flood plains and valley slopes protected from erosion by a cover of vegetation. The River Lee rises in Lake Gougane-Barra. The various fields are separated by lines of stone and shrubbery

Photograph by Ewing Galloway

THE MISSISSIPPI RIVER FROM THE 200-FOOT BLUFFS AT NATCHEZ, MISSISSIPPI

The adjacent lowlands are lower than the level of the water in the river, since both natural and artificial levees have been built along the river's banks. During floods the river frequently breaks through the levees and does great damage to crops in the lowlands. Due to its low gradient, the river has developed many meanders and ox-bow lakes between Cairo, Illinois, and Baton Rouge, Louisiana

Photograph by Chester A. Reeds

A PARTING GLIMPSE OF THE YOSEMITE VALLEY, CALIFORNIA

This view was taken from the rim as a rain storm was casting its misty veil over the valley. The granite precipice of El Capitan is still visible on the left. The towering peaks of the Three Brothers and Yosemite Falls are outlined on the right. Many a rain storm, snow storm, and glacier have worked their magic over this landscape to make it one of the great natural wonderlands of America. The valley has been eroded to a depth of 4000 feet

headlands of the stronger rock. On rocky coasts steep cliffs may be developed and undercut by the waves as they drive pebbles and other rock débris against the shore. In such cases wave-cut terraces are not uncommon a little below the surface of the water. Wave erosion is thus effective in modifying coast-lines.

Man is also an active agent in modifying the surface of the land. He builds cities and towns with tall buildings, paved streets, sewers, aqueducts, reservoirs, and thus alters the natural character of the landscape. In building railroads and highways he makes cuts through hills and fills in valleys. He digs canals, builds dams and bridges across rivers, and erects levees to confine rivers to specific channels, and modifies the natural erosive action of running water in many ways. He tills the land and in so doing destroys the native vegetation, turns over the soil with the plow and the harrow, and thus prepares the way for the more effective action of wind and running water.

The prevailing attitude of most farmers toward soil erosion is an inactive one. They are doing little or nothing to check it and much to accentuate its evil effects. Thousands of farmers have moved to town or to other farms because of the poor condition of the soil on farms that were once highly productive. The topsoil having been washed off and the fields riddled with gullies, the cultivation of many farms has been abandoned. The areas relinquished to rapid erosion are increasing every year and at a much faster rate than new soil is being formed. A 1928 circular entitled "Soil Erosion a National Menace" by H. H. Bennett and W. R. Chapline, published by the U. S. Department of Agriculture, shows that between 40 and 50 per cent. of the land now tilled in the United States has suffered to some degree from abnormal soil erosion, and about one-fourth of this has suffered seriously. Under normal conditions rock decay keeps pace with soil removal, but where man removes the forests and shrubs and breaks the ground for cultivation, he accentuates erosion to a degree far beyond that taking place under average natural conditions.

It has been stated that no less than 126,000,000,000 pounds of plant-food material are removed from the fields and pastures of the United States every year. Most of this is from cultivated and abandoned fields and overgrazed pastures and ranges. The value of this plant-food exceeds $2,000,000,000 annually. Of this amount at least $200,000,000 is lost by the farmers, and they are not in an economic position to stand the loss.

In the United States about ten million acres of land which was formerly cultivated have been permanently ruined by abnormal soil erosion, and an additional three million acres of fertile valley lands have been rendered useless or impaired by overwash of sand and gravel due to choking of stream channels. It is not necessary to go to China, northern Africa, or to some other parts of the world to see what eventually happens to unprotected slopes of cultivated areas. There are already an abundance of them in the United States. In 1908, the late Prof. T. C. Chamberlin, a famous geologist, stated: "The rainfall is an inherited asset, the soil an inherited asset, but reckless soil-wastage is a serious error."

In conclusion it may be stated that erosion of the land is a natural phenomenon which consists of three somewhat rather distinct but related processes namely: (1) weathering, which embraces the decay and disintegration of the rock, (2) corrosion, the gathering up of the loose material set free by weathering, and (3) transportation, the carrying of the loose material from one place to another. The products of normal land erosion are very beneficial to man, since they afford suitable soils for plants. Due, however, to man's unwise deforestation and cultivation of extensive tracts of land, many areas have been rendered useless by the enormous wastage resulting from erosion. In various regions it is imperative that the extensive abnormal erosion be checked. This may be done by reëstablishing the vegetative cover.

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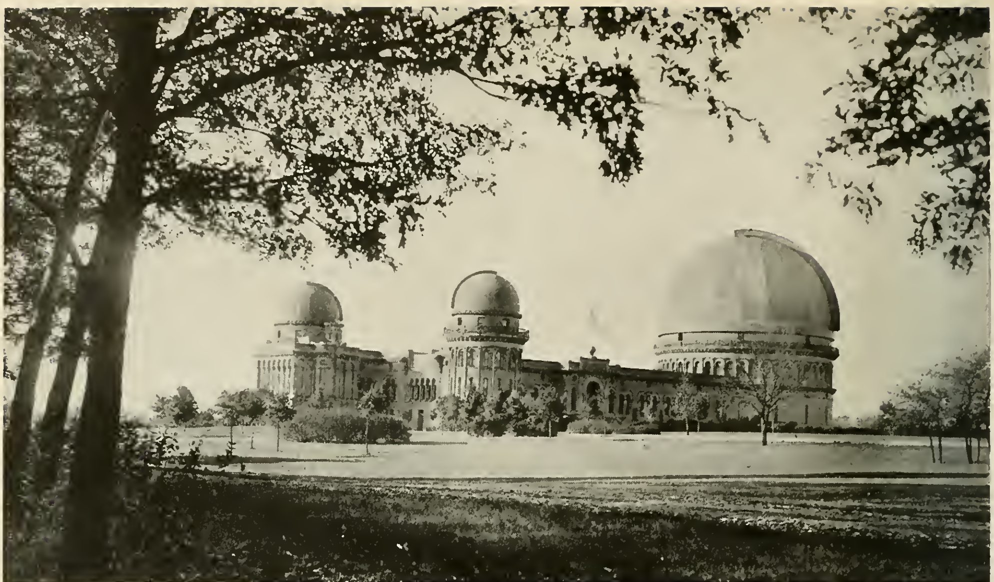
THE NORTHERN FACE OF MT. McKINLEY, ALASKA

This view taken from the low tundra shelf shows the mountain enshrouded in snow and ice. Mt. McKinley, 20,000 feet above the sea, is not only the highest mountain in the world above its own base, but also the highest above the line of perpetual snow



Photograph from Yerkes Observatory

Yerkes Observatory, at Williams Bay, Wisconsin is under control of the University of Chicago

THE ASTRONOMER'S WORKSHOP

The Instruments Which Man Has Invented to Span the Distance between the Earth and the Stars

By CLYDE FISHER

Curator of Astronomy, American Museum

Go to yon tower, where busy science plies
Her vast antennæ, feeling through the skies;
That little vernier, on whose slender lines
The midnight taper trembles as it shines,
A silent index, tracks the planets' march
In all their wanderings through the ethereal arch,
Tells through the mist where dazzled Mercury burns,
And marks the spot where Uranus returns.

—Holmes.

THE telescope is usually thought of as the primary, indispensable tool of the astronomer, and in the minds of many it is the only instrument thought of in connection with his work. While the telescope has been of vast service to the science of the heavenly bodies, much was accomplished before the days of Galileo.

The first astronomer was the first man, and the foundations of the science were laid before the dawn of history. Many of the conspicuous star-groups or constellations were delimited and named. While most of the names that have come down to us are from Greek mythology, various primitive peoples, such as the American Indians and the Lapps, had independently recognized various constellations which differed more or less from those accepted by the modern astronomer. Certain bright stars were named. All of the planets except Uranus and Neptune were known, as was their movement among the stars. The name "planet" signifies "wanderer."

More than two thousand years ago,

Hipparchus, the father of astronomy, had determined the length of the year within an error of four minutes. After Hipparchus, the most distinguished astronomer of antiquity was Ptolemy, whose system was orthodox astronomy for fourteen hundred years. Nearly three quarters of a century before the first astronomical telescope was made, the Copernican system of astronomy was born.

Galileo, who built the first astronomical telescope, made many thrilling discoveries. He was the first to see the mountains and craters on the moon, the first to see Venus as a waxing and waning crescent, the first to see the four large moons of Jupiter. Galileo was the first person to make a scientific study of sunspots, although there are records that sunspots were seen by the Chinese before the invention of the telescope. Because of the small size of his telescope, he never gained an adequate notion of Saturn and his rings. According to tradition, upon first examining Saturn through his telescope, Galileo exclaimed that he had discovered the star with wings. When we examine modern photographs of Saturn made through much larger and better telescopes than that of Galileo, we are not surprised at this comparison.

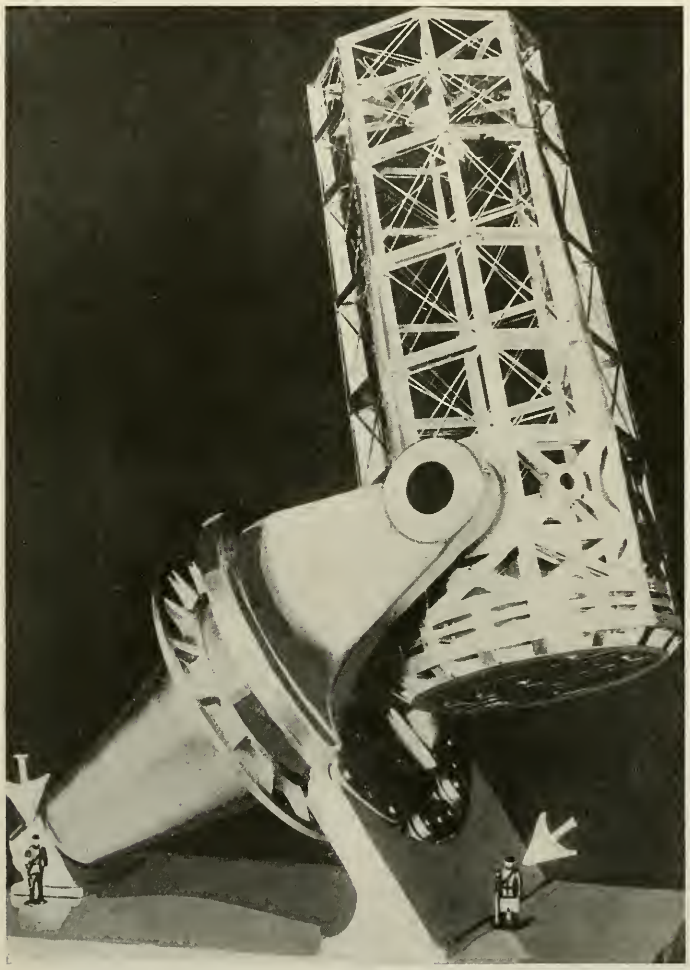
In the refracting telescope, or refractor, as it is commonly called, the large lens or object-glass is a critical part. At the present time, in all large telescopes the object-glass is made of glass. At first the object-glass was made of a single lens which was convex on both sides. But this was unsatisfactory because of color fringes, due to the fact that white light is dispersed into a number of different colors when passed through a prism,—and a lens may be considered to be made up of an infinite number of prisms. For

Photograph from Mt. Wilson Observatory

DOME OF THE WORLD'S LARGEST TELESCOPE

The dome of the 100-inch Hooker reflector at Mt. Wilson Observatory, photographed from the 150-foot sun-tower a hundred years after Galileo's time, little progress was made in the telescope because of the inability to cope with this so-called "chromatic aberration." Finally, when the remedy was discovered, it was suggested by the structure of the human eye, which contains more than one refractive medium. Following this hint, the object-glass of a telescope or of a field-glass or even the achromatic lens of a camera is made of two lenses, one of which is bi-convex and consequently thicker in the center, and the other of glass of a different density and thinner in the center. These two lenses are usually cemented together with Canada balsam, which has the same index of refraction as glass.

The glasses for the largest refracting telescope in use in the world were made by M. Mantois of Paris, and were ground and figured by the celebrated firm of Alvan Clark and Sons of Cambridgeport, Mass. This mammoth lens of forty inches aperture is mounted in the big Yerkes telescope which, with all its intricate machinery for operating, was designed and built by Warner and Swasey of Cleveland.



Photograph from Monthly Evening Sky Map.

MODEL OF THE GREAT 200-INCH TELESCOPE

The California Institute of Technology is planning a 200-inch reflecting telescope, which will probably be installed at some advantageous place in California. It will have four times the light-gathering power of the 100-inch reflector at Mt. Wilson

It is evident that in grinding and polishing an object-glass for a telescope there are four surfaces to be shaped. This necessity for so much skilful and accurate work, together with the difficulty in manufacturing a large disk of glass of high quality, has led builders of large telescopes to turn to the reflecting type, because in the latter there is but one surface to grind and figure, that is, the paraboloid surface of a concave mirror. The large lens or object-glass of a refracting telescope bends or refracts the rays of light to a focus, while in a reflecting telescope the rays of light are gathered and reflected to a focus.

The largest telescopes in the world are reflectors, — the 100-inch Hooker telescope at the Mt. Wilson Observatory

Photograph from Harvard Observatory.

HARVARD OBSERVATORY

Harvard Observatory owns the largest and most valuable collection of astronomical negatives in the world. Its big reflecting telescope is of historic interest in this connection, being the first through which an astronomical photograph was made. Dr. Harlow Shapley is the present director

being first in point of size, and the 72-inch reflector at the Dominion Astrophysical Observatory, Vancouver, being second. A reflector almost as large as the latter is being constructed for the Perkins Observatory at Ohio Wesleyan University.

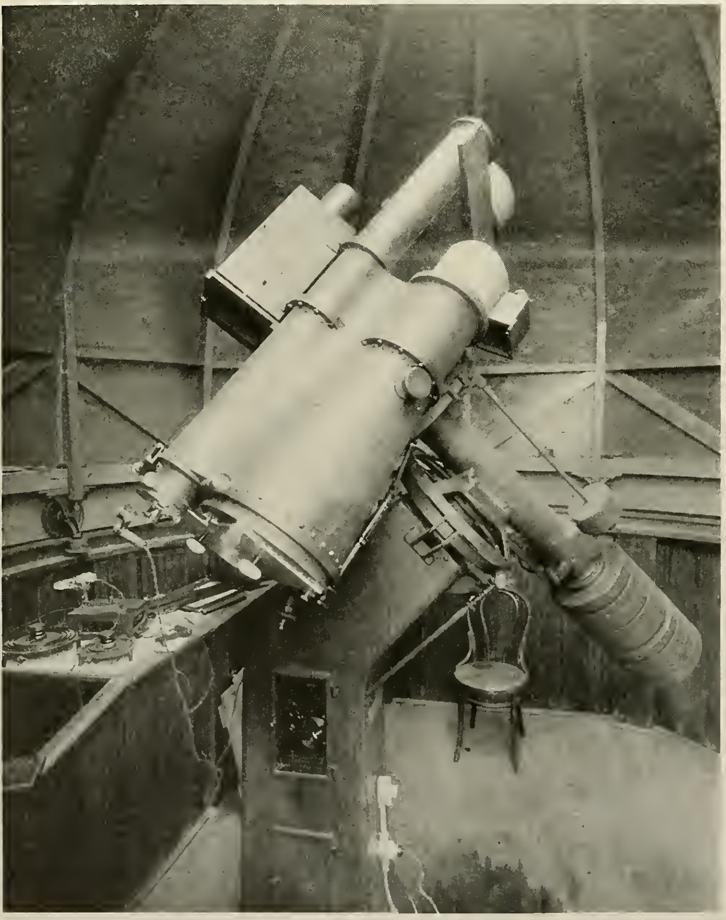
A huge reflecting telescope, 200 inches in diameter, has been projected by the California Institute of Technology, and is under way. Since it required some six years to build the 100-inch reflector, one should not be too hopeful about eliminating the element of time in the present case. The 200-inch mirror will have four times the light-gathering power of the 100-inch, and its use may make possible the solution of many problems which now puzzle the astronomer. Possibly we may settle the long discussion about the so-called canals of Mars, and probably we shall get more light on the curvature of space by examining some of the extremely distant spiral nebulæ.

Not only has the telescope greatly increased the power of the human eye, but by the aid of the photographic plate used in connection with the telescope, it has been possible to make wonderful records of objects in the sky that have never been seen. By making long time-exposures it is possible to photograph stars much too faint to be seen with the most powerful telescopes; so, too, with the extremely distant spiral nebulæ or island universes of outer space beyond the confines of our Milky Way galaxy; and so with faint nebulosity as that surrounding the Pleiades or as the so-called North American nebula in the constellation Cygnus. Exceedingly faint stars and nebulæ may be recorded on the photographic plate, because the effect of the light upon the sensitized silver is cumu-

Photograph from Monthly Evening Sky Map

ROYAL OBSERVATORY AT GREENWICH

This was built in 1675 for the advancement of navigation and nautical astronomy. The British and nearly all foreign geographers reckon longitude from its meridian. In time it is five hours later than New York



THE BRUCE PHOTOGRAPHIC TELESCOPE

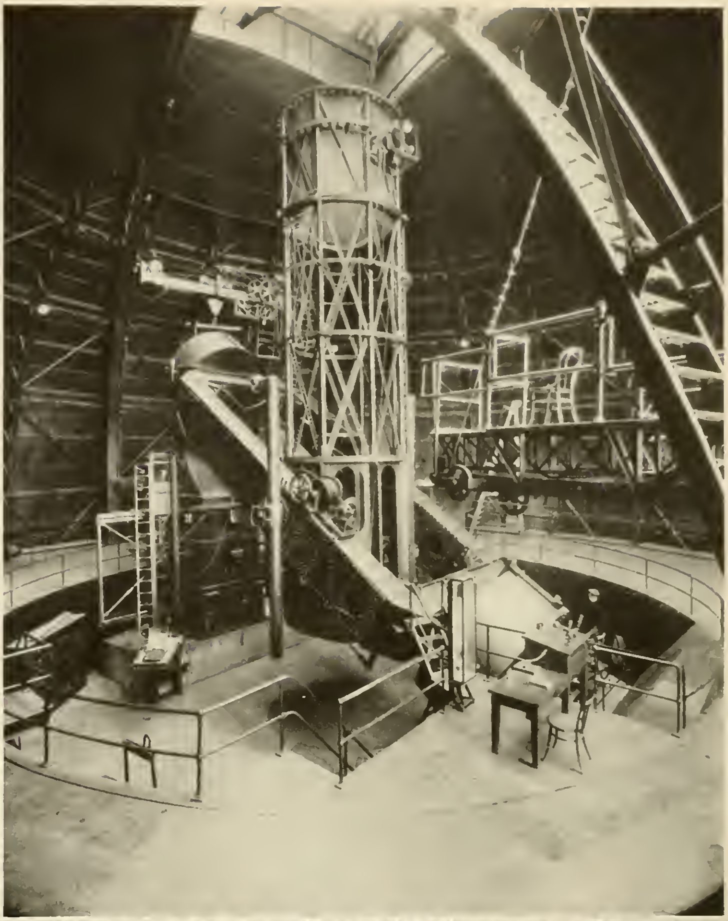
Since the rays of light which have most effect on the photographic plate are not the visible ones but the ultra-violet ones, the lens or mirror of a photographic telescope is figured correspondingly different than in a visual telescope. Photography is an extremely valuable adjunct of astronomy for several reasons, one important one being that objects entirely too faint to be seen will register on the photographic plate

Photograph from Yerkes Observatory

THE LARGEST TELESCOPE IN THE WORLD

The 100-inch Hooker telescope of the Mount Wilson Observatory near Pasadena, California, has been used by Dr. Edwin P. Hubble in his studies of the distant spiral nebulæ. In 1927 he was able to penetrate space to a distance of 140,000,000 light-years, and in 1929 he announced that the frontiers of space were 200,000,000 light years away. With this huge reflector one could see a candle at 5,000 miles, and an arc light on the moon

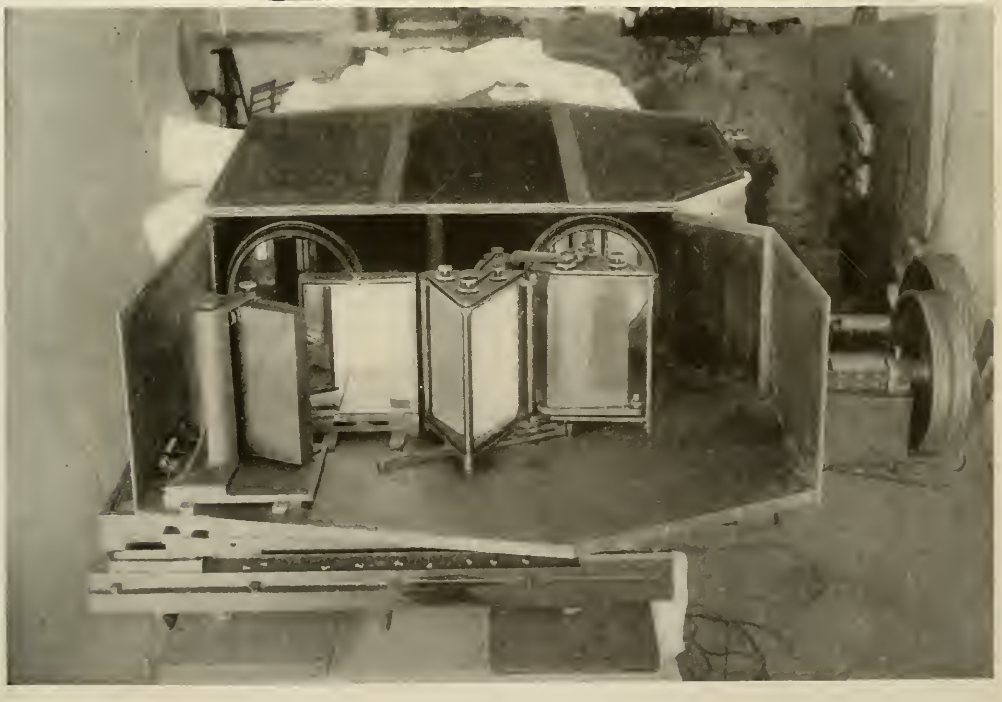
Photograph from Mt. Wilson Observatory



SPECTROHELIOGRAPH

This remarkable instrument was invented in 1890, independently by Hale and Deslandres. By means of this apparatus, the solar prominences may be photographed on any clear day. Great advances have been made in the study of the prominences and in the entire outer region of the sun, with the spectroheliograph

Photograph from Mt. Wilson Observatory



Photograph by Clyde Fisher

TWO LEADING AMERICAN ASTRONOMERS

Dr. E. W. Brown, of Yale University, president of the American Astronomical Society, and Dr. Harlow Shapley, director of the Harvard College Observatory

lative and is piled up during a time-exposure, while in seeing, the effect of light on the human eye is dissipated constantly and does not build up, an image lasting on the retina only a fraction of a second. Since the rays of light which affect the photographic plate most are not those of greatest visibility, but rather those of the ultra-violet end of the spectrum, the photographic telescope is so made that these rays will be brought to a focus and utilized.

Since the formulation of the principles of spectrum analysis by Kirchoff, about seventy years ago, the spectroscope has contributed more to the science of astronomy than has any other instrument. Of course, it is true that the spectroscope is usually used in connection with a telescope. The principle of the spectroscope is that light, upon passing through a prism, is bent out of its course according to its wave-length,—that is, the red light is bent least and violet light is bent most. Thus white light may be dispersed or separated into the colors of the rainbow by being passed through a triangular prism. A similar result may be obtained by allowing light to be reflected from a grating upon which very fine lines have been ruled very close together,—several thousand to the inch.

Kirchoff found that there were three kinds of spectra, namely:

1. *Continuous spectra,* produced by incandescent solids or liquids or gas under high pressure.

Photograph by William Henry

BLINK MICROSCOPE

Dr. Leon Campbell, astronomer of Harvard College Observatory, is using this instrument to detect proper motions of the stars. Two photographic plates of the same field, made, say, ten or twenty years apart, are viewed alternately at rapid intervals through microscopes with the same eye-piece. When the plates are properly adjusted, the images of most of the stars appear fixed when the change is made, while those stars which have moved seem to jump, or blink

Photograph from Yerkes Observatory

ALVAN CLARK AND CARL LUNDIN

Alvan Clark and his assistant, Carl Lundin, with the 40-inch objective of the Yerkes telescope, which they had ground and figured

2. *Bright line* or *gaseous spectra*, produced by an incandescent gas or vapor, under moderate or especially low pressure.

3. *Dark line* or *absorption spectra*, produced through a medium capable of absorbing a portion of the rays.

In accordance with the third of these, Kirchoff explained the Fraunhofer lines of the sun's spectrum, which had been a mystery since their discovery.

By the use of the spectroscope, the physical state of stars, nebulæ, and the so-called "spiral nebulæ" was determined. Thus the great nebula in Orion was proven to be gaseous, and the great nebula in Andromeda was proven not gaseous.

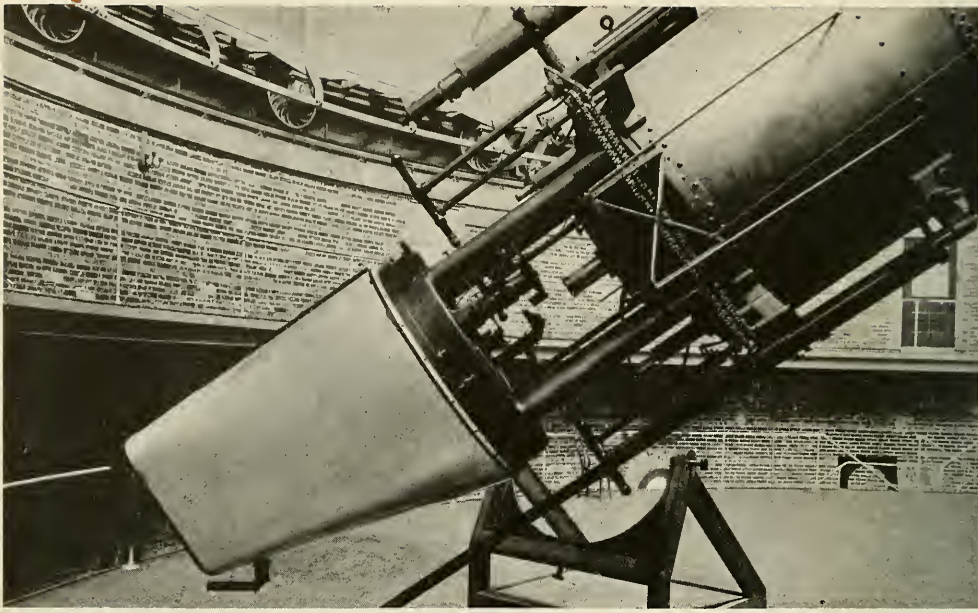
Since each of the chemical elements known on the earth, when incandescent, produces a certain line or series of lines that is different from that of every other element, it was found possible to analyze chemical substances in a qualitative way, and this method is sometimes useful in determinative mineralogy.

Kirchoff, and later Rowland of Johns Hopkins University, extended the method of spectrum analysis to the sun. Up to the present time, forty-nine, or more than half of the ninety elements known on the earth, have been proved to exist in the sun's atmosphere by the spectroscope.

In fact, one of these elements, helium, was discovered on the sun years before it was found on the earth. It was first recognized on the sun in the flash spectrum at the total eclipse of 1868, and it was named from the Greek word for *sun*. Not until 1895 was it discovered by Ramsay on the earth; and now it is found in sufficient quantities to make practicable its use in dirigibles.

Spectrum analysis has also been applied to other stars than the sun, to comets, and to nebulæ.

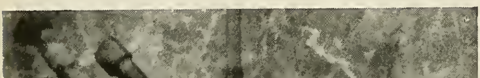
Recently it has been found possible to



Photograph from Yerkes Observatory

SPECTROGRAPH

When a spectroscope is arranged for photographing the spectrum, the instrument is known as a spectrograph and the photograph is known as a spectrogram. When photographing the spectrum of a star, an astronomer must be at the telescope constantly during the long time-exposure to keep the image of the star exactly in the same place, the motion produced by the driving-clock not being accurate enough



Photograph by Clyde Fisher

GALILEO'S TELESCOPES

Galileo made the first astronomical telescope in 1610. These telescopes are in the Museum of Physics in Florence. In the center of the old ivory mounting of the stand is the object-glass,—now cracked, but preserved as a historical relic,—through which Galileo discovered the moons of Jupiter

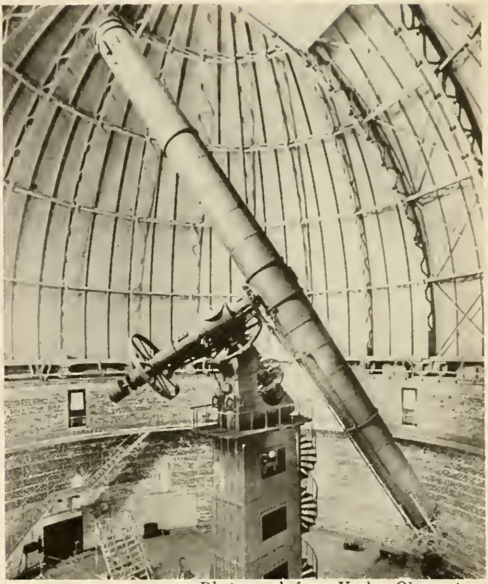
determine in a rough way the relative abundance of the elements in the sun which give rise to the Fraunhofer lines. Studies in the width and blackness of these lines has made possible some determination of the quantitative analysis of the sun.

A great deal has been learned about the movements of heavenly bodies by means of the spectroscope. If a body is moving toward us, more waves of light strike the spectroscope per unit time, and this causes a shifting of the lines toward the violet end of the spectrum. If a body is moving away from us, less light-waves strike the spectroscope per unit time, and this causes a shifting of the lines toward the red end of the spectrum. This shifting of the lines in the spectrum makes it possible to determine whether a star or other body is approaching or receding, and how fast. By an application of the same principle (Doppler effect), revolving binary stars are discovered, and the sun's rotation on its axis can be proved.

This brief discussion does not give an adequate notion of the present uses of the spectroscope, and astronomers feel that the possibilities of this instrument have not yet been reached.

When the spectroscope is used in photography, it is known as a spectrograph, and a remarkable instrument involving the principle of the spectrograph, invented independently by Hale and Deslandres, is known as the spectroheliograph. By means of this, the solar prominences may be photographed on any clear day. Formerly this was possible only at a total eclipse of the sun.

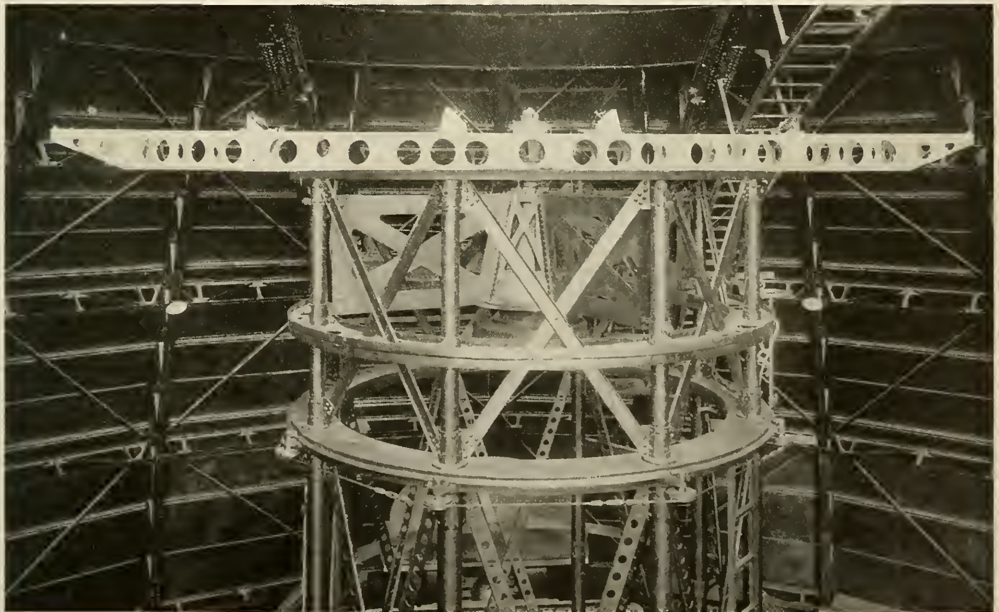
The interferometer, invented by Michelson, was used with the 100-inch Hooker reflecting telescope at Mt. Wilson Observatory in measuring the diameters of stars, and it is the only instrument by which this can be done. The first one measured was Betelgeuse, the reddish star in the right shoulder of Orion, the mighty hunter, and this was less than ten years



Photograph from Yerkes Observatory

YERKES TELESCOPE

Designed and built by Warner and Swasey, and exhibited at the World's Fair in Chicago in 1893, before being installed at the Yerkes Observatory. The object-glass, 40 inches in diameter, was ground by Alvan Clark and Sons. When built, this was and still is, the largest refracting telescope in the world. The focal length is 62 feet



Photograph from Mt. Wilson Observatory

INTERFEROMETER

With this twenty-foot beam interferometer it is possible to measure the angle subtended by a star's disk to within one-thousandth of a second of arc, "an angle about equal to that which the head of an ordinary pin at New York would fill as observed from the distance of Boston or Washington." A fifty-foot beam interferometer is now being built at Mt. Wilson ago. The largest star so far measured is Antares, the reddish first-magnitude star in Scorpio. Its diameter is much greater than that of the orbit of Mars.

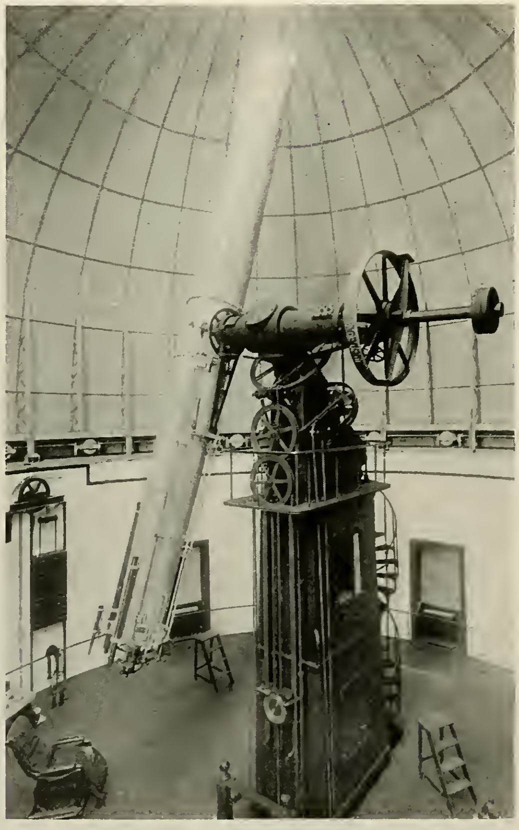
The photo-electric cell, developed by Stebbins and Rosing, makes it possible to measure the magnitudes of stars with great accuracy,—a very important advance in the study of variable stars.

The astronomer's workshop is the observatory with its domes for the telescopes, but besides these there are many other interesting and useful tools which can merely be mentioned in this brief article. The meridian circle for getting time from the stars, the chronograph for recording time, clocks and chronometers for keeping time from day to day, the photometer for measuring light, the bolometer for measuring heat, the thermocouple used to measure heat of stars and planets, the blink microscope used in detecting proper motions of the stars and also in detecting changes in brightness, the stereo-comparator used in conjunction with the blink-microscope, the spectro-comparator used in comparing spectra, the astro-camera which photographs with ultra-violet light, and the filar micrometer used in measuring very small angles in work with double stars, asteroids, etc.,—these are a few of the tools used in the astronomer's workshop.

O rich and various man, thou palace of sight and sound, carrying in thy senses the morning and the evening and the unfathomable galaxy, in thy brain the geometry of the city of God, in thy heart the bower of love and the realms of right and wrong.

—Emerson.

Photograph from the U. S. Naval Observatory



The 26-inch Telescope of the United States Naval Observatory When Built, Was the Largest Refracting Telescope in the World. Soon After, One of Equal Size Was Built for the University of Virginia. Later These Were Surpassed in Size, First by the Lick 36-inch and then by the Yerkes 40-inch. With this Telescope the Moons of Mars Were Discovered at a Favorable Opposition in 1877 by the Elder Asaph Hall

Base camp of the expedition at the foot of Ansha Mountain

IN QUEST OF THE QUEEN OF SHEBA'S ANTELOPE

PART II

Continuation of the Adventures of the Expedition in Search of the Abyssinian Nyala —The Home of the Antelope Is Finally Located and Specimens are Obtained

By GERTRUDE SANFORD AND SIDNEY LEGENDRE

Photographs by Gertrude Sanford and T. Donald Carter

OUR way led through a forest of broad-spreading trees, with great branches on which grew crimson puff balls. Emerging from the forest, we crossed a green dale, and then once more the trees closed about us in all their beauty. We camped at the foot of Ansha Mountain and from there prepared to hunt the surrounding hills. It was on the heath-crowned summits above the timber line that we hoped to secure the nyala, for here they grazed from dawn until dusk, and then descended into the protecting foliage of the forest below.

Rising before dawn, we began the arduous climb. The blackness changed to a dull gray. Gradually objects became distinguishable. We sat down to rest on a rock at the very top of one of the mountains. Slowly the curtain of fog and mist lifted, and we saw before us a valley on the other side of which rose the highest peak of Ansha. Scouring the surrounding slopes with our field glasses, we were unable to distinguish anything. Seated as we were, above the timber line, we were surrounded by giant tree heath that reached to our chests. Between clumps of this there were cleared spaces, and to one of these our boy, Bahano, suddenly pointed.

With the naked eye it was impossible to see anything, but through our glasses a magnificent nyala could be discerned slowly ascending the opposite slope. He did not appear frightened and apparently had not seen us. A wild but cautious dash down our mountain, across the valley,

A STREAM BETWEEN CHICKA AND ANSHA MOUNTAINS
Much of the trail between these two mountains was through the open, subtropical forest. Its scattered trees and bright-colored flowers gave the country a parklike aspect

up the opposite slope, around the peak in order that he should not get our wind, and we crept forward, rifles ready for instant use.

Raising my head above a bowlder, I looked. Miss Sanford, who had gone farther around, did the same. He was gone. Absolutely spirited away. It was impossible to pick up his tracks in that tangle of heath, and though we searched diligently, he was not to be found. Subsequently that day we saw several cows, but as a vow had been made by all that no shot should be fired unless at a bull, we did not stop. Mr. Carter and Morris LeGendre, who had hunted different peaks, reported having seen cows but no bulls.

For three days our luck remained unchanged. We no longer slept at our camp, but each person selected a mountain on which he hunted and slept. In this way we felt sure that sooner or later we would run that bull to earth. It was our habit to meet at one person's cot each evening and report on the day's happenings. As a result of these meetings something happened that is amusing now but was tragic then. Sidney LeGendre and Mr. Carter had gone to Miss Sanford's peak for dinner. They delayed their departure until the sun had set and when they reached Sidney's peak and tried to find his bed, night had fallen, and with it the cold and mist of mountains 12,000 feet high. No trace of the blankets could be found; undoubtedly a nyala had wrapped himself in them and dozed off behind a rock! It was freezing, yet it was impossible for Sidney and Mr. Carter to find their way back. There was nothing to do but build a windbreak of heath, make a bed of the same material and draw up covers of heath. Those who have slept out of doors without cover when the thermometer is well below freezing, and a small gale runs down one's collar and out of one's shoes, will appreciate the situation.

The following evening Morris LeGendre shot a nyala bull and Miss Sanford secured two does. We hunted this range for several days, but without further success. A native told us of Kaka Mountain, where he said nyalas were to be found in greater numbers. This was not very difficult to believe, for after ten days' hard hunting we had secured only three.

Morris and Miss Sanford set out for Kaka with a tent and two natives, while Mr. Carter and Sidney returned to the main camp, Mr. Carter to prepare the skins and Sidney to doctor an infected hand. They had been there two days when the mule boy Gabra Walda arrived, panting and blowing, declaring that he had traveled until the very gazelles stopped to admire his speed. He brought no less news than that Morris had shot a nyala whose horns measured from horizon to horizon! We had fallen into the habit of admiring a fine lie and the boy received a drink of cognac as a prize.

However, Sidney and Mr. Carter made plans to join Miss Sanford and Morris at once.

There were no regrets on leaving, for Omar, the cook, had prepared concoctions which had not only the appearance of miracles, but tasted like the unknown. Only the evening before, the meat he had served made Sidney and Carter feel sure that some rare animal had come into the camp and fallen prey to his knife. Upon being questioned, he assured them it was goat that they were eating. Then the great secret came out.

"What did you cook it with?" they asked.

T. DONALD CARTER, MORRIS LEGENDRE, GERTRUDE SANFORD, AND SIDNEY LEGENDRE, WITH A NYALA BULL

This bull is destined to be the main feature of the Nyala Group in the new African Hall

ANSHA MOUNTAIN
The slopes of Ansha Mountain are forest clad up to an altitude of 9000 feet. Above this, tree heath is the most common form of vegetation

THE HEATH-COVERED SLOPES ON THE SUMMIT OF KAKA MOUNTAIN
It was in this type of country that nyalas were found. The animals spend the night on the forested slopes, but by morning they are in the open country

ABOVE TIMBER LINE
Each one of the four members of the party selected one of the four peaks as a bivouac in order to be on the summit at dawn to observe the nyala

CAMP ON KAKA MOUNTAIN
Camp was pitched in the tree heath, about a third of the way up the mountain-side. The summit of this mountain rises over 12,000 feet, and every morning ice was found in the water buckets

Back to his kitchen he went and emerged with a tin can. This he held forth for their admiring gaze. True, it was the same color as those containing "Wesson's Cooking Oil," but this one bore in great letters the word "Flytox." Moral—never leave two cans of the same color in an Abyssinian kitchen!

Early the next morning Carter and Sidney started for Kaka and after a day's trek, arrived with the salt and other essentials for preparing the nyala skin, which proved a fine large specimen, with horns measuring more than 40 inches. Now that we were in the right country, nyala followed nyala. Kaka was an easier mountain to climb. The slopes were not as precipitous as those of Ansha, and our camp, perched halfway up, saved a great deal of climbing. Morris LeGendre secured six bulls, Miss Sanford a bull and five cows and two fawns. Unfortunately, before we could get to the fawns to skin them they had been devoured by hyenas.

Mr. Carter and Sidney LeGendre each secured a bull, but without doubt, the most thrilling of all of the hunts was when the first big bull was shot. He was sighted a little after sunrise, and was followed all day, yet, although he was always kept in sight, he was never close enough for a shot. At sunset he seemed to disappear altogether. Suddenly, just as the party was about to return to camp defeated, he appeared silhouetted against the sky. The range was rather long and the light practically gone, but as it was their last chance, they decided to shoot. The first shot, a lucky one, dropped him in his tracks.

In one day Mr. Carter had six animals to skin out and care for. The natives helping him were practically useless.

THE HEAD OF A NYALA BULL

In general appearance the nyala reminds one of the greater kudu, and it was not until 1910 that it was described as a different animal. The natives still call them both "agarzin"

Doing very little, they nevertheless managed to do it carelessly, so that he was forced to go over everything they touched. Often he worked a day and night without stopping, and it is due to his untiring efforts and skill that we were able to bring back to the Museum the skin of every animal we shot.

THE POWER IN SIDAMO

Desjasmatch Beru is one of the most powerful of the Desjasmatches in southern Abyssinia. He is an ardent admirer of Napoleon Bonaparte, and his most cherished possession, upon which his hand rests, is a volume on the life of the distinguished soldier

The group was now complete. The skins were packed on the backs of the mules and we returned to our main camp at Chika. Our boys were only too delighted, for the food had given out long ago, and nyala meat, though delicious, becomes a bit tiresome as a steady diet. We considered it advisable to send the skins straight to Addis and from there ship them to the Museum immediately. To do this, it was necessaryto split our party. Sidney LeGendre took the skins, nineteen of the mules and eleven men to Addis, while the others continued on to Sidamo.

The division of our caravan was an occasion for many tears. The boys all wept on one another's shoulders and the half of the caravan continuing to Sidamo sent messages to their families by those returning to Addis. After one-half had kissed the other half good-bye and handshakings were finally terminated, Morris LeGendre, Carter, and Miss Sanford, with thirty-nine of the strongest mules and thirty of the best men, set off on the trail leading to the south, the Sidamo country.

They camped once more on the Anshà Mountain, not far from our old nyala camp, and in a bamboo forest on the slope of the neighboring mountain, Carter was able to collect half a dozen fine *Colobus* monkeys.

For the next two weeks they caravaned south, averaging about five to six hours' trek a day, which proved the most their underfed mules could do. Providing hay and finding good grazing was not always an easy task. Water was scarce and usually very bad. On many occasions, if it had not been for generous gifts of corn from friendly chiefs, the mules would have fared very badly.

CHIEF OF POLICE OF SODDU IN ROYAL UNIFORM
This costume, given to men of distinction by the King, consists of a scarlet jacket with a long blue velvet collar trimmed with gold braid. The headdress is made from the mane of a lion

The route took them off the high Arussi plateau down many thousand feet through a primeval forest into the valleys below. They crossed hot plains and deserts and climbed again into the mountains, often losing themselves and taking their caravan many miles off the route. It seemed that every time they relied on a native guide, they invariably ended at some spot well off the line. Later they discovered the reason. Whenever the expedition was in the vicinity of a market, the boys would bribe the guide to conduct it there, so that they could all drink tala, buy food, and stop work. The party soon caught on to the scheme and no longer employed a guide. They would study the map every evening and plan their route and, regardless of trails, cut straight across country on their own line, and almost always successfully.

Water was the one great difficulty, for though rivers were marked on the map, they very often proved a disappointment, for so many times they were dry when found.

As soon as tents were pitched and mules tethered in the center of the camp to secure their safety from shiftas and hyenas, the party would hunt. Carter secured many species of mice with his trap lines and Morris and Miss Sanford collected a dozen more blue-winged geese, obtained at the same altitude, 8000 feet. Aside from shooting meat for the camp, such as reed buck and oribi, no big game was collected for the Museum in the Sidamo country.

On reaching the capital at Sidamo, Agar Salaam, the party sent a note by their interpreter to the chief of this country, Desjasmatch Beru. They camped by a small stream just outside the town and before sundown rode to a Greek store in the village to replenish supplies of sugar, rice, coffee, and tobacco. Here they found two Greeks poring over a letter, and looking very excited. They were writing down words as they read. Miss Sanford recognized the letter as one the party had sent to the Desjasmatch earlier in the day, so she asked in French whether she could interpret the letter from English to French for them. As it turned out, it was a lucky thing they happened in when they did, for these unfortunate little Greeks had translated the note which said, "We are a hunting party representing the American Museum of Natural History, traveling with a scientist in the party."—to the effect that "We were a party of missionaries, traveling with a horse doctor."

As the Desjasmatch disliked missionaries, they would have been shown little hospitality. They hastened to make their character clear to these little Greeks, who were doing their best to act as interpreters for the Desjasmatch, who had none of his own.

That evening servants poured into camp with presents of bread and wine for the expedition, and grain for the tired mules, and his messenger brought an invitation to lunch with the Desjasmatch on the morrow.

A more gracious welcome one could not wish. The boys had washed their white tunics for the occasion and were spotlessly clean. Their shamas were thrown over one shoulder, a Springfield rifle over the other. They walked two abreast before and behind as the party marched through the main street of the town to lunch at the Gebbi. The King's mule and the two old white horses had been washed and scrubbed in the stream for hours, preparatory to this, but in spite of all efforts, these animals looked more like replicas of Don Quixote's old horse than anything else.

As the guests approached the Gebbi, the Desjasmatch's guard met them and escorted them through the portals and into the courtyard, where they dismounted. These soldiers were in ludicrous military array, some shouldered rifles on their right shoulder, some on their left. Some wore felt hats and some did not, but this escort was a gesture of courtesy. And for the rest of the day the guard never left the guests.

The Desjasmatch greeted the party on

ANOTHER PHOTOGRAPH OF THE CHIEF OF POLICE OF SODDU
When the expedition party broke the law by shooting after sundown, they found that they were able to appease the Chief of Police only by photographing him. After they had taken fourteen pictures of him, in almost as many costumes, he became friendly

THE POLICE FORCE OF SODDU
The Chief is here resplendent in the royal costume of the country. This was by far the most pretentious of his many uniforms

the steps of his round wooden palace and served them vermouth under a canopy of scarlet cloth which had been placed to the left of the entrance. They were then escorted into the building and into a very large room with a high ceiling, supported by many tall, red plush pillars. In the center of the room was a long table, laden with dishes, glasses, and all kinds of wine. The interpreter told them that the Desjasmatch apologized that he could not lunch with them, as it was his fast, but would join them for coffee. He hoped they would enjoy their meal, and added in French, *Bon appetit*, and left.

Carter, Morris, Miss Sanford, and a clever little Armenian, who was the Desjasmatch's right-hand man, were the guests at lunch, and as they ate the native dishes, the Armenian would explain what each one was made of and how it was cooked. To describe what they ate would be impossible, for they counted thirteen courses altogether, and at least six different kinds of wine. It is needless to say they felt ill when they left the Gebbi, for they had been literally forced to taste every dish, which in reality meant eating all of it, for each was delicious. Every kind of native sauce with its hot peppers was served, and even the servants would beg them to eat some more. They had tedge of the very finest brew and chicken cooked in some green native leaf which was a masterpiece. After sampling every type of Abyssinian dish, they all felt they had desperately overeaten.

The Desjasmatch Beru joined them for coffee and liqueurs and showed them books on the life of Napoleon, of whom he seemed very fond. They asked if they might take his photograph, and he was delighted and pleased to dress up in his royal robes of blue velvet and gold, with a great golden cross on his chest. He showed much interest in the expedition and seemed above all impressed that a woman should like to do that type of thing, particularly shooting. He always came back to the subject, it surprised him so much.

When it came time to say good-bye, the boys were nowhere to be found. They, too, had been royally wined and dined and evidently too much tala had taken its toll, for two of the boys were already in prison, due to their unruly behavior, and the others were too drunk to appear.

That evening more gifts were brought into camp from the Desjasmatch. A big fat bullock, several sheep, more injura bread, tedge and tala, and even a couple of Toto monkeys. Miss Sanford had expressed a wish for a monkey and now they arrived from all over, big ones and little ones, and baboons as well.

It was the custom to give a Marie Therese dollar for every gift brought into camp by a servant from the Gebbi. The consequence was that the little native boys of the village were collecting monkeys from the bamboo forest near by and bringing them into camp, making a dollar clear profit. The party eventually realized this and were satisfied not to increase their menagerie beyond three baboons, three Toto monkeys, and one reed buck doe. The doe was the first to be turned into a specimen, as she would not follow the caravan, but always became hopelessly entangled at the end of her rope when passing mules and natives. The baboons and monkeys went next, for they bit every one rather often and broke away so many times from the top of the mule packs to which they were tied, that stopping each time to catch them slowed up the caravan.

The route from Agar-Salaam to Soddu led across a vast desert, where little water was to be found and the days' marches had to be long ones, ten to twelve hours. The heat was terrific and one of the old white horses had to be shot, as it could no

CHIEF OF POLICE OF SODDU IN POLICE UNIFORM
A section of the Soddu police force which attempted to arrest the party for shooting after sundown

BUSHERA
Although at first hired as cook's helper, Bushera, by his willingness and cheerful disposition, was soon advanced to personal boy

longer continue. Camp was made along the Bolati River in the midst of a desert, shadeless, thorn-bush country, with the hope of securing new specimens, but only the usual animals prevailed, namely the oribi and reed buck.

Heat, dust, sand, volcanic rock, baths in muddy streams, bad drinking water,—this was the general program of the ten-day trek from the Sidamo country into Waloma country and eventually to Soddu, where Sidney Le Gendre joined the party. He had arrived from Addis with a fresh supply of vegetables and milk, which were very acceptable.

It was at Soddu that we ran afoul of one of the curious laws of the country. A hyena, which had been running the scales in a deep bass voice, suddenly gave up singing as a none too lucrative profession and entered our kitchen. Mr. Carter came to the rescue and shot the beast. In half an hour our camp was surrounded by soldiers, who stood with ready rifles prepared for the great attack. They remained there all night, probably, we thought, to protect us against future four-footed raiders. But such was not their purpose, for in the morning the Chief of Police appeared with another army behind his back. Whom had we killed? Had we buried our victim or simply eaten him? Carter produced the hyena skin and the army was recalled. Between cognacs his Majesty's representative told us that whenever any one fired a shot within the limits of a village, he must produce the thing killed, otherwise he was considered guilty of having killed a man and must forthwith be hanged. Moral: If you are a bad shot, keep a couple of old skins handy.

From our camp we could see Lake

HEILIE
Heilie originated from one of the more southern provinces and was undoubtedly brought to Addis Ababa as a slave

PRESENT ARMS!
After a little practice, our boys became quite expert in executing the "Manual of Arms"

Abaya in the distance. Only half a day's journey away, it should certainly prove worth our while, for we were told that its shores abounded with game. From a distance this lake is beautiful, but on closer inspection it is dreadful. The water is almost black, so filthy is it, and great rock cliffs from whose sides steam gushes, rise straight up out of this disgusting mixture. Behind the cliffs there is a valley, dry, arid, covered with thorn trees, and beyond is another ridge, lava-strewn, its slopes covered with tangled creepers and coarse grass.

At one end of the lake a great open space, half swamp, half pasture land, provides grazing for the native cattle. It was here, on a raised spot above the swamp, that we pitched our camp. The heat was beyond belief. It burned through our double fly, turned all food into a nauseating mess, and left us listless and limp. The mules, driven wild by the flies, daily grew thinner. At night the mosquitoes descended upon us in legions. Our nets were mere parade grounds on which they loosened their limbs before beginning their evening meal. And yet it was here on the shores of this infernal lake that we found more game than at any other place. Specimens were secured of reed buck, water buck, bushbuck, tora, kudu, wart hog, and several species of birds. Both Morris and Sidney LeGendre thought they saw Prince Ruspoli's turacou, *Turacus ruspolii*, a bird known only from the type specimen which was supposedly collected at this lake, but though we scoured the countryside for a week, we did not obtain one.

Our men and mules were faring so badly that we thought it wiser to return to our main camp at Soddu. The day after our arrival smallpox broke out in camp, and unfortunately the victim slept in the same tent as did our cook and dish-washer. Burning the tent and blankets, we shook the dust of Soddu from our feet and set

LAKE ABAYA

One night, while the expedition was encamped on the shore of this lake, known also as Lake Margureta, a large herd of hippopotami came into camp to graze along with the mules 174

DIFFICULTIES IN TRAVEL

In crossing the swamp at Lake Abaya the mules became bogged, and only after their loads had been removed and the tents spread for them to tread upon, was it possible to lead them across

CAMP AT LAKE ABAYA
One of the most interesting of the expedition camps. Daily, baboons were seen on the rocks above. A hot spring afforded excellent bathing

BOYS CLEANING GUNS
On account of the rains, it was necessary for the boys to spend all of their spare time cleaning the firearms

our faces toward the Omo River, intending to cross it and explore the Kaffa forest on the farther side and then gradually work our way out to the Barre River and thus down into the Nile.

At this time all of our men who had accompanied us to Lake Abaya were stricken with malaria. There is nothing more pitiful than an Abyssinian when he is ill. He is absolutely helpless and merely lies and moans. To make matters worse, the rains set in before their time, catching us in the Kambatta Mountains. The trails became slippery slides, which afforded no foothold for the mules. In many places it was necessary to dig fresh dirt from the side of the hill and strew it upon the path before they were able to continue. It was disappointing work. Each night we could look back and see where our previous camp had been. Our men were now completely exhausted. It was necessary to place the weakest ones upon our own mules. The trails became worse; in fact they were no longer trails, but mountain torrents through which one splashed, pushing and pulling the worn out animals.

The banks of the Omo are precipitous. It was necessary to descend 2000 feet, cross a river in flood, and then climb the opposite bank. Our men were tired, dispirited by the fever and the rains, the mules were giving out, the equipment was soaked, with never an opportunity to dry. We had secured the nyalas, the object of our expedition, besides many other specimens, so, after a brief consultation, we turned our horses' heads toward the north and started on the homeward trail.

CAMP ON THE HAWASH RIVER

Two days before reaching Addis Ababa, the expedition again pitched camp on the Hawash River, but this time a few miles farther to the west from the camp site of four months before

NEST AND EGGS
OF THE UPLAND PLOVER

THE UPLAND PLOVER

A Game Bird Once Common on the High, Dry Prairies of the Northern States, Which Seems to be Adapting Itself to Changed Conditions and Now Is Nesting in Cultivated Fields

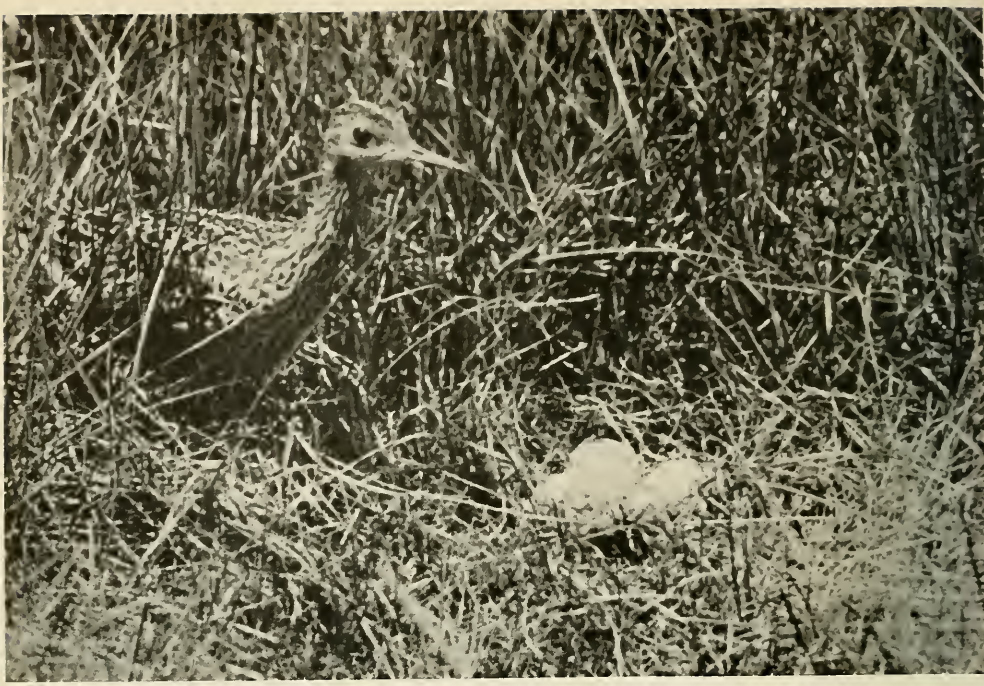
By ALFRED M. BAILEY
Director, Chicago Academy of Sciences

THE fall migration along the Louisiana Gulf Coast was under way, and many shore birds were congregated upon the mud flats of the marshes bordering the little oak ridge called Chenier au Tigre. One evening, after the sun had dropped below the horizon, we were plodding wearily through the loose sand of the beach, homeward bound; we had been hunting inland and were tired from continuous exertion, so, when we stumbled over a bit of driftwood, we stopped to rest.

A light on-shore wind rippled the waves of the Gulf against the sand, and the calls of sea birds came from across the open water. Great-bodied pelicans drifted near—vague masses in the blackness, and disappeared without a sound to tell of their passing, and sandpipers, running along the water's edge, suddenly realizing that they were within a few feet of us, took wing with startled cries. Many bird wayfarers, delayed on their feeding grounds, were on their way to their evening roosts, and there were many strange calls coming from the black void about. Suddenly, from high overhead in the starlit sky came a low trill which was repeated at intervals from other parts of the heavens. Then came other gentle, prolonged notes,—quiet, and yet far-carrying, and as the birds overhead passed on southward across the waters of the Gulf of Mexico, we heard additional voices now and then, as though the wayfarers were talking to those which had gone ahead,—and were guiding others following.

My companion was a native of the marshlands. When he heard the calls from above, he grasped my arm as though to keep me silent, and then he breathed—"Papabotte, papabotte."

It was my first acquaintance with the upland plover,—called "papabotte" by the inhabitants of the Louisiana lowlands; it was a rather unsatisfactory meeting,



THE UPLAND PLOVER APPROACHED HER NEST CAUTIOUSLY
For two hours she had circled about the blind, creeping slowly through the tangle of grass, with her large brown eyes constantly upon the photographic shelter

SHE LEFT THE PROTECTION OF THE LONG PRAIRIE GRASS
With neck outstretched, she walked so slowly that she seemed to be dragging heavy weights upon her feet. At last she turned directly toward the nest

THE PLOVER EYED THE BLIND

The bird stepped carefully over her eggs, and paused with her eye on the blind. She half crouched upon the nest, and then stood motionless for a full minute to satisfy herself that all was well

TURNING HER EGGS

Apparently oblivious to the whirring of the motion picture machine, the plover slowly thrust her beak downward among her eggs, and rolled them about to suit her fancy to be sure, except that I always remember that quiet evening when I think of birds starting on the mysterious air voyages of their seasonal migrations. My papabottes were blazing their air trail across the broad stretches of the Gulf to their wintering grounds in the vast Argentine savannahs, and I felt better acquainted with them—and more interested in them than in many species which I knew from daily observation.

Since that night along the Gulf Coast, I have always wished to meet the upland plover on its nesting ground and to photograph one upon her eggs. The upland plovers were once exceedingly common birds of the high, dry prairies of the northern states, from the Atlantic to the foothills of the Rockies. They were considered as excellent game birds, and were killed on their breeding grounds and in migration, so it is not strange that these fine "shore birds" should be near extinction. They are no longer found in many parts of their former range, and even where they do occur, they are not common. In the past few years, however, the plovers seem to be adapting themselves to changed conditions, and nest in cultivated fields when unbroken prairies are no longer available.

My first nest of the upland plover was found in northeastern South Dakota, near the little village of Waubay. The country is rolling and broken, with bowlder-strewn prairies, and these birds are still found in numbers. We were making motion films of the animal life of the region for the Chicago Academy of Sciences, and had obtained the help of the people of the vicinity. Mr. Arthur Lundquist of Webster was particularly well informed, and offered to show me a nest of my old friend, the "papabotte." It was a blustery day in June, with storm clouds scudding across the Dakota sky; the wind blew a gale and the weeds and grasses waved and rippled like the waters of the lake. We crossed the rolling prairies to the edge of Bitter Lake and flushed our bird from its nest. The three large eggs were upon the ground, and were so well concealed in the parched grass that one could not see them from a few feet away; in fact, even though we knew we were within a short distance, we could not see the plover until she took wing.

The blind was erected, but the wind was blowing such a gale that I feared the plover would never return to her nest; the canvas waved and thrashed about so that I had to stand on the edge to keep it in place. The motion-picture machine was focused on the nest, more as a matter of habit than with the expectation of the bird returning, and we concealed ourselves. From the slit in the blind I watched the sea of prairie growths, and imagined every little brown object was my intended subject. And then—three feet from the nest a rounded head appeared and large brown eyes stared unblinkingly. For five minutes the bird remained motionless while we waited anxiously. Then, as suddenly as the bird had appeared, she disappeared from sight. A few moments later she approached the nest. The camera whirred and the blind thrashed madly with loud, snapping sounds, but in spite of the noise, the plover crawled upon her eggs. She was the most satisfactory subject I have ever photographed, for she was on her nest within fifteen minutes of the time we concealed ourselves in our photographic tent.

Fortune favored me the following season, for another set was found within a mile of my home. The prairie country near Chicago is fast being subdivided, but the few remaining plovers seem to be adapting themselves, and this nest was within twenty feet of a cement walk and only one hundred yards away from a golf course. The four eggs were well concealed in the long prairie grass, but we carefully removed the vegetation from in front so that a clear view could be obtained. The nest was found on May 27, the set of four eggs being complete at that time. My experience with this plover was somewhat different from that with the Dakota bird. As she was so close to the sidewalk, and was accustomed to the passing cars, I expected she would break all records returning to her eggs. But not at all. My blind was erected at eight o'clock, and for two hours the old bird walked circles about me. She would stand motionless twenty feet away, eyeing the blind, and then suddenly disappear in the long grass. A few minutes later she would be on the other side, quietly looking things over. Then, occasionally, as though to vary the monotony, she would scold with a peculiar, rasping call; then she would take to wing and alight on a near-by telephone pole where, with upraised wings, she would utter her melodious, trilling call. It is a far-reaching, beautiful, characteristic note that is not to be mistaken for that of any other bird.

Time and patience are all that is required in bird photography, and I had the time, if not the patience. The plover finally settled to the ground and slowly approached the nest. She came from the thick grass with neck outstretched, walking so slowly she seemed to be dragging heavy weights upon her feet. Finally, she stood astride her eggs, still eyeing the blind, and, apparently satisfied that all was well, she turned her beak downward, inspected her eggs, and settled upon them.

The nest was under daily observation, for the period of incubation of this species had never been determined, and while I did not know how long the eggs had been in the nest at the time they were found, I felt it worth while to keep notes. Mr. A. C. Bent, in his *Life Histories of North American Birds*, states that the incubation period "is said to be seventeen days, but this needs confirmation."

The nest was visited every morning and evening from May 27 until the date of hatching, June 20. On the latter date I visited the nest in the morning, but not an egg was pipped; in the evening two eggs had hatched and two addled ones remained, but, although the anxious parents were flushed from the long prairie grass and their querulous calls showed that the young were near, I could not locate them. While I did not see these young, I believe there can be no doubt that the eggs were hatched, and so, it seems that the incubation period for this species is at least twenty-four days.

The prairies of South Dakota and suburban lots of western Chicago are a long way from the glistening waters of the Gulf of Mexico, but when I hear the "sweet, mellow, rolling trill" of the upland plover, I can close my eyes and visualize a dark, starlit night along the Gulf and the migrant hosts on their long trek southward across the unmarked skies.

She Settled Upon Her Eggs

The model of the whale shark, *Rhineodon typus*, in the American Museum

WHALE SHARK!

How a Specimen of the Greatest of Living Sharks, *Rhineodon typus*, Was Captured near Marathon, Florida, and How It Was Towed to Key West

By E. W. GUDGER

Bibliographer and Associate in Ichthyology, American Museum of Natural History

and L. L. MOWBRAY

Director, Bermuda Aquarium

The largest, the rarest, the most characteristically marked, the most interesting, and in many ways the least known of the Elasmobranch or strap-gilled fishes, is the whale shark, Rhineodon typus. First discovered in Table Bay, Cape of Good Hope, by Andrew Smith in 1828, it is found in tropical and sub-tropical waters the world around. We have records more or less definite of about sixty specimens, about one half of which records were made by scientific men with data sufficiently detailed to add to our knowledge of this little known monster.

Four of these specimens have been taken on the coast of southern Florida. The first, a young fish only 18 feet long, came ashore on Ormond Beach in 1902. It was described by Mr. B. A. Bean of the U. S. National Museum, where its skin and jaws are now preserved. The second was captured in 1912 at Knight's Key by Mr. Charles T. Brooks of Cleveland, Ohio, and Capt. Charles Thompson of Miami, Florida. This specimen was 38 feet long and 18 feet in girth. The capture of this fish was put on record in 1913 by Dr. E. W. Gudger, one of the authors of this article, and in 1915 he published (Zoologica, Scientific Contributions New York Zoological Society, Vol. I, pp. 349–389, 14 figs.) a monographic article describing in detail the capture and the external appearance of this huge fish, and summarizing all the data from all the then known descriptions and notices of the whale shark. This was followed in 1918 by another article, by the same writer (Science, Vol. 48, pp. 622–627) bringing together additional notes on habits and distribution.

The third Florida specimen (31 feet long) was taken by Dr. H. Schlegel and others on June 10, 1919, in the Bay of Florida, near Man-of-War Key, some eight miles southeast of Cape Sable. Both of the authors of this article were then in New York, but word of its capture was received too late for them to have reached Florida City, where it was beached, in time to have saved any of the soft parts. The skin, however, was removed, and an effort was made by Mr. Arthur D. Lord to purchase it for presentation to the American Museum. A prohibitive price was set upon it, however, so this was not done. This skin has since gone to pieces.

The fourth Florida Rhineodon was taken early in June, 1923, near Marathon, 16 miles below Long Key, by Mr. Claude Nolan of Jacksonville, who was cruising in the Keys on a fishing trip with a party of friends in a houseboat, under the guidance of Capt. Newton Knowles of Miami, and it was examined by L. L. Mowbray for the American Museum. It is with this specimen that this article deals.—The Editors.

ABOUT 10 o'clock on the morning of Saturday, June 9, 1923, while off Marathon, Florida, a party of anglers, of whom Mr. Claude Nolan was one, spied at the surface of the water about half a mile away a large object which looked like an overturned boat or some large piece of floating wreckage. Proceeding toward it, they presently saw that it was a gigantic fish. Cautiously approaching still nearer, the party found it to be a huge shark of the same kind as that caught eleven years previously in the same general locality by Mr. C. T. Brooks and Capt. Charles Thompson. After some discussion they decided to try to capture the monster.

The shark, being beautifully marked with vertical yellow bars separating vertical rows of yellow spots, was easily followed in the clear water, and the boat was able to approach the whale shark near enough for Captain Knowles to throw two harpoons into it. Pricked by these, the giant fish, which apparently had been asleep, awoke and lashed the waters into foam, causing the boat to sheer off hastily out of reach of its waving pectoral fins and the threshing of the great tail, which later was found to measure 12 feet in vertical spread. However, the harpoons held in the two-inch-thick hide and the fish had no chance to get away save by taking the boat with it. This it made little attempt to do, since both it and the boat were in a lagoon-like basin of water, shallow on the edges but deeper in the center. Here the fish, if not actually aground frequently, was at all times so hampered by the shallow water as to be unable effectually to exert its great strength. Some sixty shots from a 30–30 rifle were then fired into the region of the backbone, especially in the caudal section, in an endeavor to reach the spinal cord and thus paralyze the tail, the only weapon of offense and defense of this greatest of all sharks. Unlike other sharks which have both large and sharp teeth, the teeth of the whale shark are minute in comparison with its huge size for they are only about one-eighth of an inch long.

The whale shark was then attacked with lance thrusts in the gill region, which caused great loss of blood. Weakened by this bleeding, it was finally secured by a heavy line around the "small" of the tail, and then the anglers, who had at their disposal a power houseboat and two smaller craft, began the weary task of towing the giant to the wharf at Long Key. For some time they made progress, but presently the huge fish began to surge and to thresh around with his huge pectorals, and when he did so the three boats stopped as though they had gone aground on a sand bank. Finally, about midnight, Long Key was reached, the great shark was tied up to the dock, and the weary captors sought rest and repose.

FROM A SUBMARINE MOVING PICTURE FILM
A "frame" showing the spots on the rear of the whale shark's head in the gill-slit region on the base of the pectoral fin and the anterior part of the body. Courtesy of Mr. Mack Sennett

While this fish, like all the other specimens of *Rhineodon* taken in Florida waters, did not offer the resistance that might be expected from such a huge shark, still it manifested great vitality when it "came to" and made desperate efforts to break away. At three o'clock on the night of its reaching Long Key it went into a flurry which threatened to tear down the dock. Next day a number of persons were standing on the supposedly nearly dead fish, when it revived and precipitated them into the water. Several narrowly escaped being struck by waving fins. About noon on this day, Captain Knowles was swimming near the fish, when it again began to thresh about. He was struck by the waving lobes of the tail and knocked almost senseless. Had the rope around the tail not held, his life would almost surely have been sacrificed.

Finally, on the afternoon of Monday, June 11, the great fish went into a final flurry and died about 54 hours after being harpooned. He was then grounded in 7½ feet of water, but even though submerged, he was so heavy that five men tailing on a rope could not raise his head to the surface.

Early on the day after the capture of the fish, the Miami morning paper announced in streamer headlines the capture

ALONGSIDE THE DOCK AT LONG KEY, FLORIDA
Sitting on the back of the whale shark is Capt. Newton Knowles. He is thrusting a finger into a bullet hole

of the "Huge Monster," and Mr. Mowbray, who had arrived in Miami only the day before, took the first train for Long Key, where, from previous acquaintance with Thompson's mounted specimen and with Doctor Gudger's articles on the fish, he at once identified it as the whale shark, *Rhineodon typus.*

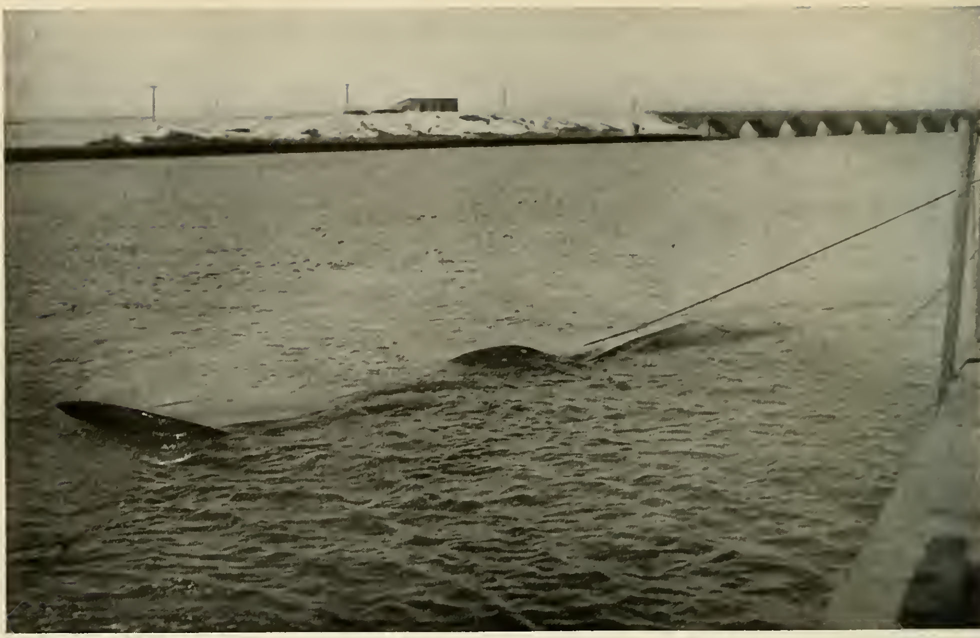
Seeing the opportunity of procuring a most valuable specimen for the American Museum, Mowbray approached Mr. Nolan on the subject, representing to him the value to science of presenting this rare fish to an institution where it would be adequately prepared and displayed to the public. Mr. Nolan with great generosity and without a moment's hesitation made the offer and Mowbray wired the Museum. The message arrived on Sunday, but since the offices of the Museum were closed and everybody away, no action could be taken until Monday. Doctor Gudger was on vacation and none other of the ichthyological staff was available, but Frederick Limekiller, of the department of preparation in the Museum, left on the first train to help Mowbray handle the specimen. However, while waiting word from the Museum, Mowbray utilized the time in making a sketch, a set of measurements, and a description of the giant fish, and in securing photographs both still and motion —a number of which are reproduced as illustrations of this article.

This fish measured 31 feet 5 inches in total length, was 17 feet 6 inches in circumference over the first gill slit, and in greatest girth (just back of the pectoral or breast fins) measured 23 feet. Unfortunately, since the fish was at best merely awash at the surface of the water, it was impossible to get a broadside photograph showing how very large it was. However, it is interesting to note that the upper lobe of the tail fin which is above water is longer than a tall man. Veritably the whale shark is a "whale" in size.

The cavernous mouth was 3 feet 8 inches straight across from corner to corner. The distance across the head from eye to eye measured along the curve was 5 feet 3 inches. From the tip of the snout to the front edge of the first dorsal fin was 14 feet 6 inches, and to the front edge of the second dorsal 21 feet 5 inches, to the base of the caudal fin 25 feet 9 inches. The upper lobe of the tail was 7 feet long, the lower 5 feet 7 inches, and the vertical spread or reach was 12 feet—twice the height of a tall man. Comparison of the pictures on pages 186 and 188 with that of the mounted fish will help make clear its great size.

Because of its remarkable vitality, it was at first thought that the fish would live until the preparator could arrive from New York, and that it would be possible when it died to beach it at Long Key, to make plaster casts of it by sections, and to skin and dissect it on the beach. All this was proposed by wire. But the fish died, and as the rise and fall of the tide was only about a foot, and as there were not men and apparatus at hand to get it up on the beach, Mowbray wired the recommendation that it be towed to Key West and there hauled out on the marine railway for dissection and study. This was authorized by wire and he went at once to Key West to make the necessary arrangements. Here Curry and Company very generously offered the use of their tug and shipways at cost, and on Tuesday, June 12, at 3 P.M. the tug

TOWING THE WHALE SHARK TO LONG KEY
Two arches of the Overseas Section of the Florida East Coast Railway show in the background



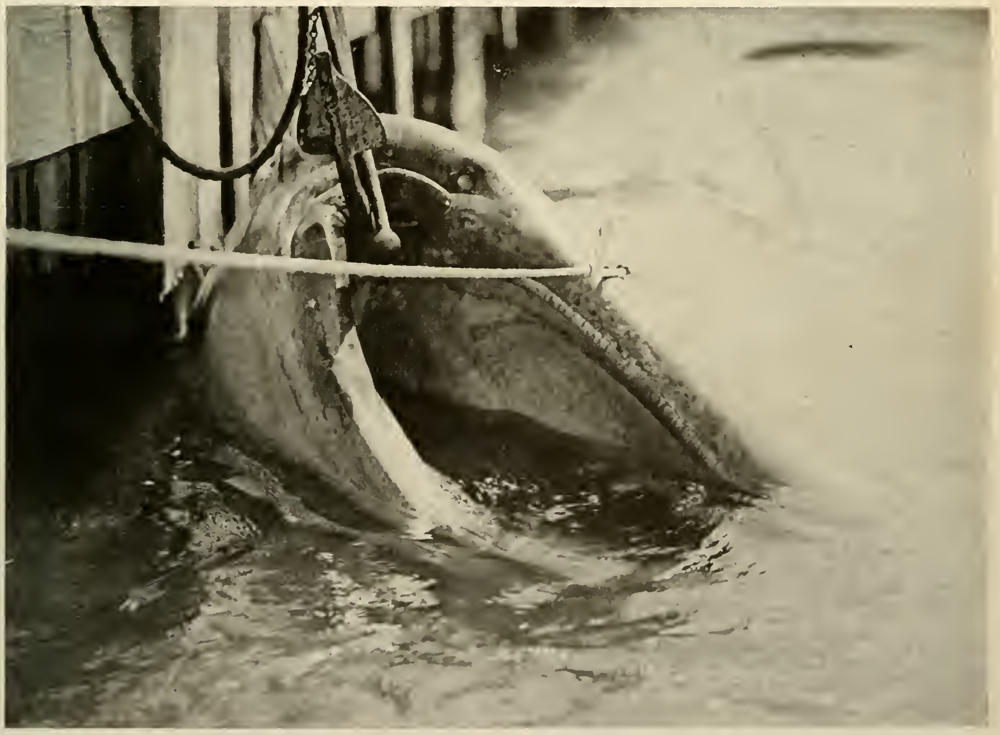
MORE THAN THIRTY FEET OF WHALE SHARK

This picture is intended to give an idea of the great length (31 ft. 5 in.) of the whale shark which is moored to the dock at Long Key.

THE BIG FISH SUDDENLY "COMES TO"

The whale shark, though tied to the dock at Long Key, went into a flurry which nearly cost Captain Knowles his life. The twelve-foot tail is lashing the water into foam

THE GREAT SHARK TIED TO THE DOCK AT LONG KEY
Note the first and second dorsal fins and the upper lobe of the caudal fin. The height of this latter equals that of a tall man



THE CAVERNOUS MOUTH OF THE WHALE SHARK
With the aid of a reading-glass, one can see the tooth bands with the teeth set in rows like those of the old fashioned "cards" used long ago for "carding" wool and cotton

1. 7

THE WHALE SHARK TURNED ON ITS SIDE
Note the great length of the fish and of the huge pectoral fin, which is nearly as long as the man holding it is tall

left Key West, arriving at Long Key at daylight the following morning.

An interesting natural history observation may here be noted. While the shark was tied to the dock at Long Key, Mowbray, in climbing over and swimming around it, noticed a foot-long brown sucking-fish (*Remora*) swimming in and out of the mouth of the big fish. This confirms what has elsewhere been recorded for a number of captured Rhineodons. Sucking-fishes are also found in the mouths of whales and in the mouths and gill cavities of other sharks, and also of rays and large bony fishes. Mowbray found that this sucking-fish (one of the brown forms, not the striped one) stayed with the big fish until the towing began, and possibly longer—such being its behavior toward the shark, its host.

As has often been proved by hard experience, towing a large shark behind a boat is no child's play but generally such a fish tows best when lashed head to stern of the boat. And so the whale shark was tied up when the tug (a gasoline driven boat) started from Long Key, at 8 A.M. Wednesday, June 13, on the long journey to Key West. The fish was held in a "bridle" made by looping heavy ropes around the bases of the pectoral fins, connecting these into a harness by circumferential lashings around neck, head, and snout, and then extending the heavy side lines forward to the two rear bitts of the tug.

Thus geared up, the boat started from the pier for the channel. However, the great shark was so broad in the head and pectoral region, so thin at the snout, and lay so heavily in the water forward, while at the same time it was so thin, light, and high-floating in the caudal region, that, caught in the wake of the propeller, it turned on its side and grounded its pectoral fin on the bottom. Then each time the boat tried to go ahead she sheered sharply about and turned almost completely around. This sheering was so violent that the heavy wheel ropes broke twice.

Consequently the shark was cast off at the head and made fast by the tail. This made it somewhat easier to steer, but the shark was still an unwieldy tow, for the caudal fin flapped from side to side, and the great pectorals caught the current made by the propeller, with the result that the fish rolled over. Again, when both pectorals, caught simultaneously in the wake of the propeller, would flare out "wing and wing," they would act like the "drogue" which whalemen attach to a harpoon line to retard the flight of a whale. With this strain, the tug would be brought up "all standing" as if she had gone aground. Under these circumstances, about the best she could do was to make three or four miles per hour.

About 3 P.M. that day, while abreast Key Vaca, the coast guard launch "Cossack," in charge of Lieutenant Brown, hove in sight and came up. Key West seemed far away to the tug with her slow-going tow and, on request, Lieutenant Brown very kindly took a line aboard and helped bring the *Rhineodon* to Key West. Here it was tied up to Curry's dock about 4:30 A.M., Thursday, June 14, about twenty hours after leaving Long Key and about forty-eight hours after its death.

An unprecedented spell of hot weather had come on. At Long Key the temperature of the water was high, and with every mile to the south it grew warmer, until in the harbor at Key West a thermometer suspended in the water stood

THE WHALE SHARK WITH VENTRAL SURFACE UPPERMOST
Captain Knowles is holding on to one pectoral fin. Note the great width between the tips of the pectorals

HARNESSING THE GIANT

Note the checkerboard arrangement of spots and bars. The longitudinal divisions are produced by the three keels which run from front to back, as may be seen in the picture on page 182

at the record-breaking figure of 91.4° F. This meant that the interior of the giant shark was simply an enormous incubator for putrefactive bacteria. With every mile of southing the fish grew "gamier" and "gamier," with blood and with products of putrefaction escaping from the vent. This of course attracted the sharks (which hunt by smell) and these attacked the *Rhineodon* ferociously. At Key Vaca a great band of voracious tiger or leopard sharks (*Galeocerdo tigrinus*), some of them 12 to 14 feet long, struck in and mauled the big fish badly. As many as eight or ten could be seen at one time on the submerged back of the whale shark, struggling to tear off huge bites of the flesh or fighting among themselves like ravenous wolves. However, the skin on the back was so thick and so tightly drawn that they had to confine themselves largely to the thinner and slacker skin over the abdomen. This they tore open and then devoured most of the visceral organs. They also mauled the fins badly.

As noted above, the boats and their unwieldy tow reached Key West about 4:30 A.M., Thursday, June 14, and the great shark was tied up alongside Curry's dock. But here fresh difficulties and disappointments arose. All the ship railways but one were now occupied, and this one was out of order. So there was nothing to do but wait for this to be repaired and strengthened, and for a flooring to be put on one of the cars to hold the *Rhineodon* while it was being hauled out. Furthermore, it was necessary to wait for the coming of Limekiller, the skilled preparator, who, by stopping off at Miami for orders, missed a train and only got into Key West at 6 P.M., Thursday, June 14. This, however, ultimately made no difference, since all hands had to wait for repairs to the shipways.

These repairs were finally finished and the huge fish was hauled out about 6 P.M., Friday, June 15. However, once out of water, the whale shark flattened

TOWING *RHINEODON* TO KEY WEST

Caught in the wake of the propeller, the great shark turned on its side, ground one pectoral fin, and brought the boat up "all standing"

ATTACKED BY THE "WOLVES OF THE SEA"
The whale shark turned on its side as it was being towed behind the tug. A tiger shark, *Galeocerdo tigrinus*, is shown tearing at one of the fins

down into a shapeless mass. This always occurs to a certain extent when sharks are taken out of water, since they do not have the bony vertebral column and ribs nor the scales which in higher fishes give the body permanence of form. However, the flattening in this case was extreme, by reason of the fact that the long continued putrefaction had thoroughly broken down the muscular and other tissues. It was now found that the skin was too far gone to be saved even if it could have been loosened from the foul-smelling body. Much of the shagreen had come off in sheets and had floated away. The tooth bands, loosened by putrefaction and by sharks biting at the lips, were hanging in patches—most of them being gone. The fins had been badly torn and were partly separated from the body, the abdomen had been torn open and the internal organs almost entirely devoured by sharks. Finally, the flesh was beginning to slip from the cartilaginous skeleton.

The odor from this huge mass of decaying flesh was such that work on the fish was almost impossible, yet Mowbray and Limekiller continued their efforts by electric light to save the hard parts of the fish, until, worn out, they quit work at 2 A.M., on Saturday, June 16. Operations, however, were resumed shortly after daylight. Under normal conditions the dissection of the internal organs of a 32-foot shark having a body cavity 10 feet long would be formidable, but when the whole body is far gone in putrefaction, the task becomes truly Augean.

On this day, despite the odor, people crowded around by hundreds, and because of it complained loudly to the authorities. Finally, having saved everything not too far gone in decomposition, and all that was allowed by the limited means at hand in Key West for preservation, Mowbray had the remainder of the carcass towed out in the stream and allowed it to float away with the tide. This was on Saturday morning, June 16, one week after its capture and four and one-half days after the fish died.

However, a considerable number of the harder parts of the skeleton were preserved—the jaw bones, part of the gill arch apparatus, the posterior part of the skull, and several sections of vertebræ, together with fragments of the tooth band and pieces of skin. These have been worked up by Dr. E. Grace White, professor of biology in Wilson College, Chambersburg, Pennsylvania, and her paper is now in press.

An interesting aftermath to this story is that about June 20, 1924, Mowbray got from some fishermen, employed by the Ocean Leather Company in catching sharks at Big Pine Key, Florida, a horny end piece of one of the vertebral segments of a whale shark. This, they said, had been taken from the stomach of a tiger shark caught there ten days before. It is highly probable that this piece came from the whale shark taken in that vicinity the year before, since these horny structures are not digestible by the acid stomach juices of even a shark.

Such, then, is the story of the capture, the towing for eighty miles, the dissection, and the attempted preservation of the skin of the largest of the sharks. The latter part is truly a hard luck story. Had there been men and means at hand for beaching the fish at Long Key, for making plaster casts by sections, for skinning the fish, and finally for preserving the skin and hard parts, the American Museum might today have the mounted skin.

However, the Museum has the carefully made measurements and an extensive series of photographs, both stills and movies, all of which have been filed away. From these and from photographs and drawings of all known specimens mounted or in the flesh, the department of preparation of the American Museum has made a model on a scale of one to five, which is believed to be the most accurate representation in existence of this great shark. This is now on display in the Hall of Fishes at the American Museum, where, as the greatest of living sharks, it attracts much attention from visitors.

HAULED OUT ON THE MARINE RAILWAY AT KEY WEST
The flattened condition of the body of the whale shark is due to the absence of ribs and other bony parts, and to the softening of the muscular tissues by putrefactive bacteria

KING ALBERT INAUGURATES THE PARC NATIONAL ALBERT

Five Hundred Thousand Acres Set Apart as a Sanctuary for the Preservation of African Wild Life, to Which Scientists from All Over the World May Come for Biological Study

By MARY L. JOBE AKELEY

During King Albert's journey through the National Parks of the United States in 1919, His Majesty recognized at once that similar Belgian parks should be located, not in the densely populated areas of the mother country but in the vast wilderness of the Belgian Congo. His act in creating the Parc National Albert points to that long-hoped-for internationalism in conservation and in science and to a widening interest in protection throughout all Africa.—The Editors.

ONCE in a long while, a vision is quickly translated into reality. More frequently the patience and loving labor of years is necessary to make the dream come true. When the final organization of the Parc National Albert occurred, eight years had passed—almost to the day—since Carl Akeley had conceived of a great wild-life sanctuary in the Belgian Congo. Africa's first national park was created by Royal Decree in 1925, and now, in 1929, increased tenfold in area, it was provided with a working machine.

On the morning of October 19 last, the golden sunlight was flooding the *Palais des Academies* where an assembly of one hundred scientists, diplomats, government ministers, and lawmakers stood awaiting the entrance of His Majesty, Albert, King of the Belgians, who was to deliver the address formally installing the *Commission du Parc National Albert*. This committee of eighteen scientists had been nominated in August. It was composed not only of Belgians but of representatives of England, France, Sweden, the Netherlands, and the United States. I deeply valued the invitation of the President of the Commission, Prince Eugene de Ligne, to be present at this ceremony. During the three years since my husband had made the supreme sacrifice in the spot he loved best in all Africa—the Gorilla Sanctuary of the Kivu—my concern for the outcome of his vision had been no less than his. That the King in his graciousness should tell me personally of his appreciation of my husband's effort, and that he should pay tribute to his achievement in the royal address was an honor that touched me profoundly.

King Albert outlined briefly the objects which he had in view in creating this reserve for various branches of scientific research. After referring to the great national parks he had seen in the United States and the useful work accomplished in that line in other countries, His Majesty pointed out the constantly growing tendency to preserve fields for scientific study, and said, in part:

> The Parc National Albert is really unique in the world on account of the infinite variety of its flora and fauna arising from its geographical situation and on account of its geological formation and the great diversity of its altitudes, which vary from three thousand to fifteen thousand feet in different parts of the area. I am convinced that, in time, it will prove of inestimable value to scientists and to all who love nature and are interested in it.
>
> Within the limits of the Parc which, without considering its surrounding protective zones, comprise five hundred thousand acres, are found species of the vegetable kingdom indigenous to

Photograph by Times Wide World

HIS MAJESTY, ALBERT, KING OF THE BELGIANS

Lover of nature and friend of the wilds, he has created a corporate body in the Kivu and in the mandated territory of Ruanda-Urundi for preservation of fauna and flora and for strictly scientific purposes the marshy tropical regions; there are also arid tropical forests and humid tropical forests and forests of both temperate and cold subtropical regions. Upon the high summits of the volcanoes one reaches the treeless alpine zone.

From the zoological point of view, the northern sector of the Parc includes species of East African fauna which differ greatly from those found in other parts of the Belgian Congo. On the other hand, the chain of volcanoes is inhabited by species peculiar to high mountains and also by a mixture of animals which have migrated from the East and from the West.

From the point of view of geology and mineralogy, the aspect of the region is not less varied. Furthermore, from the point of view of ethnography the district is remarkable on account of the simultaneous presence of Bantu and Hamitic elements as well as Pygmies. These latter represent the most primitive race in Africa.

It will be seen, from what I have just said, that no other region of the African continent offers such wide opportunity for scientific study and for the installation of scientific research stations which would be easily accessible and in a climate almost ideal for the white race.

I cannot omit recalling to mind the great part in the conception of the Parc National that is due to Carl Akeley, the distinguished American naturalist and conservationist, whose loss we deplore. He gave his life there while engaged in the task to which he had devoted himself, but his work has been carried on and completed through the brave efforts of Mrs. Akeley and the zeal of our compatriot, Doctor Derscheid, who, in carrying out the plan of the reserve, exhibited an activity, a devotion, and an ability which I cannot sufficiently praise.

I thank the members of the Commission which we have installed today for the valued collaboration which they have been kind enough to give to this work, and I wish especially to express appreciation to the foreign members who have graciously responded to our appeal. Their participation in the work of the Commission gives it that *international character* which in these days should mark every scientific enterprise. A large field of study is, henceforth, open in our Colony to geologists, biologists, ethnographers, and scientists of *all nations*.

In our day there is much zeal, and rightly so, for the preservation of the monuments left us by the Past. Here, in the Belgian Congo, you have also a monument to conserve—a monument raised by Nature during the course of thousands of years, and which has been handed down to us in the form in which it has been fashioned by the hand of Time from the earliest Ages of the world even to our own day.

There stands before you a great work to be achieved. In opening up and maintaining this exceptionally interesting region for the benefit of scientific research, Belgium will add a new contribution to the progress and application of Science.

Thus Albert, King of the Belgians, conservationist, lover of all the wild beauties of nature, compassionate and far-seeing, by his wise and generous action has created for the scientists of the world a remarkable opportunity for research—an opportunity for investigation among the extinct volcanoes where great mammals roam at will through age-old forests even to the rim of lifeless craters veiled in shifting clouds or scintillating with freshly fallen snow; where flocks of strangely brilliant birds dart to and fro—whose songs break the silence of the wilderness; where strange, naked little men—the pygmies—dwell in nest-like homes of sticks and grass; where subterranean fires have broken bounds, torch-lighting the heavens by day and night; where many hippo laze in sloth in tepid tropic rivers; where herds of antelope find pasture in a land unfit for wheel or furrow; where one of the few rare places of earth is free from man's economic need with its consequent urge to destroy or convert the gifts of nature.

That scientists will appreciate this international privilege—this rare gift to them—we are confident, since the age-old secrets of this wonderland are only waiting to be revealed, and man's investigative spirit is today increasingly and startlingly alive.

KARAMOJO

ONE OF AFRICA'S ODD CORNERS

An Area Inhabited by a Primitive Tribe as yet Unaffected by White Man's Customs and Ideas

By GEORGE F. SHEARWOOD
Captain, Royal Army Reserve of Officers

With Five Drawings by A. A. Jansson

THOUGH Africa, thanks to the work of Livingstone and Stanley and their successors, has to a large degree ceased to be the "Dark Continent," there remain many sections about which little or nothing is known. These are odd corners, perhaps, well off the beaten and over-exploited tracks, but all possess peculiarities of their own, and there is a queer satisfaction to be obtained from delving into them which is sufficient reward for the curious. One of these "bits left over" is the land of the Karamojo, a border strip of the British protectorate of Uganda, and a country which can very justly be tagged with that somewhat grandiloquent British label, "an outpost of Empire."

To convey an idea of the location of this practically unknown district it is easiest to take the Victoria Nyanza, the largest of the African backbone of great lakes, as the jumping-off place. Leaving Jinja, the port at the northern end of the lake where the waters of Victoria tumble over the Ripon Falls to form the source of the River Nile, the journey commences by train to Namasagale, about sixty miles distant and the first point at which the Nile becomes navigable. From there the familiar flat-bottomed tropical river steamer chugs slowly along the river, with its interminable vista of papyrus swamp, and turns eastward into Lake Kioga which is in effect nothing more than a swampy bulge in the right side of the river. Disembarking at the far eastern end of Kioga, a road, and a good one for this part of Africa, leads about sixteen miles still farther to the east to Soroti, the government headquarters of the Buteso district. Soroti boasts a District Commissioner's office, small hospital and police post and a few Indian "dukas" (stores). Its white population probably at no time exceeds six or seven people, but, at that, it is the last place at which it is possible to replenish food supplies and in which the amenities of more or less civilized life can be enjoyed before taking off for the last stage of the journey, a strenuous safari of seven or eight days over country for the most part devoid of roads of any sort.

Practically due east lies Karamojo, and after the safari leaves the Buteso district it treks for two full hard days across open plain entirely uninhabited by human beings. North of the safari's line of march lies Lake Kirkpatrick, named for an early adventuring pioneer. This section of the country is a sort of No Man's Land dividing the Buteso from the Karamojo, and while harboring some game, is, on the whole, pretty desolate. The welcome end of the safari is Moroto, a post established at the base of Mount Moroto and the only passably livable spot in the whole of Karamojo. Moroto, incidentally, is on the road over the Uganda boundary into the Turkana district of Kenya Colony and on eventually to Lake Rudolf.

Karamojo is situated at the extreme

A CHIEF OF THE KARAMOJA

He is wearing a headdress of ostrich feathers and, just below the knees, strings of iron cow bells. The shield he carries is made of hide

THE LAND OF THE KARAMOJA

The area of Karamojo, which is roughly twelve thousand square miles, is indicated by the black circle on this map of Africa

northeast corner of Uganda, its boundaries being, on the north, the southern border of the Soudan, on the east the great escarpment which forms the wall of the Rift Valley and at this place divides Kenya from Uganda, on the south the Turkwel River with the southwestern corner marked by the majestic bulk of Mount Elgon, the fourteen-thousand-foot extinct volcanic peak seen in the distance by everyone who has traveled the Uganda Railway to its terminal at Kisumu. The Turkwel also marks a part of the Kenya-Uganda boundary line, though curiously the small village of Kacheliba on the Karamojo and Uganda side of the river was in the writer's time, and probably still is, the headquarters of the officer administering the Suk country of Kenya Colony. To the west of Karamojo lies the Buteso district already mentioned, and north of it the Acholi country of which Kitgum is the headquarters.

The area of Karamojo is roughly twelve thousand square miles, about a three-hundred-mile long strip of country perched on the edge of a three-thousand-foot escarpment, the southern part of it being mainly plain and thorn bush, with occasional high points like Moroto and Mount Debastien and plenty of evidence of past volcanic activity in the shape of huge bowlders and stones left strewn about where such things were obviously never meant to be. Rather more than a third of the district at its northern end remains thick wild jungle, almost impenetrable and practically impossible to supervise. The Karamoja proper do not inhabit more than the fringe of this part of the country, but out of it come occasional raiding parties of the wild Donyiro and Marille tribes from the Soudan, and sometimes the dreaded Havash—as the Abyssinians are called—from southern Abyssinia, which is little more that the proverbial stone's-throw away to the northeast.

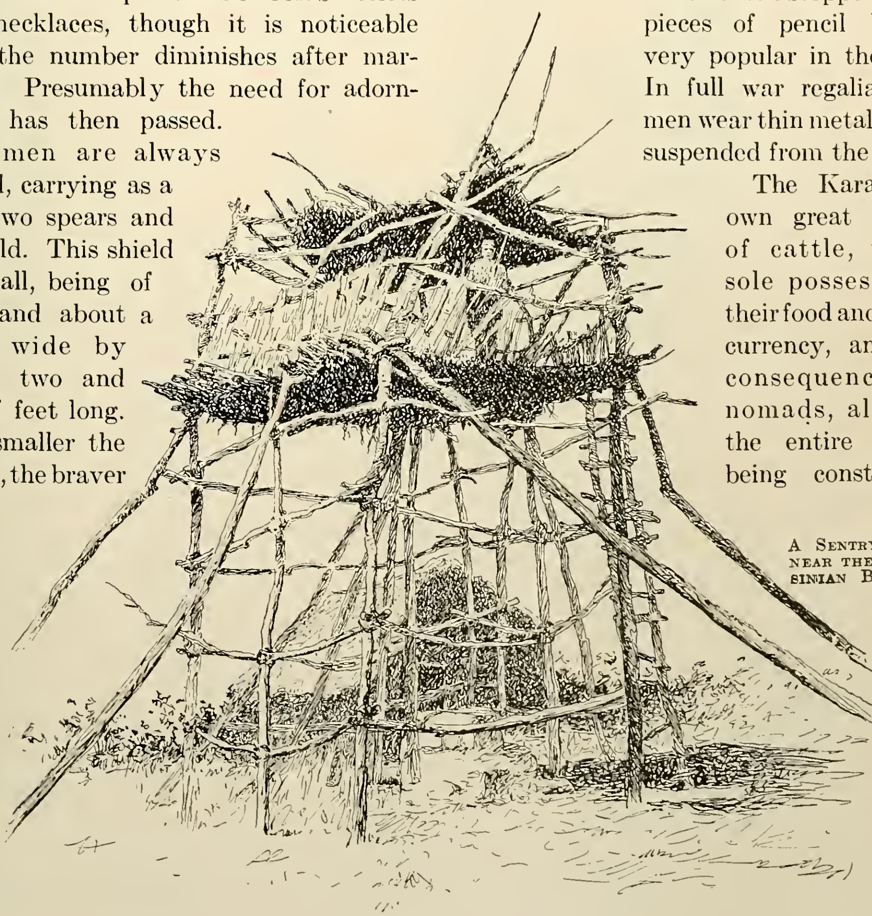
Karamojo is on the road to nowhere in particular and probably can never be of any real value, but it forms a buffer between the wild and the lawless tribes of the north and the more peaceful and settled countries of the south and west. Its people need protection from outside aggression, as well as whatever help the white man can give to a tribe whose principal need in life is rain in the dry season.

The Karamoja are Hamitic and in general appearance and physique closely resemble their neighbors, the Turkana, and the famed Masai, though they do not possess in anything like the same degree the extreme warlike characteristics of the latter. They are tall and slim, with long heads and thin nostrils and lips, and are almost dead-black in color. Active and brave enough when occasion demands, they are not a particularly martial tribe, probably because their country, being high and comparatively arid, has not been, so far as is known, the scene of serious invasion. The raids from the north have been generally inspired by the desire for ivory, and the capture of cattle and girls from the Karamoja has been rather in the nature of a side-show for the raiders, though serious enough for the victims.

The tribe is primitive in the extreme. The only article of dress—if such it can be called—worn by the men is a skin hung from the shoulders and reaching down the back to about the middle, while the women wear a skin of about the same size hung from the waist,—much like an apron worn behind instead of in front of the body. Sometimes the women wear two or three skins in this fashion, but with both sexes the skins so worn are less articles of clothing than protection from the cold of the night and from rain. It is merely a convenient method of carrying the blanket!

Women wear quantities of iron bracelets and necklaces, though it is noticeable that the number diminishes after marriage. Presumably the need for adornment has then passed. The men are always armed, carrying as a rule two spears and a shield. This shield is small, being of hide and about a foot wide by about two and a half feet long. The smaller the shield, the braver the race. For instance, the Kavirondo, who live beyond Elgon, in war array carry enormous shields, and are painted and feathered into the most grotesque and fearsome creatures, but in battle cannot compare in courage with the Masai or Karamoja. The Karamoja, in common with most Africans, don war-paint, smearing their bodies with whitish and reddish clay, and wear a headdress of ostrich feathers, and, just below the knees, strings of iron cow bells. Auxiliary weapons consist of a bracelet with a circular knife edge, and finger-rings with hooks an inch or more long used for the pleasant purpose of gouging out an enemy's eyes or tearing any other handy part of the anatomy. The ears and lower lips of both sexes are pierced to hold ornaments,—Worcester Sauce bottle stoppers and pieces of pencil being very popular in the lip. In full war regalia the men wear thin metal discs suspended from the nose.

The Karamoja own great herds of cattle, their sole possession, their food and only currency, and in consequence are nomads, almost the entire tribe being constantly



A Sentry Post near the Abyssinian Border on the move in search of grazing land and water. In the rainy season there are many roaring rivers, but in the dry season it is common to see holes dug in the river beds to a depth of twelve feet and more before water is reached. This nomadic form of life is mainly responsible for the clan form of government practiced, and there is no paramount chief of the tribe.

Each clan or section has its headman who may hold his post by right of inheritance, election, or sometimes strength of arm. The headman holds all authority in his section, though in the normal round of peaceful life he seldom acts without consulting with the older men.

Life is one monotonous round. The only task of the men is to prevent attack by either animal or human. The women do all the communal work of cooking, dressing of skins, collecting of fuel, hunting for the rather rare edible berries, while the boys tend the cattle and the girls the sheep and goats. At night, a boma, or circle, of thorn-bush is built, into which the clan and its cattle retire. Fires are lit, and each family resting place consists of nothing more than a branch of a tree placed to windward and covered loosely with some spare skins which are supposed to act as a shield from wind and storms. Father and mother and infants sleep together, while the older, but still unmarried, children spend the night away from their elders. Young men and girls are supposed to sleep apart but the rule is not very strictly observed.

The Karamoja, being nomads, eat virtually nothing but meat and drink only milk, or milk mixed with blood, a peculiarly filthy looking concoction. Sick cattle are eaten as a matter of course, apparently without any ill effects. Game is preferred to

The Women of Karamojo Wear Quantities of Iron Bracelets and Necklaces cattle, merely because the cattle—which is the measure of wealth of the community—is preserved. The few clans that have established themselves in one place because permanent water and grazing are available, grow some matama, a type of grain from which porridge is made.

When in Full War Regalia, the Men Wear Thin Metal Discs Suspended From The Nose

Such an extremely primitive mode of living has not made for intelligence on the part of the people, who are mentally very simple though not necessarily stupid. In a life which is measured entirely by a bare sufficiency of food and drink and freedom from attack, there is little to sharpen the wits, and, as with most savages, no thought is given to tomorrow, no curiosity exists as to what may lie beyond the confines of the tribal grazing grounds.

In dealing with such a back-of-beyond tribe, the most important attribute of the white man is patience. With patience might be bracketed honesty of purpose, for it is the writer's opinion that the savage senses at once whether or not he is going to get a square deal. When satisfied on this point, he will at least tolerate the intruder, who then may accomplish some useful work, otherwise the white man will find his lot a hard and dangerous one.

As Uganda is a protectorate, the British administration is concerned primarily with the protection and betterment of the natives, and no attempt is made to impose the white man's customs and ideas willy-nilly on people wholly incapable of understanding them. The law of the protectorate is the Indian Penal Code, but this is only operative when an offence is committed against an established order of the white administration. To what extent the law is applied may differ in various sections of the country, and depend on local conditions and the state of development.

Karamojo was, in the writer's time, a closed or military district, with the administration in the hands of officers of the King's African Rifles, a native force commanded by British army officers lent for the purpose. The district's classification made permission necessary before any outsider could visit, settle, or trade in it. No attempt was made to interfere with the age-old customs and social code, and the exclusion of all unauthorized persons made the work of administrative supervision as straightforward as possible.

The Karamoja tribal law, probably as old as the beginning of time, is fascinatingly simple. There are only three forms of crime recognized, or in fact possible among such very primitive folk. These three are murder, theft, and seduction. Trial is by a meeting of the "Atuk," or court, which consists of as many clan or section headmen as can be brought together conveniently, and is an extremely interesting exposition of fair play and Solomon-like justice. The law relating to homicide is only applicable when the crime is committed within the various sections of the tribe itself, as murder of a member of another tribe is rather a mark of herosim and an occasion for celebration.

The writer had the good fortune to attend an "Atuk" immediately after arriving in the district and while still a stranger to the tribe. The case was the murder of a girl by a young man and the procedure was simplicity itself. In a grass hut were seated the judges, twenty or more of them; the prisoner, led in at the end of a hide rope fastened round his neck, was placed before the court. The father of the murdered girl acted as prosecutor and produced himself and others to prove the case against the defendant, who was allowed to testify in his own defense. The court conferred for a perfunctory minute or two, for the case was to all appearances a clear one, and found the prisoner guilty, whereupon the bereaved father led him out to his doom. There was a slight scuffle, a gurgle, and the sound of a falling body just a few feet away. Justice had been done! The tribal law takes an eye for an eye and a tooth for a tooth, and even goes one better, for it gives the nearest male relative of the victim the right to carry out the sentence.

Theft, which can be only of cattle, as there is nothing else to steal, is generally punished by the imposition of a fine on the whole of the thief's section, besides the return of the stolen cattle. The fine can amount to the same number of cattle stolen or a greater number, and can even be made to extend over a period of time. Naturally, a thief is not exactly popular, so that theft is a comparatively rare crime, for generally the thief is forced to become an outlaw, and, as such, he is not welcome among other sections, and he may even see his ill-gotten gains die from lack of the water and grazing he cannot share with others. A very considerable part of the inter-tribal trouble and fighting is caused directly by outlaws, who, resenting expulsion from their own people, go over to neighboring tribes to act as leaders in raids.

Seduction of a man's wife can be as serious a crime as murder and punishable in the same manner, or, if the outraged husband chooses to take the law into his own hands and kill the seducer, it might be regarded as justifiable homicide. Also a fine of cattle can be imposed on the offender's section, though this is not often done. On the other hand, the offence may be forgiven entirely and no punishment imposed other than that the offender keep the woman. It all depends on the husband and how highly he prizes his wife. In the case of an unmarried girl, the situation is much the same, but invariably is regarded more seriously, and at least a fine is almost certain to be imposed, for, though no punishment is inflicted upon the girl, her value in the marriage market is considerably reduced, and this means an economic loss to her family.

Marriage is by purchase, the price for a bride being from five cows downward, according to the age and comeliness of the girl. There are some traces of courtship, probably because the man wants to ascertain the desirability of his prospective wife, her temper, and, most important of all, her ability to work. The arrangements are made by the bridegroom and the family of the bride, and after the price is agreed upon, the couple do not see each other for a period lasting anywhere from a couple of weeks to two months, when the marriage is celebrated by the man coming with his friends to claim his bride. A sham battle begins the celebration, a survival of the days when the bride actually was won by force, and much feasting is indulged in, often lasting for days after the pair have begun life together. The number of wives a man may have is ruled entirely by his purchasing ability. On a man's death, the care of his family devolves on his brother or next surviving relative. This involves no hardship, as the more women a man has, the greater degree of comfort he lives in.

As with most savage tribes, the Karamoja youth remains a boy and of no account until he has proved his warlike proclivities satisfactorily and has won the status of a warrior. To do so, he has to fight and kill an enemy, and herein

A Soldier in the Kings African Rifles, a Native Force Commanded by British Army Officers lies one of the chief reasons for the inter-tribal feuds which are the worst thorn in the side of the white authorities. This killing of an enemy is most often plain murder of some unsuspecting member of another tribe, a spear in the back while he sits guarding cattle or sleeps at night. The method matters not, so long as positive proof of the kill is supplied.

The lad is recognized as a warrior after undergoing the ceremony of blooding. This horribly painful performance consists of branding the body of the young warrior with a succession of inch-long cuts across the body from the center of the chest outward, and from the shoulder to the waist. The number of these marks is only limited by the man's ability to endure the pain caused by the cutting and burning performed to record his bravery. The one discrimination observed is that, if the victim of the new warrior was a man, the right side is tattooed, while for a female kill the left side is used. Among the older men are many marked completely across the body, signifying that they have killed both a man and a woman. Though it has not been completely eliminated, this practice is fast dying out, owng to the action of the British authorities, for apart from all humanitarian aspects, it is the cause of much worrying and senseless inter-tribal war.

Karamojo has its quota of wild animals, but it is not the so-called "sportman's paradise" that parts of Kenya and Tanganyika are. However, a wide variety of game roams the plains, while in the north the elephant thrives in the dense bush.

An undistinguished country in many respects, yet Karamojo has a fascination and interest which so many regions in Africa have lost since the advent of the white man and the gradual conversion of the native to his methods.

Stark naked and supremely indifferent to progress, as they are, the inhabitants of this African odd corner live their lives as their ancestors did back in the distant past, and one leaves them with a feeling that one's association with them has been well worth while.

AN ADULT SOCIABLE WEAVER BIRD NEAR ITS NEST

THE SOCIABLE WEAVER BIRD OF SOUTH AFRICA

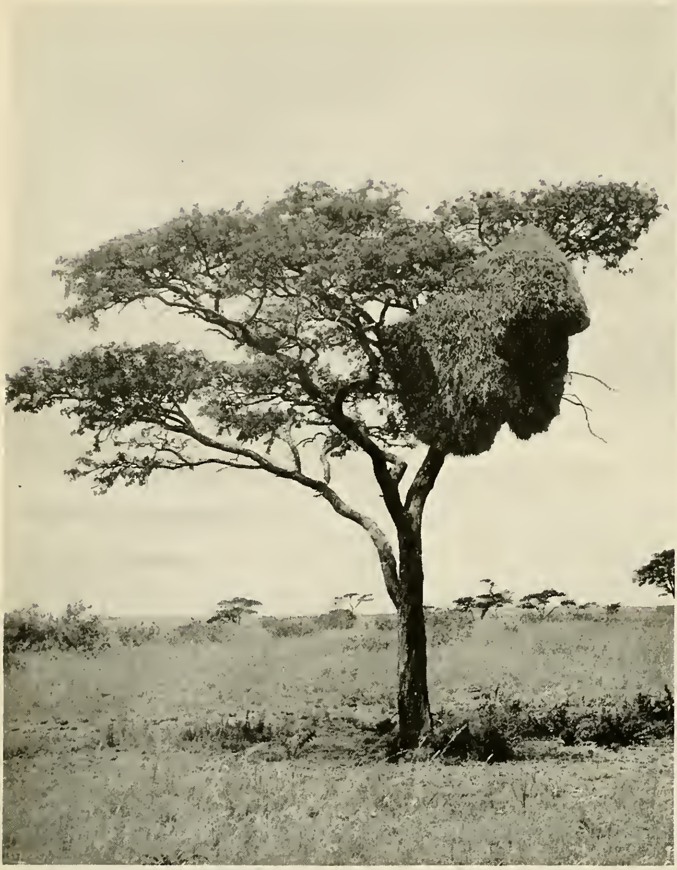
How the Social Habits of this Remarkable Bird Architect Prompt it to Construct "Apartment-house" Nests, in which it Lives in Colonies

By HERBERT FRIEDMANN
Curator, Division of Birds, U. S. National Museum

The American Museum greatly desired to obtain one of those marvels of the bird world, a nest of the sociable weaver bird, both for the information and pleasure such an exhibit would give to the public as well as for its scientific value. Therefore, when in 1924 Doctor Friedmann was planning to go to South Africa on quite another mission, it was decided that the opportunity to procure materials for an exhibition group of the social weaver might not repeat itself for some time, and Doctor Friedmann gladly undertook to try to collect the desired material. The remarkable structure will be put on exhibition at the American Museum. Doctor Friedmann's observations, on which this article is based, were made chiefly around Maquassi, Transvaal, January 15–23, 1925, and are published in this issue of Natural History *by permission of the Secretary of the Smithsonian Institution.*—The Editors.

AMONG the many wonders of Africa's teeming bird population, surely one of the most prominent is the sociable weaver bird. As a bird among other birds, it is very ordinary looking. Its modest plumage and unimposing appearance, however, form but the outer aspect of what in all fairness must be granted to be the mightiest of all avian nest-builders, the greatest bird architect in the world. When we consider the delicately constructed and ingeniously decorated or concealed nests of some of the orioles, humming birds, and tailor birds, this statement has all the more force. It is freely admitted that some other birds may build nests of finer structure or of more intricate workmanship, but if we think of such aspects of building as bulk, strength, durability, and the consequent safety afforded the inhabitants, then the achievements of the sociable weaver stand out in their true value.

The wonderful colonial "apartment house" nests of this bird have excited



A NEST COLLECTED FOR THE AMERICAN MUSEUM

Doctor Friedmann covered an area approximately one hundred miles long and ten miles wide looking for a nest which was suitable for exhibition

appreciative Hottentots or Bushmen, or scrutinized by the inquiring eyes of a casual explorer.

A rather tawny, sparrow-like bird with a black patch on the chin and upper throat, and with the back presenting a somewhat scale-like appearance due to the buffy edges of the dark brownish feathers, the sociable weaver strikes the observer in its native haunts as being exactly what it is—a close relative of the now ubiquitous house sparrow of our city streets. In voice, gregariousness, feeding habits, pugnacity, and general mannerisms, it recalls its more cosmopolitan relative. This is all the more noteworthy in view of the recent discovery by Sushkin that the latter is a weaver bird and not a member of the true finch family. In this particular instance field observations and laboratory studies supplement each other unusually well and point independently to the same conclusion. In view of the fact that both are very generalized in form and structure, neither eminently specialized in any one direction, it is quite puzzling that one group (*Passer*—the genus to which the house sparrow belongs) should have spread all over Africa, Europe, and Asia, and, more recently, through artificial means, the rest of the world as well, while the other (*Philetairus*—the social weaver) should have remained in a very restricted area.

The social weaver is an inhabitant of the rather arid acacia-dotted grass veldt

much comment on the part of the relatively few naturalists who have had the privilege of seeing them and studying the builders in their remote African home. The massive bulk of the nest structures, however, made it impossible to collect and transport specimens to museums in other lands before a railroad had been pushed through the rather dreary part of Africa that produced these remarkable birds. But now that has all been accomplished, and a person may travel in a comfortable train from Cape Town, and, in a day's journey, get to where he can see these famous nests that were hitherto gazed upon only by indifferent and unof southwestern Africa—the extreme western Transvaal, adjacent portions of the Orange River Colony and the Cape Province (Griqualand West), and particularly of Damaraland and Namaqualand, north to Ovampoland and the Kalahari Desert. Like most denizens of dry regions, it is subdued and sandy in coloration, but otherwise it is not obviously adapted to a semi-desert environment.

As the common name of the bird implies, *Philetairus* is very social in its habits; in fact it is probably as social as any bird could possibly be. It is always found in flocks, feeds in flocks, and breeds in large, "many-apartmented" compound nests. The smallest flocks that I saw contained about twenty birds; the largest one at least a hundred and fifty. The flocks seem to stay pretty much in the same general vicinity all the year round, and the birds use their huge, massive nests as roosting places during the nonbreeding season. With this extreme sociability and sedentary habit of life the territorial relations of the species have been modified in a way that is quite remarkable, perhaps unique, among birds. Instead of each pair of birds having its own breeding territory, each flock seems to have a definite territory, and as the individual flocks are usually far enough apart not to compete with one another, the boundaries of these territories are seldom crossed by individuals of other flocks and other territories. However, in a few cases in my own experience, two flocks were fairly close together (i.e., two nests were on trees not very far apart), and the birds mingled more or less while feeding, but in these cases far more fighting and quarreling was observed than in all the others

THE UNDERSIDE OF A NEST

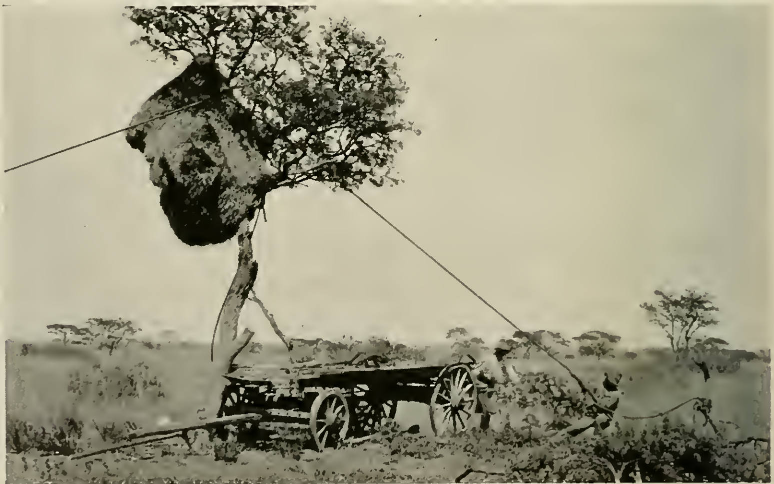
It is possible to distinguish numerous entrances in this close-up view. These lead to the individual nests which make up one large, compound, "apartment house" nest

COLLECTING A NEST
The first step in preparing this nest for its journey to the American Museum was to trim all extra branches from the tree on which it grew

together. In an area approximately one hundred miles long and ten miles wide, or a thousand square miles in all, that I covered while looking for a nest suitable for transport to New York for exhibition purposes, I found only twenty-six nests of the social weaver, so it can be seen that the flocks ordinarily do not live in very close juxtaposition to each other. (The nests are so large and conspicuous at great distances, and the country so open and easy to examine, and the trees so relatively few in number, that I am quite certain I found practically every nest in this area.)

The nests observed varied in size as did the flocks. The smallest nest found measured some three feet in diameter at the base, was about three feet high, and had perhaps ten entrances on the under surface, indicating that it contained that number of individual nests. The largest one found was incomplete, i.e., a piece of it had broken off, breaking its supporting branches by its weight, but the remaining part was a large, flat, horizontal mass of straw, more or less repaired at its broken edge, and measuring about twenty-five by fifteen feet at the base and about five feet in height. The part that had broken off must have been about five feet in diameter each way. This nest contained about ninety-five nests within it.

In a locality where these birds occur it is impossible to remain long unaware of their presence. Trees are not so numerous but that each one becomes an object of considerable importance in the landscape. Needless to say, a tree on which



LOWERING THE NEST TREE
The second operation was to chop the tree nearly through at its base, and then very carefully lower it until the nest reached the waiting truck

there is a social weavers' nest is a very conspicuous object, visible for a great distance and widely proclaiming the presence of the builders. But the birds themselves soon intrude upon one's consciousness with their noisy, harsh, chattering notes, as they fly by in flocks, or feed in scattered bunches upon the seeds of the small, stunted shrubs and plants that wrest an existence from the inhospitable soil. While feeding, they keep up an incessant chatter much like a flock of house sparrows, and like them, frequently quarrel over bits of food. In flight they all act in unison with a precision quite remarkable for birds of their type, the whole flock turning, rising, falling, wheeling, and stopping more or less together.

READY TO START FOR THE RAILROAD STATION
The nest and accessories were then drawn across the arid grass veldt to the railroad where the packing and crating were finished

Although the birds live in compound "apartment-house" nests, feed and fly in flocks, and are at all times exceedingly gregarious, they mate in regular monogamous fashion as far as my field observations indicate. If they were promiscuous they would be forever in one another's way getting in and out of the entrance holes of the individual nests in the large communal structures. As a matter of fact the harmony of life within each colony, the lack of what may be likened to "traffic congestion," that is, the coming and going of birds in the task of providing food for the young, the fact that out of numbers of individual nests examined by various observers none were found with unusual numbers of eggs or young, all argue for the actuality of monogamy.

WRAPPING THE NEST
A covering of burlap, followed by burlap soaked in plaster, then chicken wire and more plaster, were used as a protection

CAMP NEAR MAQUASSI, TRANSVAAL

A new, and consequently small, social weavers' nest is hanging on the tree at the left

There have been several attempts to explain the structure of the large, composite nests of this species, some writers claiming that each pair of birds builds an individual nest, all of them close together, and then the flock builds the common roof over all the nests, while other writers have recorded that the flock builds a large structure and then each pair builds its individual nest into this structure. I have never seen the actual beginning of a nest and the smallest nests I found were, as mentioned above, complete structures with numbers of nests within them.

We may therefore quote the account of the building process given by Sir Andrew Smith, from Shelley's *Birds of Africa* (Vol. IV, 1905, p. 131).

The most striking peculiarity observed of the species is the extraordinary manner in which a number of individuals associate, and build their nests under a common roof. When a nesting place has been selected, and the operation of building the nests is to be commenced *ab initio*, the community immediately proceed conjointly to construct the general covering which interests them all; that being accomplished, each pair begins to form their own nest, which like the roof, they construct of coarse grass; these are placed side by side against the under surface of the general covering, and by the time they are all completed, the lower surface of the mass exhibits an appearance of an even horizontal surface, freely perforated by small, circular openings.

They never breed in the same nests a second time, though they continue for many years attached to the same roof. With the return of the breeding season, fresh nests are formed upon the lower surface of those of the previous year, which then forms an addition to the general covering. In this manner they proceed, year after year adding to the mass, till at length the weight often becomes such as to cause the destruction of its support, upon which a new building-place is selected. They appear to prefer constructing the nests upon large and lofty trees, but where such do not occur, they will even condescend to form them upon the leaves of the arborescent aloe (*Aloe arborescens*), as occasionally happens towards the Orange River. The commencement of the roof is firmly interwoven with the branches of the trees to which it is intended to be suspended; and often a great part of a principal branch is actually included within its substance.

The only point that I can add to Smith's description is that not only do the birds build their individual nests, but during the non-breeding season, all the members of the flock do a certain amount of roof building and repairing of the whole structure. All the birds work together equally, the males as well as the females, and even during the breeding season, when they have eggs or young in the nest, the birds may be seen carrying straw to the roof or other parts of the common structure, not necessarily close to their own respective individual nests. The huge, massive affairs are composed chiefly of small twigs and of dried grasses of a rather coarse, tough sort that grows commonly in southwestern Africa, and the seeds of which enter very largely into the diet of the weavers. The material is not really woven or even plaited on the surface of the nest, but is rather roughly put together in about the same way that hay is put into a well-made hay rack, but with a fairly definite thatching arrangement, causing the rain to run off and not to soak through. The under side of the nest presents the rough, hard ends of the coarse straws, and forms a very uneven surface.

The breeding season of this bird in western Transvaal is at its height in December and is practically over by the middle of January. Consequently I was too late to learn much of the nest

A NEST BROKEN BY ITS OWN WEIGHT

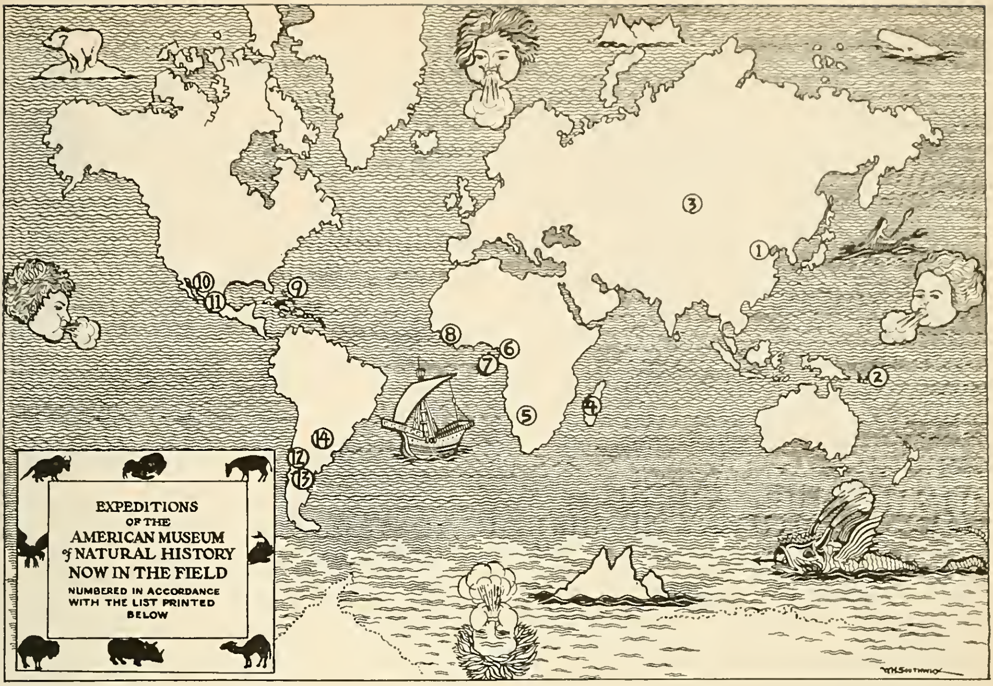
This nest became too heavy, and parts of it broke down with the supporting branches, leaving three pieces of what was once one large nest. The middle portion is about ten feet long life of the young, or of the eggs. In fact, I found but two nests with eggs, three in one case and two in the other. In both cases the eggs were addled and broke when I tried to blow them. The eggs are very similar to those of the house sparrow, *Passer domesticus*, and are dull, dirty grayish-white, feebly speckled and marked with darker cloudy gray. Numbers of young birds were seen flying about with the adults and a few slightly younger individuals were seen being fed by the adults.

In the colonies of social weavers we find several other vertebrates living in close relations with the weavers. The pygmy falcon, *Polihierax semitorquatus*, lives in the nests with the builders, and seems to have established a most remarkable type of symbiotic relationship with them. I never saw more than a single pair of these little hawks at any one nest, no matter how large the nest was, and I never saw any sign of the slightest hostility between the weavers and the falcon. Frequently I noted both species perching side by side close together on the same branch, not more than a few feet apart, and yet in the stomachs of all the *Polihierax* I collected (three individuals) I found nothing but feathers and bird bones, but the feathers were certainly not those of *Philetairus*! It looks as though the hawk, while feeding largely on small birds, did not molest the weavers. The only good the weavers could possibly derive from this curious symbiotic arrangement is that they would be assured that any other small bird coming to their nest would not survive to usurp any breeding space there. In some nests the rose-collared love birds, *Agapornis roseicollis*, usurp an unused nest and breed in it. In such cases there seems to be no particular advantage to the weavers. I do not know of any instances of the love bird and the pygmy falcon nesting together in the same colony of social weavers. I personally never found the love bird at all, but it has been recorded by several observers as a regular breeder in these large nests.

The chief enemy of the social weaver aside from man is a tree snake or, as it is called by the Boers, "boomslang" which gets into the nests and eats the eggs and young and any adults it can catch as well. The natives are very much afraid to pass under one of the nests lest a snake drop down on them, and consequently they often set fire to the nests after they have attained considerable proportions. However, some of the nests persist for years and grow with the passing of time. The largest nest that I saw was known to some of the Boer residents for more than twenty years, and the one I collected for the American Museum of Natural History was known for at least nine years.

Because of the difficulty of transporting bulky objects, I limited my search to within five miles of the railway line. The nest collected was on the farm of Mr. James M. Lamont near Maquassi, Transvaal. Mr. Lamont prized the nests on his land, but very generously allowed me to cut down and take away the one now on exhibition in New York. When it is remembered that this gentleman has never been in the United States and has no personal interest in the public served by the American Museum, his friendly gift assumes all the more significance.

A YOUNG SOCIAL WEAVER JUST OUT OF THE NEST



1. Central Asiatic; 2. Whitney South Sea, Solomon Islands, for birds; 3. Morden-Graves, Turkestan, for mammals; 4. Madagascar, for birds, mammals, and fossils; 5. Vernay, to Africa, for mammals; 6. Columbia-University-American Museum, to Africa, for anatomical study; 7. Thorne-Correia, Gulf of Guinea, for birds; 8. Murphy, to Liberia, for birds; 9. Bacon-Miner, Bahamas, preliminary biological survey; 10. Frick-Rak, New Mexico, for fossils; Frick-Falkenbach, Nebraska, for fossils; 11. Vaillant, Valley of Mexico, archæological study; 12. Olson, South America, archæological reconnaissance; 13. Ottley-Anthony, South America, biological reconnaissance; 14. Naumburg-Kaempfer, Southeastern Brazil, for birds

AMERICAN MUSEUM EXPEDITIONS

Edited by A. KATHERINE BERGER

It is the purpose of this department to keep readers of Natural History *informed as to the latest news of Museum expeditions in the field at the time the magazine goes to press. In many instances, however, the sources of information are so distant that it is not possible to include up-to-date data*

The Columbia University-American Museum Anatomical Expedition.—On January 21 the scientific and administrative staffs of the Museum gathered to meet Dr. William K. Gregory upon his return from the Columbia University-American Museum Anatomical Expedition to Africa. President Osborn and Director Sherwood welcomed Doctor Gregory and spoke of the interest with which the progress of the expedition had been followed, as under the able leadership of Associate Curator Raven, the members had visited the homes of the mountain gorilla, west of Lake Kivu, and of the coast gorilla in the French Cameroon.

Doctor Gregory regretted that the other members of the expedition could not be present, Mr. Raven, because he was still in the interior of the French Cameroon, Professor McGregor, on account of his duties at Columbia University, and Professor Engle, on account of illness contracted in Africa. Doctor Gregory said that the success of the expedition was due chiefly to Mr. Raven, who had worked out the long itinerary across the continent, planned the bulk of the equipment, and secured and preserved the entire bodies of the gorillas for anatomical studies in the laboratories of the Museum and of Columbia University.

Doctor Gregory said that the geological history and present geological structure of Africa, which had especially interested him, naturally had a direct bearing on the present distribution of the mammals and birds of Africa. The geologists, under the leadership of Prof. J. W. Gregory of Glasgow University, had shown that the greater part of Africa consisted of a high plateau of excessively ancient crystalline and metamorphic rocks, which had apparently never been covered with marine formations, so that the geological succession of marine invertebrate faunas, so familiar to American and European geologists, was lacking. The upraised central portion of the plateau had in early times been eroded by rivers and had later been filled by enormous fresh-water deposits, covering the Congo Basin and containing fossil ganoid fishes, judged to be of Upper Triassic Age. The great Congo River system, however, with its hundreds of branching tributaries, apparently did not belong to this Triassic lake system but was the remnant of a far more recent enormous fresh-water lake, which, according to the evidence of the geologists, submerged a great part of the Congo Basin until perhaps after the close of the Glacial period. Then, possibly through the tilting upward of the northeastern corner of the lake bottom, the lake was drained off and the Congo River system was formed after its disappearance. Consequently the dense Congo forest, which is now the home of thousands of species of plants and animals, must have invaded that great area quite recently, perhaps only a few hundreds of thousands of years ago. At present the mountain gorilla of the Kivu region and the West Coast gorilla were separated by at least seven hundred and fifty miles of the Congo forest and for the most part by a much greater distance. They had usually been considered to be distinct species but Mr. Harold Coolidge of Harvard University, who has just completed a very carefully prepared monograph on the gorilla, has concluded that these two groups are at most only subspecies.

By what routes have the mountain gorilla and its relative the coast gorilla reached their respective ranges, which are now so far separated from each other? This would be an interesting subject for consultation with other students of the distribution of plants, animals, and birds of the Congo region, but perhaps it is significant that during the second half of the Tertiary period the group of anthropoid apes, as known chiefly from fossil jaws and teeth, ranged from Spain on the west to India on the east. Hence the gorillas and the chimpanzees, which are all rather closely related to each other, might perhaps have reached Africa from the Asiatic-European continent to the north and one section might have migrated around the north end of the Congo lake toward the west coast.

Doctor Gregory then described the experiences of members of the expedition in watching living gorillas in the field. This will be the subject of special articles in Natural History.

THE MORDEN-GRAVES EXPEDITION TO TURKESTAN.—The latest news comes from Mr., George Goodwin, postmarked Khabarovsk, December 14. He met Mr. George Graves at Vladivostock on December 5, after leaving Mr. Morden in Moscow. Mr. Morden expected to rejoin the expedition about the middle of January. In the meantime Mr. Goodwin has succeeded in obtaining a good series of mammals in Kazakstan under most difficult circumstances. At the time of writing, it looked as though the expedition would have to travel farther north and to the west of the Amur for tiger.

"The tigers" says Mr. Goodwin, "travel long distances and more or less follow the abundance of game, more especially the wild boar, which are in turn governed by the nut and acorn crop. This year the food for the wild boar was a complete failure and they have completely vanished somewhere, but where nobody knows—and where they are, the tigers are."

THE OTTLEY-ANTHONY SOUTH AMERICAN EXPEDITION.—A cable received the latter part of February said that the expedition was leaving Puerto Montt, Chili, for the voyage around Cape Horn.

THE BACON-MINER EXPEDITION TO THE BAHAMAS.—Dr. Roy W. Miner, curator of lower invertebrates at the American Museum, is planning to spend March and April in the Bahamas. During March the expedition will make its headquarters at Nassau, where it will be engaged upon work connected with the new coral reef group now being constructed in the Hall of Ocean Life. This part of the expedition is made possible through the generous coöperation of Mr. Daniel Bacon and Mr. Junius S. Morgan, Jr.

About April 1, Doctor Miner plans to join the International Expedition to the Bahamas conducted under the auspices of Princeton University. This expedition, under the direction of Prof. R. M. Field of Princeton University, is being supported by Mr. Hugh Matheson of Miami, who is lending his yacht, the "Marmion." The work is being carried on with the coöperation of the following:

The Percy Sladen Trust of London,
The Rouse Ball Fund of Trinity College, Cambridge,
Die Notgemeinschaft der Deutschen Wissenschaft,
The U. S. Coast and Geodetic Survey,
The American Museum of Natural History,
The Buffalo Society of Natural Sciences,
State of New Jersey Agricultural Experiment Station,
The International Summer School of Geology and Natural Resources.

The subjects of research will be undertaken by a staff of ten scientists, and studies will be made of the sponge banks on the western shore of Andros with particular reference to their geology, marine biology, bacteriology, and oceanography. Doctor Miner will coöperate with Prof. Ulric Dahlgren of Princeton on marine biological questions and with Dr. Charles Fish, director of the Buffalo Society of Natural Sciences, who has charge of the oceanographic work.

This expedition is of a preliminary character to formulate problems of a more extensive biological survey at a later time.

A RACIAL SURVEY OF THE POLYNESIAN PEOPLES.—Since March of last year Dr. Harry L. Shapiro has been in Polynesia visiting the Marquesas Islands, the Society Islands and the Tuamotus. He has just returned to the American Museum, where he is analyzing the data collected. The purpose of Doctor Shapiro's expedition was to make a racial survey to determine, if possible, the origin of the Polynesian people in relation to continental races, and also to gather material on race mixture. Much of the time Doctor Shapiro worked alone, but he visited the Tuamotus in company with Messrs. K. P. Emory and J. F. Stimson of the Bishop Museum, Honolulu. Traveling in a twenty-nine foot boat which they had built in Tahiti, they found some isolated islands where life was very primitive and therefore very interesting from an anthropological point of view.

Doctor Shapiro made a small collection of ethnological specimens and found one trephined skull, the first reported from the Tuamotus. He also discovered several groups of people of a physical type heretofore unreported from Polynesia.

THE CHARLES L. BERNHEIMER PICTOGRAPH RESEARCH EXPEDITION.—One of the most interesting mediums for the manifestations of primitive American art may be found in the innumerable engravings and paintings on rocks cliff and cave walls. A great many of these pictographs, as they are called, antedate the historic period, while others have been made more recently. Besides adding to our knowledge of primitive art, a study of these pictographs will undoubtedly reveal much information on native American life to be added to that secured through archæological excavation.

Therefore, such a study of pictographs in Southwestern United States has been undertaken by the department of anthropology at the initiative of Mr. Charles L. Bernheimer, and has been organized as the Charles L. Bernheimer Pictograph Research. The field studies were begun by Ann Axtell Morris in Cañon del Muerto, Arizona, where Mrs. Morris copied in water colors a series of compositions that were on the cañon walls. These paintings are now on exhibition in the Southwest Indian Hall, and have a chronological range from the Basket Maker period to modern Navajo.

THE ANGELO HEILPRIN EXPEDITION TO SANTO DOMINGO.—Mr. William G. Hassler has returned from Santo Domingo after a successful expedition for reptiles and amphibians. More than ten thousand specimens were collected, the lizards and their eggs alone numbering more than six thousand. The purpose of the expedition was to infiltrate reptiles in the field for exhibition purposes. Three grouplets were obtained for the Reptile Hall in the American Museum. One portrays the home life of the gecko, *Aristelleger;* a second shows the field habits of the curious tree snakes of the genus *Uromacer*, and a third illustrates the courtship antics of the giant Haitian "chameleons."

NOTES

ASTRONOMY

SOLAR ECLIPSE OF 1929 SHOWN IN MOTION PICTURES.—The first successful motion picture film of the continuous progress of an eclipse of the sun was shown to members of the Amateur Astronomers Association at their February 19 meeting when Dr. Harlan T. Stetson of Perkins Observatory gave a talk on "Eclipse Hunting." The film portrayed the eclipse from its beginning to the instant of totality, showing the solar corona, and then the gradual recession of the shadow of the moon from the disc of the sun. The presentation stirred the audience to spontaneous and prolonged applause.

The program for the final two months of the season is as follows:

April 2. Dr. Weld Arnold, F.R.A.S., "Where Are You and How Do You Know?—Navigation on Land, Sea, and Air."

April 16. Meeting postponed to the following week.

April 23. Dr. S. A. Mitchell, "One Thousand and One Stars: Their Distances."

May 7. Dr. Oswald Schlockow, "The A B C of Stars and Planets—A Talk for Beginners."

THE RADIO BROADCASTS OF THE AMATEUR ASTRONOMERS ASSOCIATION over station WOR every Saturday at 5:45 P.M. during April will be:

April 5. Dr. Clement S. Brainin. "Starshine."

" 12. Miss Jean Conklin. "How an Astronomer Finds the Distance of a Star."

April 19. Mr. C. J. Liebman, Jr. "Changing Concepts of the Solar System."

April 26. Weld Arnold, F.R.A.S. "Locating Yourself Astronomically—Navigation by Land, Sea, and Air."

CONSERVATION

THE PARC NATIONAL ALBERT.—It has been considered desirable by the Commission du Parc National Albert to organize a local committee in each of several countries to maintain liason between the central Commission and the local scientific institutions abroad. To carry out this purpose, Prince Albert deLigne, Belgian Ambassador at Washington, was asked to form the American Committee for the Parc National Albert, Belgian Congo, under his presidency. He has appointed President Osborn to serve as one of the vice-presidents of the American Committee with Dr. John C. Merriam as the other. Mrs. Mary L. Jobe Akeley has been invited to accept the post of secretary

AN APPEAL FOR CONSERVATION OF WILD LIFE IN THE BRITISH EMPIRE.—Some years ago President Henry Fairfield Osborn coined the happy phrase, "The End of the Age of Mammals." Few of those who heard him at the time realized the vast significance of the term. We all knew that the Age of Mammals was passing, but hardly grasped the imminence of the end.

In the past few decades the last vacant places of the earth have been occupied and developed with an intensity never before equalled. We had supposed that the opening up of the Far West in the last half of the Nineteenth Century was unique in its rapidity. In a few decades the Indians, the bison, the antelope and the elk, in their great herds, had marched into oblivion, but we had fondly hoped that the rich fauna of Africa, rich not only in numbers of individuals, but also surpassingly rich in the number of species, would endure indefinitely.

In November, 1929, Mr. C. W. Hobley, secretary of the Society for the Preservation of the Fauna of the British Empire, came to New York with a message of appeal from British sportsmen and British naturalists to help in the efforts of the Society to preserve what was left of the wild life within the British Empire. This would include about seventy per cent of the world's animals, and fifty per cent of these world animals are in Africa.

Everywhere the story is the same. The opening up of the country to cultivation; the fencing in of the best grazing tracts and sometimes the only available water holes; the new roads everywhere and motors in swarms to use them; the increase of population; the arming of the natives with modern weapons and, above all, the sentimental regard for the natives which encourages them to take up the only available water holes and gives them the right to slaughter for meat without restraint. The vast herds of African game move with the seasons from one grazing ground to another along the line of established water holes. If these water holes are taken up by the natives to grow a few bushels of mealies, it means the diversion of these migration routes and the death by thirst of thousands of animals. We have precisely the same experience in British Columbia, where the Stony Indians were allowed to kill game at any season and everywhere, while whites were strictly limited as to seasons and numbers. The result was that the Indians swept the country-side absolutely clear of game.

The Society for the Preservation of the Fauna has undertaken to make intensive studies as to ways and means of educating the local white settlers to conserve their game resources and to restrain improvident natives from destroying their own food supply and, above all, to secure inviolate game refuges. This last is best exemplified by the Kruger National Park, which is almost the sole hope of preserving from extermination some of the wild life in the Transvaal.

Early in January, 1930. Major Frederick R. Burnham came to New York after completing a trip around the world, during which he visited his old camps and battle grounds in South Africa, Rhodesia, and East Africa. Major Burnham reported a shocking decrease in the game everywhere and appealed to Americans to help the men on the spot to preserve their game. This purpose can best be accomplished, in the opinion of the writer, by subsidizing existing agencies for the protection of animals. For this purpose a committee has been formed and about $10,000 secured from various institutions, such as the American Museum, the Zoological Society of New York, Boone and Crockett Club, American Nature Association, Field Museum of Chicago, Wilderness Club of Philadelphia, and some individuals like Mrs. Grace Rainey Rogers in memory of her hunter brother, the late Paul Rainey.

We Americans must come to the financial assistance of those members of our race who are settling new countries and enable them to profit by our own bitter experience,—that in killing off the wild animals of the world they are destroying their best assets. Game refuges must be everywhere established and enlarged. Marketing of game, the sale of hides and horns, except for scientific and museum purposes, must everywhere be prohibited, and legislative enactments must be made *and enforced* limiting the killing of any species to the natural average annual increase in numbers. Scientific studies must be made everywhere in order to ascertain the maximum number of any species which can be maintained on a given area.—Madison Grant.

The British Society for the Preservation of the Fauna of the Empire.—C. W. Hobley, formerly well-known geologist and explorer of Central Africa, after whom was named the *Dinotherium hobleyi*, visited the American Museum recently as acting secretary of the Society for the Preservation of the Fauna of the Empire. For the last ten years he has been engaged, through this Society, in promoting by every means the movement which is as nearly world-wide as the British Empire itself to create game preserves, to establish and enforce game laws, and to coöperate with other governments in game and forest preservation. President Osborn suggested that American coöperation would be enhanced by the formation of an American auxiliary which would assist both in propaganda and in raising funds. It was agreed that the chief causes of destruction are now economic. Mr. Hobley believes that as many as 30,000 animals are being destroyed annually for purely commercial purposes. It is estimated that between 1,500 and 3,000 elephants are being killed in Africa every year. Mr. Hobley pointed out that there would be no African and Asiatic Hall but for the efforts of his own and other societies in creating the great game preserves of Uganda, Kenya, the Sudan, and Nyasaland.

About two years ago orangs were being exported from Sumatra in such large numbers as to threaten their extinction. It was found that some of them were being smuggled over to Singapore and Penang and shipped from there without question, as they were not derived from British Territory. The Malay States Government has been directed by the Colonial Office to introduce a law prohibiting export of these animals from any port in the Federated Malay States or Straits Settlements. Apropos of this conservation movement, the Zoological Society of New York is prohibiting the purchase of young gorillas.

Due also in a great measure to the efforts of the Society for the Preservation of the Fauna of the Empire, a goodly portion of the famous Serengeti Plains in Tanganyika Territory has been declared a reserve. It was here that the murderous slaughter of lions and other animals from motor cars was being carried on.

HISTORY OF THE EARTH

Fossils of the Oldest Known Plants.—Mr. Lincoln Ellsworth, of Arctic fame, in a recent interview states that for the future he hopes to see commercial air lanes girdle the world via the Arctic circle. He points out that the distance from London to Hongkong is reduced one half by a short cut across the North Pole, and cites the ideal flying conditions of Arctic summers where the sun never sets for six months out of the year, and the constant summer temperature hangs around the freezing mark. Another advantage is the absence of air pockets. He says that his own interest in the Arctic is geographical exploration, although there are commercial possibilities there, when one is aware of the stability of meteorological conditions during the summer. He refers to his association with the late Roald Amundsen, which began in 1925, as being a lasting friendship, for a squarer man nor better comrade never lived. "Exploration was his work, his ambition, his calling, his recreation, his life, his death."

Mr. Ellsworth is the author of *Air Pioneering in the Arctic* and is intensely interested in navigation problems. In this connection he has assisted Lt. Commander P. V. H. Weems of the U. S. Navy in bringing out the Weems line of position book from which it is possible to determine latitude and longitude in 67 seconds. This system of simplified navigation is invaluable to navigators of the sea and air.

In recent years Mr. Ellsworth has frequently gone by plane from Coronado Beach, California, to the Grand Cañon of the Colorado River, Arizona, where he has been intensely interested in the 1927 work of Dr. David White of the U. S. Geological Survey and the National Academy of Sciences. Doctor White has obtained from the Bass limestone near the Phantom Ranch in the Bright Angel Creek Cañon four different types of fossil algæ, the oldest known plants so far discovered. Three of the forms have been called *Collenia*, *Girvanella* and *Chuaria*, the other one has not yet been identified. These fossils belong to the blue-green algæ family Cyanophyceæ.

The Bass limestone is the basal member of the Unkar division of the "Grand Cañon Series" of rocks, which are Algonkian in age. Stratigraphically speaking, this limestone appears about 12,000 feet below the rocks of Cambrian age, the first period of geologic time to contain abundant fossils of various invertebrates. Pre-Cambrian fossils have been found at higher levels in the Grand Cañon series and elsewhere (See NATURAL HISTORY, Vol. 29, p. 334), but they are not as ancient as those found by Doctor White.

Two months ago Mr. Ellsworth was so impressed with the softly tinted "old rose" rocks of Algonkian age, near the Phantom Ranch, from which Doctor White obtained these early forms of life, that he had Gunar Wildforss, noted Swedish artist, go to the spot and paint a water color with the following inscription:

> NATIONAL ACADEMY OF SCIENCES
> FROM
> LINCOLN ELLSWORTH
> Because of his interest in the rocks (lower Algonkian) that contain fossils of the first life that have left distinct records.

—CHESTER A. REEDS.

MINERALS

POPULAR LECTURES ON GEMS.—The American Museum of Natural History has been giving a free course of popular lectures on gems and gem minerals by Mr. Herbert P. Whitlock, curator of minerals and gems, on Saturday evennings during February and March. The subject matter was "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."

These lectures were well attended and seemed to be reaching the type of adult audience to which it was hoped they would appeal. This was apparent from the high percentage of people connected with the jewelry trade present in the audience and from the technical trend of the discussions which followed each lecture.

SCIENCE OF MAN

THE NEW LABORATORY OF ANTHROPOLOGY AT SANTA FE.—A competitive series of architects' plans for the construction of the new Museum and Laboratory of Anthropology in Santa Fe, New Mexico, is now on exhibition in the Southwest Indian Hall of the Museum. The plans are unique. Instead of being developed along the usual lines, they are excellent examples of what may be termed the new Southwestern type of architecture, which draws its inspiration largely from that of the near-by Pueblo Indians and the early Spanish conquerors.

THE BASHFORD DEAN MEMORIAL FUND

THE BASHFORD DEAN MEMORIAL FUND has recently received large gifts from Mrs. Dean and Miss Harriet Dean, Doctor Dean's wife and sister, who have constantly given their loyal support and encouragement to the department Doctor Dean founded.

Part of this fund, which was the contribution of Doctor Dean's friends and colleagues from all over the world, was used for the bronze memorial to Doctor Dean, which now stands at the entrance to the Bashford Dean Memorial Exhibit of Fossil Fishes, on the fourth floor.

The committee in charge plans to call further on the Fund for the arrangement and publication of the large and valuable collection of plates and drawings of the embryology of certain lower fishes which was left unpublished at the time of Doctor Dean's death. Dr. E. W. Gudger, and Dr. B. G. Smith of New York University, are at present working on this collection, which is to constitute a Bashford Dean Memorial Volume.

DISTINGUISHED GUESTS

THE AMERICAN MUSEUM ENTERTAINS GENERAL SMUTS.—On January 8 last President Osborn and Director Sherwood of the American Museum had the pleasure of welcoming General Jan Christian Smuts to the Museum as a guest. In company with the President and Director Sherwood he visited the more important exhibition halls and the new School Service Building. He was deeply interested also in the model of the African Hall, the details of which Mrs. Mary L. Jobe Akeley explained to him.

After the tour of inspection, General Smuts addressed the members of the scientific and administrative staffs who had assembled in the Members' Room to greet him. Turning to President Osborn, he said:

"I congratulate you on having built up something here which is distinctive, and a monument to American science, art, and adventure. The romance that lies behind all this gives me a thrill more than anything else in New York. . . . You have developed a technique that is wonderful. I hope I shall live to see accomplished the changes that are being made here. I mean to come back to see them before I die. Many years ago I met Carl Akeley, who told me about the work being done at the American Museum, but I did not believe him. You see, in meeting men with such enthusiasms as his, one sometimes takes the things they say with a pinch of salt. Yet now that I see these tremendous developments I know that he was very modest. You have covered the history of life here. You count back 100,000,000 years and reconstruct it all, traveling down the ages, and all this is in the heart of New York."

EDUCATION

At the American Legion Aviation Show held recently in New York City the American Museum was granted an exhibition space of 63×14 feet. Mr. William H. Carr, assistant curator in the Museum's department of public education, installed the exhibit, and did a very interesting and splendid piece of work. Included in the exhibition material were the two sledges used by Peary in his dash to the North Pole, and the sledge in which Amundsen reached the South Pole, also the equipment used in the dirigible "Norge" when Amundsen and Ellsworth made the memorable flight across the Polar Sea in 1926. Manikins of an Eskimo man and sledge dog in full harness showed the old method of Arctic travel. The natural history material attracted great attention, particularly from engineers and aviators, who were so deeply interested in studying the flight mechanism of the condor and the marabou stork in the exhibit, that the bird department of the Museum has been busy answering inquiries ever since. Another interesting feature was a series of insects, among which were mounted specimens of cockroaches—the first animals of any kind to fly, and dragon flies—expert fliers of the present day, whose shape somewhat resembles that of an airplane. Original paintings for Natural History Magazine covers lent color to the exhibit.

A SECTION OF THE AMERICAN MUSEUM EXHIBIT AT THE AVIATION SHOW
The flight mechanisms with which nature equips birds, fish, and insects, was the keynote of the American Museum exhibit

Two Lectures on Local Bird Life by Mr. Maunsell S. Crosby.—Owing to the death last August of Mr. Waldron DeWitt Miller, associate curator of birds in the American Museum of Natural History, the lectures on local bird life scheduled for March 26 and April 2 in the Cultural Courses for Teachers of High Schools and Colleges, will be given by Mr. Maunsell C. Crosby of Rhinebeck, New York. Mr. Crosby is an accomplished ornithologist who has for many years made a special study of bird life inDutchess County, New York, and the Hudson Valley. He has also taken an important part as a volunteer in American Museum ornithological expeditions in tropical America.

OTHER MUSEUMS

The Resignation of Dr. N. L. Britton.—For more than thirty-three years Dr. Nathaniel Lord Britton has served in the capacity of director-in-chief of the New York Botanical Garden. Last May, having passed his seventieth birthday, he resigned his office in order to have his time free for scientific investigation.

The scientific directors, desiring to express their recognition of his distinguished and important services to the Garden, at a special meeting appointed him Director Emeritus, and recommended the assignment of Associate Curator Percy Wilson to be his research assistant.

A record was drafted for publication in the

Journal of the New York Botanical Garden, of the services of Doctor Britton, "not alone in the inauguration and conduct of the Garden, but in the earlier years when public sentiment in New York City was being prepared to entertain and develop the idea of such an institution."

Dr. Elmer D. Merrill was appointed director-in-chief to succeed Doctor Britton.

STEPHEN TYNG MATHER
1867-1929
Former director of the National Park Service, Department of the Interior

OBITUARY

THE CAUSE OF SCENIC RESOURCE PRESERVATION suffered a great loss, when on January 22, Mr. STEPHEN TYNG MATHER, former director of the National Park Service, Department of the Interior, died in Brookline, Massachusetts. Mr. Mather had retired from his position as head of the nation's great park system because of ill health, in January, 1929. He undertook his work fifteen years ago, in the development of the national parks as the result of a letter he wrote to the Department of the Interior which came to the attention of Franklin D. Lane, secretary of the department at that time. In answer to Mr. Mather's written objections to the exploitation of the national parks system, Mr. Lane suggested that Mr. Mather come to Washington and direct them himself. Mr. Mather did. From that time on he was one of the foremost exponents of the creation of a greater system of park lands. His work was done quietly and unobtrusively, but at the time of his retirement in 1929 seven new national parks had been created under his direction: Hawaii, Lassen Volcanic, Mount McKinley, Lafayette, Grand Cañon, Zion and Bryce Cañons. Furthermore, the Shenandoah and Great Smoky Mountain parks, which he planned, have also received the approval of Congress.

In 1926 Mr. Mather was awarded the gold medal of the National Institute of Social Science for his great work in conservation.

Mr. Mather had a genius for friendship. His passing is mourned by a great host of friends, as well as by the multitude of those who did not have the privilege of knowing him personally but who did know and admire his wisdom and high devotion to the work for which he stood.

THE DEPARTMENT OF MINERALOGY OF THE AMERICAN MUSEUM suffered the loss of Dr. Lea McIlvaine Luquer, research associate in optical mineralogy, who died January 30.

Doctor Luquer was a graduate of Columbia University, School of Mines, and served his Alma Mater in the department of mineralogy for thirty-eight years.

He retired from active teaching in 1925 with the rank of associate professor of mineralogy, and was made Professor Emeritus.

Doctor Luquer was regarded as an authority on his subject, optical mineralogy, and his book, *Minerals in Rock Sections* published in 1898 is widely used as a standard text.

He was a fellow of the American Association for the Advancement of Science, and of the Mineralogical Society of America.

BOOK REVIEWS

Ends of the Earth. By Roy Chapman Andrews. With 67 illustrations from photographs. G. P. Putnam's Sons, New York and London, 1929.

IN this handsome volume Doctor Andrews has turned out a product which should prove acceptable to a wider clientele than any of his previous writings. Indeed, the reviewer is inclined to place its claims to circulation above those of any recent work of exploration known to him. This is not equivalent to saying that *Ends of the Earth* is the best book in its field, or the most important from Andrews' pen, but it is certainly the simplest, sprightliest, and, in many respects, the cleverest account of a crowded and serious, even though still short, life that has been offered to a jaded public for many a day.

The simplicity of the book is amazing. The apparent absence of "style," the seemingly naïve disregard of certain rules of composition, might easily mislead the reader into comparing some of the writing to that of a child. But when paragraphs build themselves into pages and chapters without once letting go the interest of the most sophisticated, the artistry of plan and treatment can no longer be wholly concealed. The author is either remarkably shrewd or deeply gifted, probably both; in any case his work deserves to be bought and read.

The book is written in the manner of a straight biography, opening, after very brief introductory remarks, with the beginning of Doctor Andrews' connection with the American Museum in 1906. (The reviewer well remembers him during the early months of that period, when he had a beautiful head of hair and went singing lustily about his work—even the floor-sweeping, which may have happened once or twice!) From that fortunate day, everything has been rapid action, but despite the diversified travels with totally different objects, one feels constantly the singleness of purpose, the devotion to the institution that Andrews has represented so well, the boundless energy, the resourcefulness in making the most of opportunities.

Broadly speaking, the book may be divided into the early whaling episodes of the author's career, the cruise in the Fish Commission Steamer "Albatross" and life in Malaysia, the period of his notable studies on whales from the Japanese stations, the pioneer work in Korea, the Arctic cruise, and the long, dramatic succession of expeditions in continental Asia which have culminated in the greatest palæontological discoveries of modern times. Every incident is related without a labored phrase; no morals are pointed; you learn only by inference that the hero of this high romance has had any other aim than to enjoy himself!

Out of such a wealth of material it would be difficult to pick high spots for special citation. Doubtless each reader will have his own favorites. The delightful story of the fur seals' love affairs in Bering Sea is surely one. Life in unspoiled Japanese villages is another, and the unsuccessful tiger hunt in Korea a third. Especially appealing is the record of the old care-free, hard-riding, irresponsible, almost Olympian existence of foreigners in the Peking that is no more. All in all, one might do no better than borrow the alleged comment of Thackery about the writings of Dumas: here is a book to read from morning until evening with perfect contentment of mind.—M.

The Great Apes. A Study of Anthropoid Life. By Robert M. Yerkes and Ada W. Yerkes. New Haven, Yale University Press, 1929.

FROM the first the great apes have intrigued the imagination of man. And they are still an enigma, stooping bipeds, fleeting and illusive shadows of the human. No wonder the ancients romanced about the hairy men of the forest, even after Aristotle gave a good scientific description of the apes which begins thus: "Some animals share the properties of man and the quadrupeds, as the ape, the monkey and the baboon." In our own day there is still some romancing as to the behavior of apes, though this is gradually giving way to the application of experimental methods. In America, Professor Yerkes of Yale is justly distinguished for his exhaustive studies of the chimpanzee, and now he and Mrs. Yerkes give us a comprehensive volume dealing with all the "Great Apes," the Gibbon, the Orang-Outan, the Chimpanzee, and the Gorilla. This is not just another new book that has been added to the ever-expanding list.

Doctor and Mrs. Yerkes have given us an outstanding contribution. The illustrations are well chosen, 172 in all, with 652 pages of text, and the book, though a learned summary of what is known about these creatures, is by no means technical or dull. The first chapter opens with the history of man's early acquaintance with the apes, calling our attention to the lack of evidence that man ever tried to develop social relations with these apes or succeeded in domesticating them, the probable reason being that in some respects the apes were too near to the human and in others too distant, for though the behavior of apes is often human enough, they lack the one trait that makes all men kin, the power of speech. Not the least interesting parts of the book are those in which our authors recount the efforts of themselves and others to teach apes to talk. These, like the attempts of their predecessors, came to naught, for though the chimpanzee undoubtedly varies his cry in keeping with his emotions, he does not use words, nor does he compose them phonetically. But it is agreed that this is not because his vocal organs are not adapted to speech, but because the brain mechanism is faulty. On the other hand, we are told that the chimpanzee learns the meaning of simple words better than do other trained animals (monkeys, dogs, and horses) and that a certain kind of communication between them, the one with the other, is possible and probable. Seemingly, what the authors intend to convey is that the great apes do not acquire our speech because, for lack of the essential brain structure, they possess none of the ideas we put into words. One is tempted to add that apes do not talk because they have nothing to say; if this is not taken too literally, it may not fall far short of the true distinction between apes and man.

However, when one turns to performance, to the things apes can do, it is far less clear that they always work differently from the ways of men, for, by pen and camera the authors show us chimpanzee and gorilla learning by experiment how to improvise step ladders by piling up boxes, poking objects out of pipes with a stick, assembling jointed rods when a longer stick is needed, etc. Some of the problems solved by laboratory apes may well astonish the reader, as the matching of colors by a chimpanzee trained by Mrs. Kohts. Unfortunately, less is known about the ability of the gorilla than of the chimpanzee; in fact, Professor Yerkes seems to have been the first to subject a gorilla to experimental tests and even then upon a single individual. Yet, meager as are these observations, it should be noted, they were made by a most experienced hand and a master of technique. Anatomists tell us that

> All things considered, the convolutional and fissural patterns of the human and the gorilla brain coincide so closely that were it not for the great disparity in size between the organs of these two species, the hemispheres of the one might be mistaken for those of the other.

So there is some ground for expecting that the gorilla will more closely simulate the human method of solving experimental problems than does the chimpanzee. Professor Yerkes, however, hesitates to rank the gorilla, though in his descriptions of the experiments the reader comes to feel that the blundering methods of the gorilla are a little more human than the jumpy, nervous methods of the chimpanzee.

In the end the reader will put down this book with a clearer understanding of the appeal the great apes have made to man, a historical perspective of what man has written about them, an insight into the accomplishments of the experimental method as applied to ape behavior, as well as many suggestive and stimulating questions as to the nature of intelligence.

—Clark Wissler

Le Rapport Entre le Poids et la Surface de l'Hemisphère Cérébral Chez l'Homme et les Singes. By Georges Leboucq. Bruxelles, (Lamertin), 1929.

Brain Weight and Intelligence.—Georges Leboucq, professor of anatomy at the University of Ghent, has recently published this most interesting paper on the relation between the weight and surface of the cerebral hemispheres of man and apes, from which we may make the following extract:

> In the series of brains which I have studied there is *a constant ratio between the weight of the hemisphere and its surface. Large brains have more surface than small ones,* in man as in woman. I have not observed any case in an adult where low weight of the encephalon was compensated by a higher ratio R, but it is not impossible that such cases exist.
>
> Being completely ignorant of the life history of my subjects, I would not venture to suggest a relationship between the morphological substratum and the psychic faculties. I only have information about two individuals:
>
> 1st. Brain No. 12 is that of Monsieur Eugène Houthoofd, aged 69 years, who in his will left his body to the Anatomical Laboratory of the University of Ghent so that he might be of use to science after his death. Monsieur Houthoofd was assistant pharmacist; he was a man of lively and original mentality. His brain was very asymmetrical, (the left hemisphere 620 gr.; the right hemisphere 606 gr.). The ratio R =2.72 for left is normal for a man of 69 years; for the right R =2.65, appreciably below the average.
>
> 2nd. Brain No. 9, of Louis H., 55 years. At the age of 20 he killed his Mother; condemned to a life sentence of hard labour, he hung himself in his cell after thirty-five years of imprisonment. The encephalon weighed 1,515 gr.; the left hemisphere 9 gr. more than the right and had an R ratio of 2.83. It would be rash to deduce from this observation that parricides have the brain of genius.
>
> Since Gall affirmed that the cerebral shell is the seat of the intellectual faculties, people have tried to find a relation between the intelligence and the quantity of cerebral matter. Great men would supposedly have a large brain. There has been testimony to confirm this hypothesis: the encephalon of Byron weighed 1,807 gr., that of Cuvier 1,829 gr., that of Tourgenieff 2,012 gr. But it is contradictory to find brains of illiterates weighing 1,800 and more. It is still more provoking to find that Gambetta had a brain of 1,246 gr. and Anatole France of 1,017 gr. The conclusion is that the weights do not prove anything and that it is only the surface which should enter into calculations. But here the data are lacking. The exterior morphology of the cerebral case of savants and artists has been examined; subtle observations and ingenious deductions have been made, occasionally reminiscent of the phrenology of the ancient Gall, but nothing has been proved.
>
> Brain of Anatole France
>
> The latest study which has been made on this sort of material is that of Monsieur Guillaume-Louis on the brain of Anatole France.[1] This writer of genius did not have the Byronic brow and his encephalon weighed only 1,017 gr. A certain degree of senile atrophy may be taken into consideration: Anatole France was 80 years old; but assuming even the maximum diminution of 300 grams admitted by Manouvrier, a brain of 1,317 gr. would still be below the average.

The author notes on page 27 that all calculations were made on brains which had been at least fifteen days in 5% formalin, and had therefore gained about 10% in weight.

A Handbook of the Mosquitoes of North America. By Robert Matheson. Charles C. Thomas, Springfield, Ill.

Here we have a book on the mosquitoes which should satisfy a long-felt need. The general public will find in it a great deal of interest in the chapters dealing with the habits of mosquitoes, their breeding places and the methods employed in reducing their numbers. The history of malaria and other diseases carried by mosquitoes is presented in a way which is pleasing and concise. The medical man, with a 'flare' for tracing diseases to their source will find the book invaluable, and the illustrations and thorough explanations of all

[1]Guillaume-Louis et Dubreuil-Chambardel, Le cerveau d'Anatole France. Tours, s.d.

characters used in the identification of the flies in their various stages will enable him, with a little practice, to readily determine the exact name of the creature before him. The entomologist particularly interested in mosquitoes is as well served as the others. His only objection can be that *all* the North American species are not included, but Doctor Matheson explains that he merely deals with the common species; nevertheless, there are not many omitted and a list of them is given.

The "Handbook" is beautifully printed and bound and is copiously illustrated. It is safe to say that, in its field, it is the finest thing of its kind which has yet appeared, and Doctor Matheson need offer no apologies for having omitted a few obscure and little known mosquitoes.—C. H. C.

The Oldest Known True Rhinoceros.—The evolutionary significance of *Prohyracodon orientale* Koch has usually been overlooked. A new description and more satisfactory figures in *The American Museum Novitates* No. 395 show that it is unquestionably a true rhinoceros, and that it is correctly assigned to the Eocene, being about equivalent to Lower Bridger. Although in a stage of evolution comparable to *Trigonias* of the Lower Oligocene, it is older than any other true rhinoceros, and is only exceeded in age among rhinocerotoids by the Lower Eocene representative of *Hyrachyus*. Structurally, it is closer to American than to typical European rhinoceroses. The closest resemblances are with *Eotrigonias* and *Meninatherium*, but *Prohyracodon* is at present isolated geographically and geologically. Its progressiveness for its Eocene age suggests that the common ancestor of all rhinoceroses and near-rhinoceroses should be sought in the Lower Eocene, or even the Paleocene. A third upper molar has been obtained by the American Museum.—H. E. Wood, II.

NEW CONTRIBUTORS TO "NATURAL HISTORY"

After completing a prolonged series of studies of the cowbirds of North and South America, **Dr. Herbert Friedmann**, now curator of birds in the U. S. National Museum, went to South and East Africa in 1924–25 to make a comparative survey of the various groups of birds with parasitic breeding habits. It was while on this trip, conducted under a grant from the National Research Council, that he made a special side trip to collect materials for an exhibition group of the sociable weaver bird for the American Museum, which he describes in his article "The Sociable Weaver Bird of South Africa."

During his many years' experience as an aquarist and collector of fishes, **Mr. L. L. Mowbray** has been connected with the New York Aquarium from 1914 to 1919, and from 1922 to 1926, and was director of the Miami Aquarium in the intervening time. Several years ago he accepted an invitation from the government of Bermuda to build an aquarium there. Under his directorship it has become one of the big attractions of Bermuda. In both the Miami and Bermuda aquariums a special feature introduced by Mr. Mowbray was the installation of living corals as group backgrounds. These he kept alive by pumping fresh salt water from the ocean to them through hard rubber pipes.

It was while on one of his collecting trips for the New York Aquarium that Mr. Mowbray had the adventure which he and Doctor Gudger describe in the article "Whale Shark!"

Capt. George Fillary Shearwood, R.A.R.O., British Army, a native of Victoria, B.C. served in East Africa from 1916 to 1920 with the King's African Rifles (4th Battalion, Uganda Protectorate). He took part in the East African campaign, serving in Kenya, Tanganyika, and Portuguese East Africa. In command of a company of 4th Bn. K.A.R. he was sent to the Kenya-Uganda Turkana Territory in 1919 to take entire charge of the Karamojo (Uganda) district. His article "Karamojo—One of Africa's Odd Corners" describes the primitive life of the natives inhabiting that area.

THE COVER

The Call to the Feast, the cover design of this issue, was painted by **Arthur A. Jansson**, and represents a scene in a village of the Manus people of the Admiralty Islands. On the veranda of his lagoon dwelling, the wealthiest man in the family of Lo is calling his relatives together for the bethrothal feast of his five-year old son. In all of the forty-five houses of the village, people will cease work to listen to the drummed announcement, dividing their interest between the staccato message and the canoe in the distance which is returning from another island laden with trade valuables.

NEW MEMBERS

Since the last issue of Natural History, the following persons have been elected members of the American Museum, making the total number 11,946.

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Mr. Geo. F. Baker, Jr.

Associate Benefactors

Mrs. Walter Wehle Naumburg.

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HAWTHORNE DANIEL
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Associate Editor

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Drawn by E. Rungius Fulda

THE WOOLLY MAMMOTH PIT OF MORAVIA

Aurignacian hunters in the act of killing a bull mammoth by hurling giant stones upon him
After the discoveries and studies of Dr. Carl Absolon of the University of Prague, with acknowledgments to A. Forestier and The London Illustrated News

—SEE "THE ROMANCE OF THE WOOLLY MAMMOTH," PAGE 227

VOLUME XXX

NATURAL HISTORY

NUMBER THREE

MAY-JUNE, 1930

THE ROMANCE OF THE WOOLLY MAMMOTH

The First Extinct Mammal to be Found by Man—The Million-Year Quest for Ivory—Fidelity and Accuracy of the Aurignacian and Magdelenian Artists—Aurignacian Mammoth Hunters of Moravia—Eastward Migration of the Woolly Mammoth to North America

BY HENRY FAIRFIELD OSBORN

Honorary Curator, Department of Vertebrate Palæontology, American Museum

Since 1907, when the American Museum sent an expedition into the northern fringe of the Libyan Desert bordering the richly fertile Fayûm area of northern Egypt, the author of the following article has been continuously engaged in studying the lineage of the mastodon and elephant family in all its branches. In 1900 the author had predicted that it would be found that the Proboscidea originated in Africa; this prediction was fulfilled in 1901 by British discoveries, and in 1907 the author, accompanied by Walter Granger, led the American Museum expedition which yielded a rich collection of primitive mastodonts.. Africa is now definitely proved to be the homeland from which no less than fourteen different branches of mastodonts and elephants spread northward to populate the whole world except Australia. 'The farthest north' was reached by only the Woolly Mammoth, whose romantic habits of life and migrations are described in the present article.—THE EDITORS.

THE woolly mammoth is the classic of palæontology; it is the first extinct mammal to be found by man; it is the first to be used as proof of a universal deluge; it is the first to be used as proof of the existence of a long extinct world of mammalian life antecedent to the deluge; it is the first to receive a scientific description in the Latin language; it is the first to receive a scientific name—*Elephas primigenius* or 'the first of all, or original, elephant.' It took nearly two centuries thus to baptize the woolly mammoth as the honored primate of the fossil mammalian world and to usher in the elaborate and intricate science of mammalian palæontology through which we now decipher the prehistory of the earth for the past thirty million years almost as clearly as if we were able to project ourselves back into these long corridors of time.

The romance of the woolly mammoth stretches back for thousands—perhaps for hundreds of thousands—of years to the time when the men of the Old Stone Age discovered that the ivory of the tusk of the mammoth and of other elephants was superior to bone for several utilitarian purposes, as well as for the expression of man's

The Jeffersonian mammoth was probably hairy, with a fine undercoating of wool in the winter season. Its tusks are incurved exactly as in the remotely related woolly and imperial species. Its concave forehead is quite distinct from that of the modern elephant. As found in Indiana, it measured $10\frac{1}{2}$ feet at the shoulder

After the original painting y Charles R. Knight

JEFFERSONIAN MAMMOTH OF INDIANA

sculptural instinct. Thus the ivory tusks of the three mammoths depicted on the cover of NATURAL HISTORY by Mr. Arthur A. Jansson are appropriately designed as an introduction to a recital of this romance. At all times, from the very beginning of the Age of Man or close of the Pliocene period when, on the authority of Charles Depéret, its ancestors first appeared in the warm forests of Italy, the woolly mammoth has kept its beautiful, brightly shining tusks sharpened at the tips, both for prowess in combat for the mastery of the female herd, and to further the efforts of the young mothers to ward off the many enemies that might surround and attack the baby mammoths straying for a moment from the sheltering maternal

After the mural painting by Charles R. Knight

WOOLLY MAMMOTH, SOMME RIVER, FRANCE

This mammoth is a little more than 9 feet at the shoulder, whereas the Jeffersonian mammoth is $10\frac{1}{2}$ feet and the imperial mammoth 13 feet. The painting closely follows the drawings in the cavern of Combarelles (p. 241). The rapidly sloping hind quarters of the animal serve as a water-shed for rain and sleet

After the original painting by Charles R. Knight

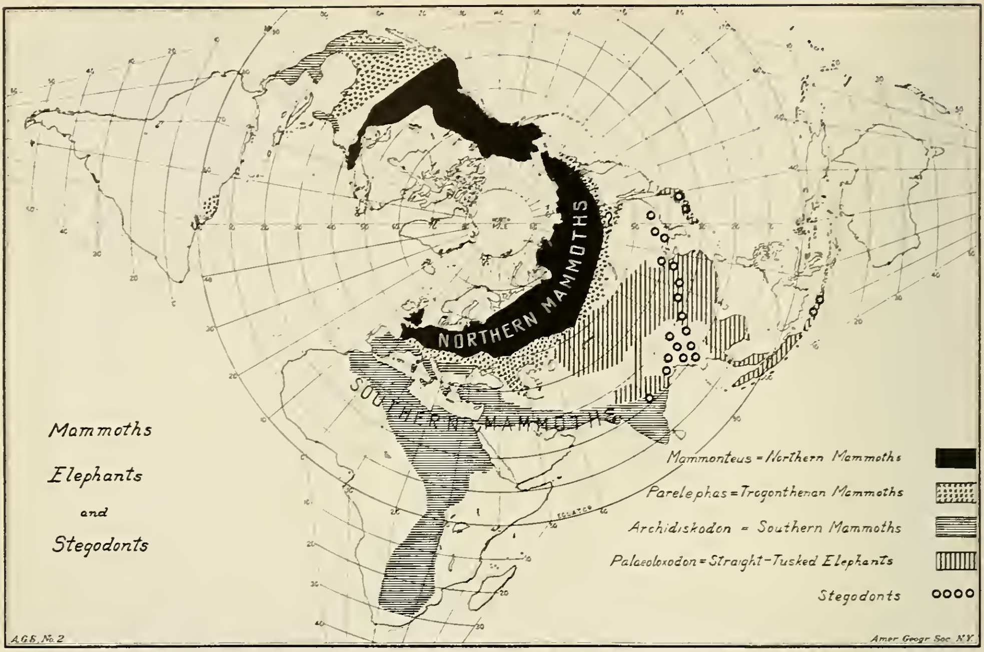
IMPERIAL MAMMOTH OF NEBRASKA

This superb animal, first named *Elephas imperator* by Leidy, stands fully 13 feet at the shoulder—4 feet taller than the woolly mammoth but with similar curved tusks and sloping hind quarters. The best skeleton is in the Nebraska State Museum (*Archidiskodon imperator maibeni*); the finest cranium is in the zoological museum of the City of Mexico. The animal ranged from Nebraska to Mexico. Like the Indian elephant, it probably had little hair and no wool

side. It is only when the old bull mammoths retire from their paternal duties to a quiet, bucolic life on the northern tundras that the ivory tusks begin to curl inward, even to the crossing point, thus rendering them useless both for purposes of combat and for herd protection. This is true also of the Jeffersonian and the imperial mammoths of North America.

Similar tusks glisten today in the African and Indian elephant, their beautiful 'ivory-white' contrasting with the somber gray sides of these animals, just as during the million-year Stone Age they contrasted with the hairy and woolly covering of the mammoth of the North.

Upon observation, however, a very important difference between all the mammoths and the living elephants is revealed in the curvature and uses of the tusks, namely, that the tusks of the mammoth, while emerging from the upper jaw closely side by side, soon begin to spread apart and then, slowly rotating on their axes, turn inwards toward each other to finally form a huge ivory circle with tips actually crossing. It was to this great wheel-like circle that one of the first authorities applied the name *Dicyclotherium.* A similar ivory circle around the large proboscis is also observed in two other extinct elephants to which for this and other reasons the name 'mammoth' may be applied: these are the Jeffersonian mammoth, *Parelephas jeffersonii*, probably a hairy type lacking the heavy undercoating of wool of its northern relative, which roamed from the north temperate region to about N. Lat. 40° over France through Germany to the United States; also the imperial mammoth, *Archidiskodon imperator*, probably hairless, with



GEOGRAPHIC DISTRIBUTION OF MAMMOTHS IN UPPER PLIOCENE AND PLEISTOCENE TIMES

Relatives of the southern imperial mammoth, *Archidiskodon imperator*, are now known to have ranged from South Africa to India and from Nebraska to Mexico. The temperate Trogontherian and Jeffersonian mammoths of the genus *Parelephas* ranged along the 40th parallel from southern France to central United States. The northern mammoth, of the genus *Mammonteus*, ranged about the Arctic Circle from western Europe to eastern North America

great incurved ivory tusks that attained a gigantic size in its antecedents of the more southerly latitudes of Europe and Asia. As shown on the map above, these three mammoths—the 'woolly,' the 'Jeffersonian,' the 'imperial'—formed three great mammoth belts around the Northern Hemisphere which were as sharply demarcated as are the reindeer, the moose, and the stag, or wapiti, belts today.

We know that Stone Age man hunted the bone of the elephant and mastodon for a million years, for we find that the Piltdown Man of Upper Tertiary time fashioned one of the long bones of the mastodon for a tool; it is not improbable that he tried to fashion the ivory tusks as well, although we have no proof of this until ivory carvings are discovered toward the close of the Old Stone Age. Certainly ivory has been treasured by man for thousands of years. Primitive traders carried ivory from point to point. It is not surprising, therefore, that man knew about ivory long before he knew about its source. Thus, again, in the early and wide-spread quest of ivory by man for utilitarian and artistic purposes it is not surprising that the word 'ivory' is the actual source of the scientific name *Elephas*, a Greek term of vague linguistic origin, subsequently Latinized. Homer used this Greek term not in reference to the elephant itself but to its tusks or 'ivory.' With both Homer and Hesiod the word *Elephas* means ivory. Aristotle (384–322 B.C.) in his *History of Animals*[1] used ἐλέφας in its modern generic sense as applying to the elephant

[1]Translation by Richard Cresswell, London, 1887, p. 234.

of India, in referring to its courage in combat:

. . . Elephants also fight fiercely with each other, and strike with their tusks; the conquered submits entirely, and cannot endure the voice of the victor: and elephants differ much in the courage they exhibit.

The word 'mammoth' has a similar non-classic and indirect origin. In allusion to the fact that the Tatars of Siberia first discovered the ivory tusks by digging in the earth, the word 'mammoth' is probably derived from the alleged Tatar word *mamma*, signifying 'earth.' As early as 1696 this was combined with another Tatar word *kost*, signifying 'ivory,' and the two words were Latinized by Ludloff into *Mammontova Kost*. The buried tusks were sometimes mistaken for horns; Cuvier alludes to these words of Tatar origin as follows: "C'est sous le

THE MAMMOTH PIT OF VĚSTONICE, MORAVIA
Beneath the loess-covered limestone hills of Věstonice was discovered this station, more than 130 square metres in extent. Here three heaps of mammoth tusks were piled in orderly fashion by Lower Aurignacian hunters. (After photograph by Doctor Absolon)

STRATA OF THE PEKÁRNA CAVE, MORAVIA
New and Old Stone Age strata, from historic time downward to Lower Aurignacian—altogether ten distinct layers, representing a period which Doctor Absolon believes extended over 100,000 years. The mammoth layer is contemporaneous with the Lower Aurignacian. (After photograph by Doctor Absolon)

nom de *cornes de mammont*, *mammontova-kost*, qu'ils désignent les défenses." Thus in the Latinization of the Tatar word *mamma* into the Gallic *mammont* there was assigned by Camper in 1788 the name *Mammonteus*, which is now applied by Osborn to the woolly mammoth as a genus distinguished in many external and internal characters from the genus *Elephas* which is typified by the elephant of India.

Thus apparently originated the word 'mammoth,' variously spelled in different languages *mammot*, *mamant* (Russian), *mammouth* (French), *mammuth* (German), from the Tatar *mamma* because the remains of these animals were found imbedded in the earth, the natives therefore believing that the animals burrowed like moles. Undoubtedly the woolly mammoth was in its time the colossus of living mammals of northern or western Europe; in consequence the word 'mammoth' has become a con-

(*Above*)

THE MAMMOTH PIT OF VĚSTONICE, MORAVIA

Another view of the mammoth pit of Věstonice shown on page 231. Mammoth skeletons are strewn over the floor. (Photograph by Doctor Absolon)

After Photograph by Doctor Absolon

(*Left*)

GIANT KILLING STONE OF THE MORAVIAN HUNTERS

Doctor Absolon interprets the large stones found in the cave as the weapons with which the mammoths were killed after being trapped. (See frontispiece)

venient adjective to signify gigantic, immense, of great comparative size. As a matter of fact, the woolly mammoth is a dwarf in comparison with its relatives, the Jeffersonian and imperial elephants, as is shown in the illustrations by Knight which have been brought to uniform scale for the present article (Pages 228 and 229).

Long before the elephant was known in Europe, Phœnician traders brought ivory from the South to Greece; in the North it was also procured in the tusks, the average weight of which was 288 pounds, of the more or less fresh or partly frozen bodies of the woolly mammoths. This northern source of the primitive ivory trade has been thoroughly studied in recent years by Basset Digby (1926), Pfizenmayer (1926), and Tolmachoff (1929), and also summarized by Herbert Lang (1925). In Tolmachoff's recent and comprehensive memoir[1] is found a map (Page 234) and a list of not less than thirty-nine localities where frozen carcasses have been found, beginning with Ysbrand Ydes (1692) and ending with Andrews' discovery of 1923. The author gives due credit to the works of Basset Digby and of Pfizenmayer. He also gives a most detailed and interesting history of the progress of discovery of the woolly mammoth, *Elephas primigenius*, and of its woolly companion, *Rhinoceros antiquitatis*, the 'rhinoceros of antiquity.' The export ivory industry of Siberia, dating back to very ancient times, furnishes a very good idea of the immense number of mammoths that have been discovered by exploring parties in the frozen ground of Siberia, estimated by Middendorf (1885) at 20,000 during the past two centuries and by Nordenskiöld (1882) at a very much higher figure. The highest estimate is 46,750 for the last two and a half centuries, although one estimate even puts the number at 250 specimens annually, a total of 62,500 for the two hundred fifty years. The northern ivory trade to China is now traced back as far as 500 B.C. Doubtless the value of northern ivory rose as the Chinese gradually exterminated their own native or imported breeds of elephants from India.

[1]I. P. Tolmachoff: The Carcasses of the Mammoth and Rhinoceros Found in the Frozen Ground in Siberia. *Transactions of the American Philosophical Society*, N.S., Vol. XXIII, Pt. 1, 1929.

Herbert Lang notes[1] that Ides, the famous Dutch traveler and ambassador to China, seems to have been the earliest to gather first-hand information regarding the frozen Siberian mammoths. In traversing northern Siberia between the years 1692 and 1695, Ides learned that many of the Yakuts, Tunguses, and Ostyaks steadfastly believed that these huge monsters spent their lives deep underground, moving about easily in spacious tunnels even though the earth was thoroughly frozen. Should they become particularly active, the whole ground might rise above them, caving in later as they passed on; but should they come to the surface and breathe the warm air, they instantly died.

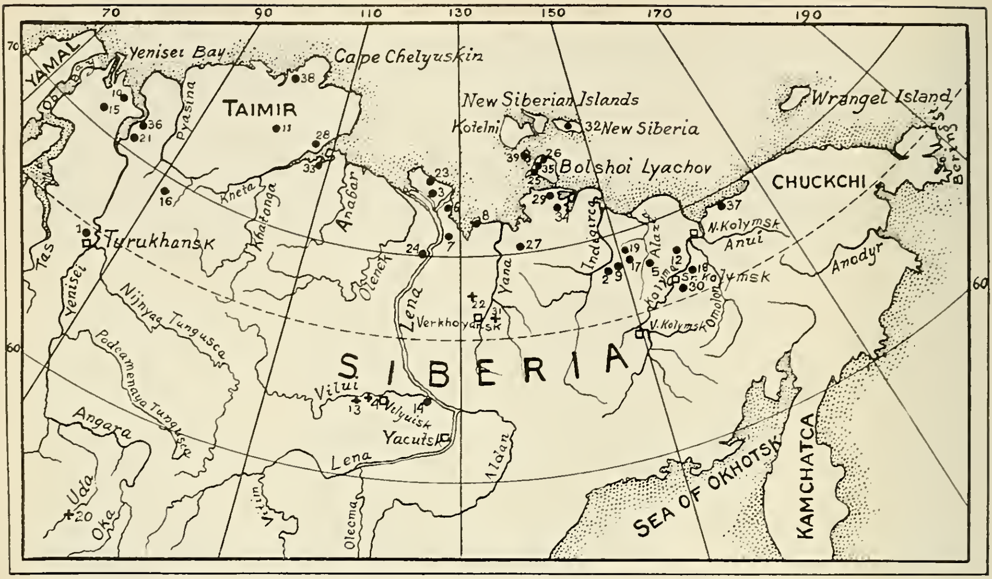
Like many other fossil mammals the mammoths appear to have become rather suddenly extinct after the climax of the Old Stone Age, namely, during the slow northward recession of the final great glaciers of Scandinavia and North America. The cause of their disappearance at the very moment when they reached the highest degree of specialization and perfection of their grinding teeth (Page 240) is a mystery; it is attributed by Tolmachoff to further specialization and by Howorth to the universal flooding which accompanied the sullen northward retreat of the great glaciers. A more likely explanation is that during this unfavorable period the herds may have become numerically reduced by underfeeding through lack of grassy food during the summer season. During these decades the underfed mothers were probably unable to protect their young from the attacks of wolves and other carnivorous mammals. Fortunately for us, during the height of their supremacy in western Europe they had been superbly drawn, modeled, and painted by the artists of the closing period of the Old Stone Age. In fact, it was not very long after the recognition of the woolly mammoth as a true fossil that man was also discovered in the fossil state.

It seems as if the very gradual recognition of the woolly mammoth as actually an extinct elephant extended well over a whole century; in 1696 the Russian explorer Ludloff described the mammoth of Siberia under the name *Mammontova Kost;* two years later the German scholar Tentzelius defended against all sceptics the discovery of a really fossil elephant at Burg-Tonna near Gotha, but this classic skeleton has recently proved to belong not to the mammoth family but to the

[1]Herbert Lang: Problems and Facts about Frozen Siberian Mammoths (*Elephas primigenius*) and Their Ivory. *Zoologica,* Vol. IV, No. 2, 1927.

SKULL AND TUSKS OF THE WOOLLY MAMMOTH

Skull and half-grown tusks of a middle-aged male specimen of *Mammonteus primigenius* found on the Yukon River, Alaska. With advancing age these tusks would curve inward and cross in the middle line



MAP OF THE DISCOVERY SITES OF FROZEN CARCASSES OF THE WOOLLY MAMMOTH AND RHINOCEROS

The discovery sites of the woolly mammoth are indicated by black dots (•) and those of the woolly rhinoceros by crosses (+). (After Tolmachoff, 1929)

straight-tusked elephant family known as the 'elephant of antiquity'; in 1728 Sir Hans Sloane confirmed the finding of Tentzelius by reference to the discovery; seven years later (1735) John Phil. Breyne wrote to the Royal Society as follows:

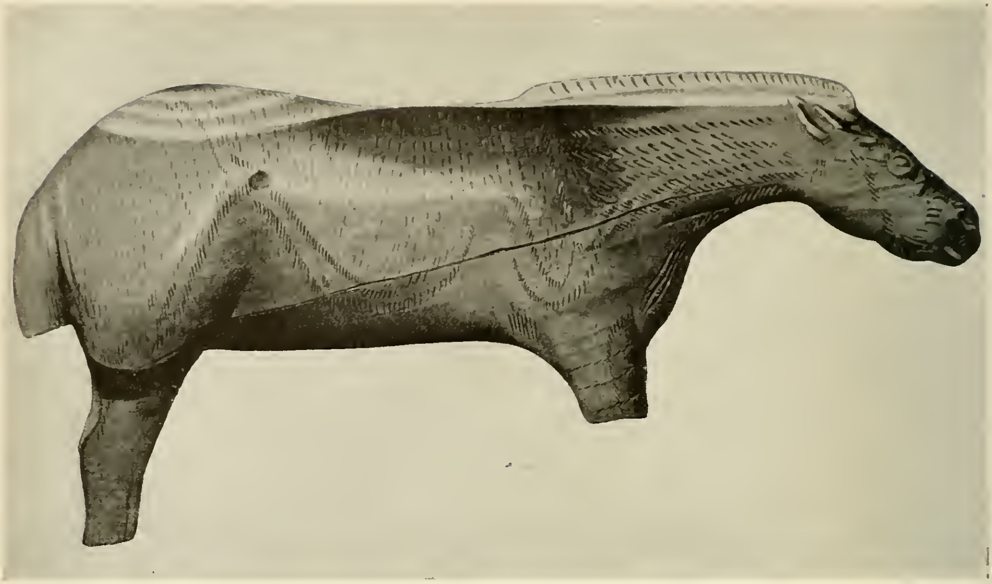
> . . . I was busied . . . to prove, that the extraordinary large Teeth and Bones found under Ground, and digged up in several Places of *Siberia*, by the name of *Mammoth's* or *Mammut's*, Teeth and Bones, were,
>
> I. True Bones and Teeth of some large Animals once living; and,
>
> II. That those Animals were *Elephants*, by the Analogy of the Teeth and Bones, with the known ones of *Elephants*.
>
> III. That they were brought and left there by the universal Deluge. I made likewise several useful Inferences about this matter.

The first finely etched figure of the cranium of the mammoth brought by Messerschmidt from Siberia was published by Doctor Breyne in 1737 [1741?]. Thus step by step the way was prepared for Blumenbach to name the animal in 1799 and for the great Cuvier to thoroughly describe it in a series of memoirs between 1796 and 1834. Since that time our knowledge has advanced by leaps and bounds. The first bones of the mastodon found on the banks of the Hudson River in 1705 and of the Ohio River in 1739 were naturally confused in Europe with those of the mammoth when Blumenbach first labeled them *Ohio incognitum* and then *Mammut*. A century later, in 1842, DeKay described his *Elephas americanus*, a fossil mammoth tooth found in Monroe County near Rochester, New York. Finally, in 1924, the present author described his *Mammonteus primigenius compressus*, the most highly specialized and perfected mammoth thus far found, as known both near Rochester, Indiana, and in Alaska (see page 240).

Beginning with the discovery of a complete frozen mammoth skeleton—known as the Adams' mammoth—near the mouth of the Lena River in 1799, other complete skeletons were unearthed and mounted in the museums of St. Petersburg, Leipsic, Stuttgart, and Brussels, all closely similar in size, in the wheel-like curvature of the great tusks, in the extraordinary foreshortening of the skull (Page 240), in the rapid falling away or sloping of the hind quarters, in the shortness of the backbone and of the tail, in the reduction or complete loss of one of the digits of the hand—briefly, in the truly marvelous adaptation, in every part of the skeleton as well as in the teeth, to the very severe conditions of boreal life. In 1912 Felix described a mammoth found near Borna, whose death must have been so sudden that the animal did not have time to swallow a mouthful of food which lay in the form of a wad between the upper and lower teeth; in the stomach of this animal were about twenty-four pounds of undigested plant food, exceedingly interesting because it consisted of plants that are still native to the place (Berezovka River, northern Siberia), the tundra flora which the mammoths stored up during the short summer season for the long winter. These plants are *almost exclusively grasses* and form the characteristic meadow flora; the needles of conifers occur very rarely. From other discoveries we know that the mammoth fed during the winter on the arctic willow, *Salix polaris* of *Wahlenberg*, and on other northerly dwarf plants.

The description by Felix not only gives us complete knowledge of the skeleton of *Elephas primigenius* but shows conclusively the proper position of the tusk in the jaw and also its inclination. As to the animal's outward appearance, it involved a number of corrections in even the best reconstructions that had been made; the proportion of the length of skull and trunk in the mammoth is quite different from that of existing elephants: in the mammoth the skull is more than half the trunk length, in the elephant (*E. indicus*) it is always less than half. The

THE CHARGING MAMMOTH OF THE UPPER STONE AGE
This figure is engraved on the classic ivory tusk of La Madeleine, now in the Natural History Museum of Paris. As fully set forth in the text of the accompanying article, it represents the animal as he appeared in summer. (After E. Lartet.)



EQUINE IVORY STATUETTE FROM LOURDES
This statuette, found in the Grotte des Espélugues at Lourdes, is carved from mammoth ivory. Twice natural size. (After J. Pilloy in Edouard Piette's *L'Art pendant L'Age du Renne*, 1907.)

mammoth's head, therefore, was higher and larger in proportion to the body than that of recent elephants and in consequence the tusks could attain enormous proportions. The largest of the tusks in the Leningrad Museum measures no less than 13 ft. 8 in. and in the Franzens-Museum of Brünn there is a tusk that actually exceeds 16 ft. 5 in. in length, including the long basal portion of the tusk which was incased within the exceptionally long tube-like premaxillary bones shown in our figure (Page 240) of the female mammoth skull of Indiana, the type of Osborn's *M. primigenius compressus*.

The trunk of the mammoth was extremely well developed. The ear was somewhat smaller than that of the Indian elephant, being about 15 in. in length and 6.7 in. in breadth, and, like the rest of the body, was covered with a thick coat consisting of short wool and longer hair. The tail is conical in form, about 14 in. broad at the root, sharply pointed at the end where it terminates in a bunch of bristles. The skin was extraordinarily thick and underneath it was a layer of fat up to 3½ in. deep. The whole body was thickly covered with fine soft hair about an inch long, varying in color from faded blond to yellow brown; coarser and longer hair, sometimes 20 in. in length, of a dark, rust-colored brown, covered the entire neck and trunk, perhaps forming a fringe of hair still heavier and thicker from the cheeks along the shoulders and sides to the rump.

The above details regarding the external appearance of the mammoth are given very fully because they enhance the reputation of the Old Stone Age artists not only as close observers but as portrayers with marvelous fidelity of the external appearance of the woolly mammoth. Among the very numerous etchings, drawings, and paintings there is one which possesses high artistic merit as truthfully depicting the characteristics of the charging mammoth (Page 235). The majority of these etchings and sculptures, as fully enumerated[1] in MacCurdy's encyclopedic volumes, are of the modern comic supplement order; they give the impression that our Stone Age ancestors were struck only with the humorous side of the mammoth as he appeared in the full panoply of his winter coat. But our increasing knowledge of these animals, derived from study of the frozen skeletons of Siberia and from the extremely close studies which Osborn is making in the preparation of his memoir, *The Evolution of the Proboscidea*, assures us that even the crude outlines on the walls of the cavern of Combarelles (Page 241) are not of the comic supplement order but are very truthful portrayals of the woolly mammoth as he actually appeared during the winter season, rounded out with his huge thickness of fat (three and a half inches in places) over the entire body and with a woolly covering extending down to his very hoofs and masking the muscular outlines of the limbs beneath. His extremely elevated head was followed by a deep nick or indenture of the neck, then by the rising hump of the back which sloped rapidly downward into the depressed region of the pelvis and terminated suddenly in a short, blunt tail.

IVORY FIGURINE FROM BRASSEMPOUY
Front and top views of a woman's head carved on ivory, found in a state of perfect preservation. (After J. Pilloy in Edouard Piette's *L'Art pendant L'Age du Renne*, 1907)

Thus the apparent caricatures of the Stone Age artists are realities; the mammoth in his winter pelage was even more disguised than the yak of Tibet. The sloping hind quarters served admirably as a watershed for the torrents of sleet and rain and the whirlwinds of snow that raged during the northern blizzards. Not only this, but the apparently weak and sloping hind quarters were all that the mammoth needed for the forward propulsion of his body, since, unlike all modern elephants, he never used his tusks for digging or uprooting purposes; consequently the hind limbs were not propellers of the body as they are in the African and Indian elephants of today. Another important feature is the bulbous or well-rounded

[1]George Grant MacCurdy: *Human Origins.* Vol. I, 1924, p. 265.

IVORY FIGURINE FROM BRASSEMPOUY
Back and profile views of the ivory carving shown above. (After J. Pilloy in Edouard Piette's *L'Art pendant L'Age du Renne*, 1907)

forehead, which rises like a sloping dome at the top of the otherwise pointed head; this swollen forehead, we are sure, was a food reservoir for the winter season which disappeared as winter advanced into spring, when the deep fatty covering all over the body was exhausted and the animal began to assume the normal outlines and proportions of other elephants.

This interpretation is to our mind absolutely demonstrated by the contrast between the comic outlines of the Combarelles mammoths of midwinter and the wonderfully spirited charging mammoth of midsummer engraved on a section of mammoth ivory tusk discovered beneath the Magdalenian shelter of La Madeleine along the Vézère River, reproduced with slight modifications on page 235. Here we see that the round fatty outlines of winter give place to those which conform very closely to the lean profile of the summer season; the high, peaked skull especially, with its characteristic concave forehead, affords us a view of the actual summer profile of the mammoth which corresponds with that of the Indiana mammoth shown on page 240. The classic Magdalenian engraving is one of the most realistic pieces of Palæolithic art that has ever been found; there are indications that the artist used the relatively small piece of ivory for the representation of three mammoths, for the tusks and trunks of two other elephants appear in the distance. Observe especially the outline of the ear, the elevation of the highly peaked, acrocephalic head, and the remarkably lifelike action of the limbs and body.

ARCHED TUSKS OF THE AFRICAN ELEPHANT

Giant arched tusks of the African elephant, 11 feet in length, presented, by Charles D. Barney to the Heads and Horns Collection of the New York Zoological Park

Toward the close of the Old Stone Age there began the wide-spread custom of the ceremonial burial of the dead to which we owe our really remarkable knowledge of the great hunting races that swarmed over central and western Europe during closing glacial time, succeeding the last of the Neanderthal race which seems to have had full possession of the river shores and caverns at the height of the fourth or last descent of the Scandinavian glaciers. Largely known by their flint implements found in the burials of hunters and warriors of Neanderthal time, we know little of their prowess; the Neanderthal flint implements are relatively small and clumsy and it would appear that the Neanderthal hunters were not equipped to pursue the large and formidable woolly mammoths of their time.

Succeeding the Neanderthals, however, was another race, probably from the Far East of central Asia, first found buried in the cavern of Aurignac and hence known as man of the Aurignacian stone culture. This race is known as the Brünn or Předmost; they are long-headed, with a narrow, short face and rather prominent brow ridges, and with brain development inferior to the broad-faced, artistic Cro-Magnons who drew and painted the mammoth. The Brünn people were apparently more interested in eating the mammoth than in depicting it, but they have left some sculptures in bone and ivory of both animal and human figures. This was one phase of the Brünn Aurignacian culture, but their culture is more largely known by their stone implements adapted to the making of clothing and to the killing of smaller kinds of animals—none of the Aurignacian implements so far found in western Europe was adapted to the chase of larger game. Evidence of the killing and consumption for food of a great number of the wild horses of the period has recently been found near Solutré in southern France, but, so far as I know, without the accompaniment of very large flint implements of the chase.

The discovery of giant killing flints by Dr. Carl Absolon of the University of Prague and the Museum of Brünn, one of the most distinguished archæologists of central Europe, is therefore a revelation not only of the pursuit of the woolly mammoth for purposes of food, but of the killing methods employed, whereby the animals were driven into great pits and then felled by giant stones let down by their captors. These stones appear like greatly magnified *coups de poings* of the long bygone Chellean and Acheulean age. The following passages may be cited from his recent description of his remarkable discoveries in the years 1924–1929 of mammoth-hunting stations of Moravia:[1]

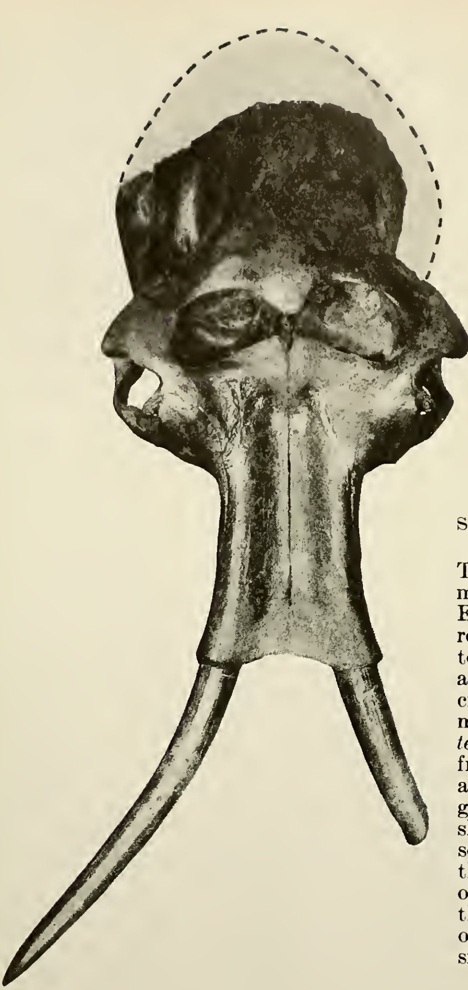
CIRCULAR TUSKS OF THE WOOLLY MAMMOTH OF SIBERIA

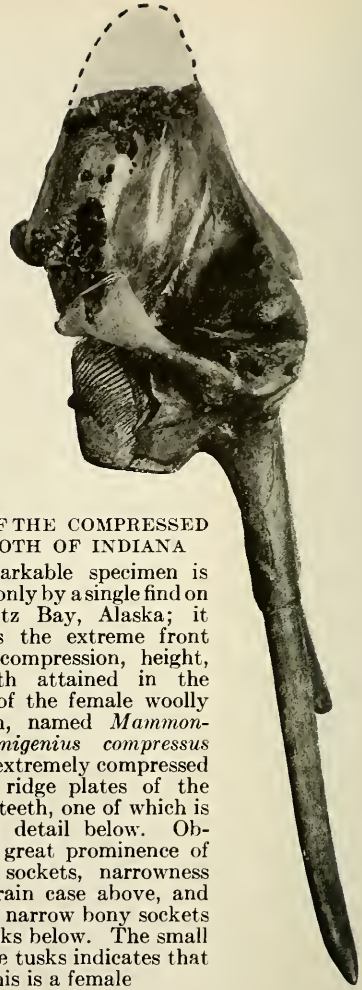
Contrast these circle-shaped tusks, 8 feet in length, of the male woolly mammoth of Siberia with the arched tusks of the African elephant shown on page 238

Moravia was a kind of passage, by way of which the fossil mankind of the increasing Aurignacian tribe penetrated from Asia through Russia, to the West of Europe. . . . Of these [Lower Aurignacian] stations we now know about one hundred in Moravia, but only a small part of their area is explored as yet. . . . . They are: Věstonice, Předmostí, Petřkovice, Pekárna, and Ondratice. Pekárna is a cave; the rest of them are in loess on the slopes of hills. Pekárna is the most important, Věstonice the largest of them. . . . This was the first culture of the Old Aurignacian invasion of mammoth-hunters coming from Asia, the cradle of mankind.

. . . One thing is certain—namely, that the mammoth-hunters killed these huge pachyderms in hundreds, and that in diluvial Moravia a great tragedy, like the destruction of elephants in Africa, took place. . . . In the refuse-heap discovered in 1925, no tusks were found in the whole area of 45 square metres; but in that encountered in 1926, on the other hand, three heaps of tusks were piled one over another, between which was left a narrow path (page 232). In the same year an imposing sight opened before our astonished eyes, when we discovered a field of huge pelvic bones of adult mammoths. The skulls are usually broken to pieces, because mammoth-brain was appreciated by primitive hunters as a delicacy. Nevertheless, we found an intact skull of strikingly large proportions in 1928. Long bones (femurs, tibiæ) were found also in strange position forming a half-circle, so that their broken ends all pointed in one direction: evidently the fire was kept alight by the fat which flowed out of the ends of the burning bones into the flames.

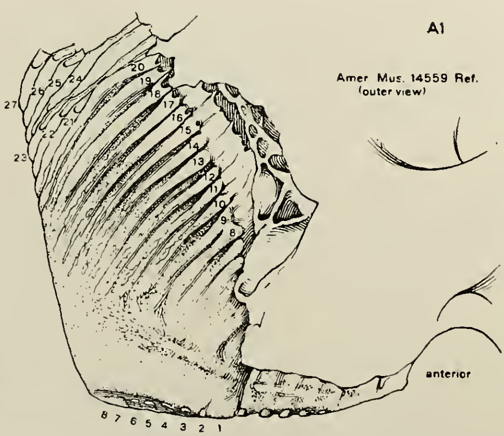
[1]Carl Absolon: An Amazing Palæolithic "Pompeii" in Moravia. *Illustrated London News*, November 23, 1929.





SKULL OF THE COMPRESSED MAMMOTH OF INDIANA

This remarkable specimen is matched only by a single find on Eschscholtz Bay, Alaska; it represents the extreme front to back compression, height, and depth attained in the cranium of the female woolly mammoth, named *Mammonteus primigenius compressus* from the extremely compressed and tall ridge plates of the grinding teeth, one of which is shown in detail below. Observe the great prominence of the eye sockets, narrowness of the brain case above, and the deep, narrow bony sockets of the tusks below. The small size of the tusks indicates that this is a female



GRINDING TOOTH OF *MAMMONTEUS PRIMIGENIUS COMPRESSUS*

Detailed aspect of the remarkable compressed superior grinding tooth of the right side of the compressed skull shown above. Here we observe no less than 27 ridge plates, separately numbered in the drawing, whereas there were only 24 ridge plates in the typical *M. primigenius* of northern Europe, Alaska and the United States. This is the most elaborate dental mechanism ever found in any mammal

THE CLIMAX OF THE "COMPRESSED" MAMMOTH EVOLUTION IN AMERICA

Lower jaw-bones lie generally apart, and the teeth have often been knocked out and piled up in heaps. In 1927 we found at Předmostí a jaw-bone within which was a red-painted stone club which might have been used for striking out the teeth from the jaw-bones—a unique discovery. From 1924 to 1929 we counted as many as sixty mammoths, all of them caught and killed by man, on the area of 1600 square metres.

There cannot be the least doubt that the hunters did not attack these powerful animals face to face, but caught them by cunning, enticing or driving them into large pitfalls. . . . Mammoths trapped and caught were killed by large stones, trimmed to serve such a purpose. I have found one such stone, trimmed like a big pear, or bomb, 1 metre long, and weighing over 120 pounds (Page 232). These stones might have been suspended in strong leather straps and thus let down on the animals by the united efforts of several men, in the same way that navvies drive piles into river-beds by means of rams.

The woolly mammoth appears to have ranged almost exclusively north of the 40th parallel; it loved the borders of the retreating glaciers of the close of the Glacial Age both in Europe and North America. In Alaska it was extremely abundant and was occasionally found in frozen form along the ancient shores of Eschscholtz Bay. Alaska, broadly connected with the Asiatic mainland by a great isthmus bounded on the south by the present mountain peaks of the Aleutian Islands, yields abundant remains not only of the true woolly mammoth closely similar to the *E. primigenius* of Blumenbach, but also an extremely rare and highly specialized grinder (Page 240) to which the specific terminal *compressus* was recently applied by Osborn in descriptive relation to the exclusively compressed and fine-plated grinding teeth which attain the very high number of 27 compressed ridge plates above and below, in comparison with the 24 ridge plates above and below in *E. primigenius* of Siberia and western Europe. This proves that the marvelous adaptability of the mammoth did not cease when he entered the continent of America but reached even a higher point of specialization in his essential grinding tooth mechanism, just as we Americans pride ourselves today on our mechanical achievements.

This grinding tooth is a perfect marvel of adaptation and it is lodged below the very highly peaked cranium with a correspondingly deep depression and foreshortening of the jaw and approximation of the front and back planes of the skull which are so extreme as to appear almost artificial. It is this high, narrow, and deep skull to which the Greek adjectives hypsicephaly, acrocephaly and bathycephaly especially apply as absolutely unique in the animal kingdom; in adaptation to grassy diet it is the extreme antithesis to the long and relatively flat-headed cranium of the American mastodon which was the contemporaneous forest dweller of Alaska and as far south as Florida.

The woolly mammoth, however, like the polar bear, arctic fox, ptarmigan, and arctic reindeer, was at its best when in the severe climate of the far North, defying with its woolly covering the coldest arctic blasts. During the summer season it lost not a moment's time in laying in its grassy hoard for the coming winter, in comparison with its less hardy relative, the Jeffersonian mammoth of the mid-temperate region, and its subtropical and more remote relative, the imperial mammoth of the South Temperate zone.

THE NEW PLANET
A DRAMATIC DISCOVERY

A Brief History of the Planets Known to Science, and the Most Recent Triumph of Scientific Investigation

By CLYDE FISHER
Curator of Astronomy, American Museum

Then felt I like some watcher of the skies
When a new planet swims into his ken.
—John Keats

THE finding of a new major planet had occurred but twice since the dawn of history,—so one can understand the excitement occasioned during the early weeks of 1930 by the picking up of an ultra-Neptunian world. Predicted by the late Percival Lowell, and first "sighted" as a faint spot on a photographic plate, the discovery of the new planet was completely established by Director V. M. Slipher and the astronomers of his staff at the Lowell Observatory. A brief survey of the earth and neighboring worlds already known possibly will help us to appreciate this recent dramatic event, this triumph of scientific investigation.

To the ancients five planets were known, namely, Mercury, Venus, Mars, Jupiter, and Saturn. They, of course, did not know that the earth belonged to this group. In fact, for many centuries preceding the adoption of the Copernican theory of astronomy, it was thought that the earth was the center of the universe.

When we consider the matter, we realize that this geocentric notion was a natural conclusion to be drawn from observation. The sun was seen to rise in the east, to pass over the sky, and to set in the west, and the next morning it was again seen to rise in the east. It surely seemed that the sun went round the earth. The moon was seen to rise in the east, to pass over the sky and to set in the west, and the next day it was observed to rise again in the east. It also seemed that the moon went round the earth. (We now know the moon does go round the earth about once a month, but this motion does not account for its daily rising and setting.) The stars were also observed to rise in the east, to pass over the sky, and to set in the west, and the next evening the same ones were seen to rise in the east again. Thus it seemed that all the bodies in the sky revolved around the earth, and the earth seemed to be the center of the universe.

The great Ptolemy believed the earth to be the center of our family of planets, and his system was orthodox astronomy for fourteen hundred years. However, there came a time when this theory received a rude jolt. About the middle of the Sixteenth Century there was published a book by the great Polish astronomer, Copernicus, setting forth the theory that the sun is the center of our system of planets, and that the rising and setting of the various heavenly bodies is only an apparent motion due to the rotation of the earth on its axis.

Mercury is the innermost of the known planets, according to the Copernican system of astronomy. Although it is 36,000,000 miles from the sun, it is still so close to that huge incandescent body that it is generally overwhelmed by the light of the latter. It can be seen only when at or near its greatest eastern or western elongation, that is, when it makes the greatest angle with the sun. It is so close to the sun that it goes round that body in eighty-eight of our days. We are not quite sure whether Mercury has an atmosphere, but very probably not. It is believed that it keeps the same side toward the sun all the time, and that the temperature of that side is high enough to melt lead. Mercury, like all the rest of the planets, shines only by reflected sunlight, and since its orbit is inside that of the earth it goes through phases as our moon does, and for the same reason. If Mercury had any satellites, it is believed they would have been discovered at one of the recent transits of the planet across the sun.

Venus is the second planet in order from the sun, and it makes the circuit around that central body in 225 of our days. Venus comes closer to the earth than any other of the major planets. It comes nearly ten millions of miles closer than Mars. When at or near its closest position to the earth, Venus is the brightest object in the sky except the sun and moon. There are only two known planets that can go through the crescent phase,—one is Mercury and the other is Venus. The first person to see Venus as a waxing and waning crescent was Galileo. If Venus had any satellites, it is believed they would have been discovered at the last transit of Venus across the sun. Only two planets can come between us and the sun, namely, Mercury and Venus. The last transit of Venus occurred in 1882, the next will be in the year 2,004. Very little is known about the surface of Venus because of the dense, opaque

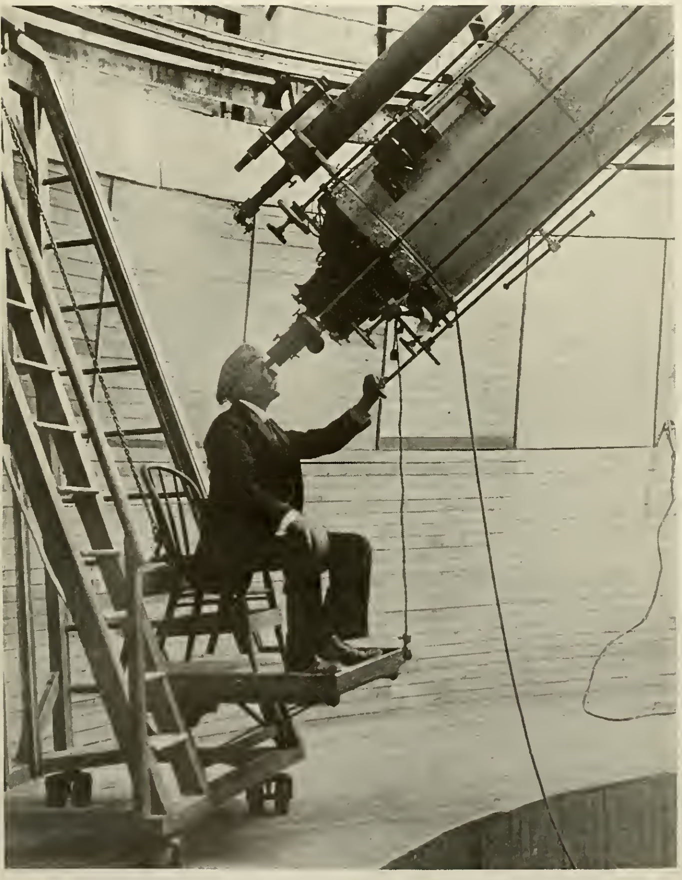
Courtesy of the Associated Press

THE NEWLY DISCOVERED ULTRA-NEPTUNIAN PLANET

This photograph was made by Lampland at the Lowell Observatory. The position of the planet is indicated by arrows. The large, bright object at the left is the star Delta Geminorum, which is about 3½ magnitude. The cross-shaped marks on the image of this star are caused by the supports of the mirror of the reflecting telescope atmosphere which surrounds the planet. This member of the solar system may have been given the feminine name because of its great beauty as a morning or evening star. When Venus is near the earth and the telescope reveals it as a thin crescent, resembling the new moon, the observer is no less charmed by the surprising beauty. Venus is now an evening star near Jupiter.

The earth is the third planet from the sun, although the ancients did not realize that it was one of the group of wanderers through the sky, five of which they knew besides. On our imaginary journey from the sun, the earth is the first planet that is known to have a satellite, and this satellite, which we call the moon, is the only body in the sky which goes round the earth. The moon completes this circuit in about four weeks, as can easily be observed. If one notices the moon on any particular night, he will notice on the next succeeding night at the same hour that it has moved eastward by about thirteen degrees, and this motion may be observed from night to night.

The mountains and craters on the moon were first seen by Galileo, through the first astronomical telescope ever made. These features of the moon's surface may be observed best at first quarter or on the two nights thereafter, or at the equivalent time about last quarter. At full moon there are no shadows to bring out the relief of the moon's surface. There are several ranges of mountains on the moon, the lunar Apennines being the most extensive. This is a slightly curved range four or five hundred miles long, and rivaling the Andes of South America in height.



THE FOUNDER OF THE LOWELL OBSERVATORY
Prof. Percival Lowell observing Venus in the daytime with the large refracting telescope of the Lowell Observatory. This photograph was taken about 1912

The so-called seas, so named by the ancients, are now known to be plains, for there is no water on the moon. A large part of the surface of the moon is abundantly covered by craters of all sizes up to one hundred miles in diameter, named for astronomers, philosophers, and others. The Crater Copernicus is fifty-six miles in diameter while the Crater Tycho has a diameter of eighty

TWO ASTEROID TRAILS

They are the long-shaped images among the round ones of the stars. The brighter trail is that of (28) *Bellona*. Photographed with the 10-inch Bruce lens at Yerkes Observatory. Exposure, one hour

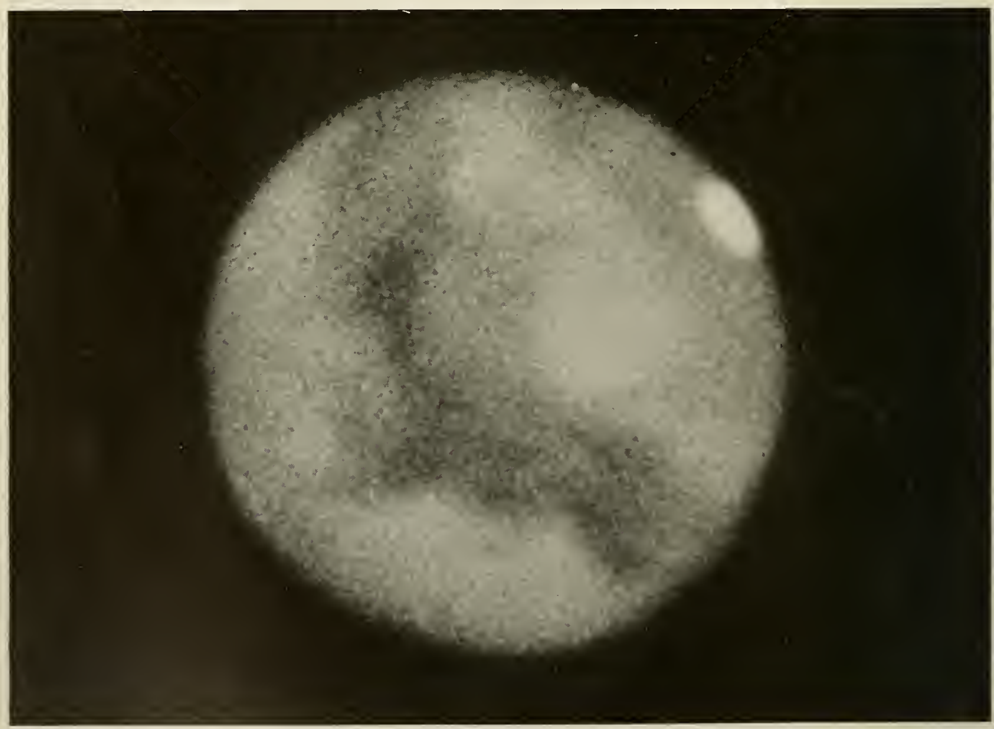
miles. Two theories for the formation of these craters have been advanced, namely, the volcanic theory and the impact theory. According to the former they are thought to be due to volcanic action in a manner similar to the formation of volcanic craters on the earth. According to the latter they are supposed to have been caused by the falling of meteorites or planetesimals into the moon. There is one crater on the earth which seems to give weight to this theory, and that is, Meteor Crater in Arizona. Aeons ago there may have been many more on the earth, but if so, the agencies of erosion would probably have removed them. Since there is neither atmosphere nor water on the moon, these craters, regardless of their origin, have probably changed little or none. Their large size, whatever may have been their origin, is probably correlated with the lesser force of gravity on the moon than on the earth. A man weighing 150 pounds on the earth would weigh about twenty-five pounds on the moon. Therefore volcanic matter, or matter thrown by the impact of a body falling into the moon, would be thrown six times as far as on the earth. The moon with its "seas" and mountains and craters is a magnificent object through even a small telescope. One's first sight of the moon through the telescope can never be forgotten.

Mars is the fourth planet from the sun, and next outside the earth. It is the one that appeals most to the popular fancy, on account of the perennial question of whether there is life on this neighboring world. Although Mars does not come as close to the earth as Venus, we are able by means of the telescope to make out much more about its surface, due partly to the greater transparency of the atmosphere of the former. Mars presents a ruddy surface relieved by darker areas, polar caps, and the much-discussed "canals."

The polar caps can be seen with a small telescope, and they have been observed to change in size according to

NEPTUNE AND ITS SATELLITE

The bright object to the left is a star. Photograph by Barnard with the 40-inch refractor at Yerkes Observatory



MARS

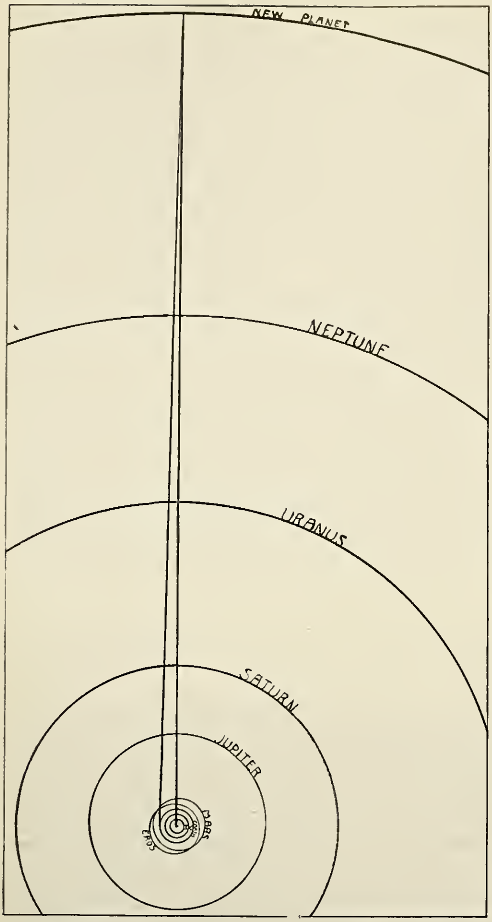
The south polar cap may be seen at the top; and Syrtis Major is visible as the dark wedge-shaped area pointing toward the north. Photographed by Barnard with the 40-inch refractor at Yerkes Observatory

URANUS AND TWO OF ITS SATELLITES

Uranus was discovered in 1781 by Sir William Herschel. Photographed by Hubble with the 24-inch reflector at Yerkes Observatory

SATURN

Some people consider this planet the most beautiful telescopic object in the sky. The rings here show Cassini's division. Photograph by Barnard with the 60-inch reflector at the Mt. Wilson Observatory



THE NEW PLANET IN RELATION TO THE SUN AND THE EARTH

To an observer on the new planet, the earth is so close to the sun that it cannot possibly be seen, except at a possible total eclipse of the sun by a satellite of the planet, if there be any. The narrow angle at the new planet gives the greatest angle subtended by the earth and the sun. Drawn by H. S. Rice

the season, just as the polar caps of the earth do, and it is believed for the same reasons.

The line-like markings on the surface of Mars, which were first designated "canals" by Schiaparelli, have occasioned much discussion. Whether they are waterways bordered by vegetation, thus making them wide enough to be seen through our larger telescopes, is still an unanswered question.

The axis of Mars is inclined almost the same as that of the earth; hence, the planet must have similar seasonal changes, since there is atmosphere and water on the planet, but on account of the longer time required for revolution around the sun (687 days), the seasons must be nearly twice as long as those on the earth. A Martian day is 24 hours and 37+ minutes in length.

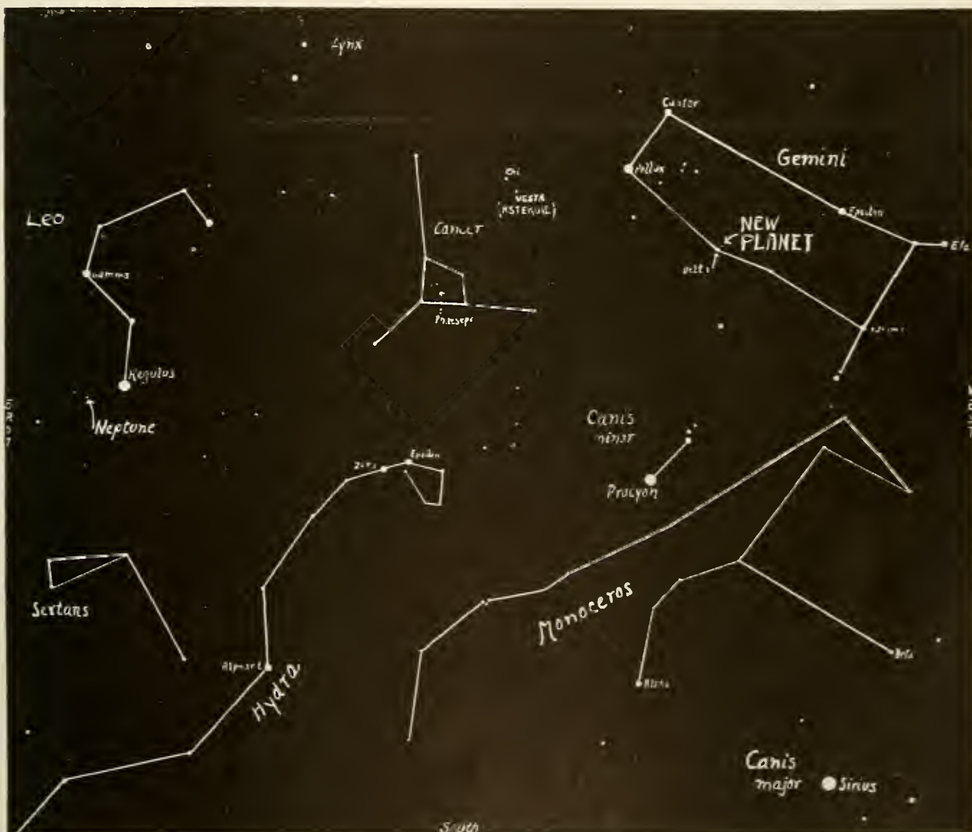
Two satellites are known, having been discovered at a favorable opposition in 1877 through the large 26-inch telescope of the U. S. Naval Observatory by the elder Asaph Hall. When discovered, these satellites were the smallest bodies known in the sky. Now some asteroids are known which are estimated to be smaller. Phobos, the inner satellite, revolves about the planet in less than eight hours, that is, less than one third of a Martian day. Therefore, it must rise in the west and set in the east. Phobos is the only satellite known to revolve about its primary in less than the primary's period of rotation.

Since the temperature of the surface of Mars has been measured and found not too low to preclude the possibility of life, and since there is air with oxygen, and since there is water as vapor in the clouds, which however are rare, and solid in the polar caps, and probably liquid,—these conditions considered together with the motions of the planet—it seems to be the concensus of opinion among astronomers that there is life on Mars. This planet is too near the sun at present to be well seen.

The asteroids are to be found next outside the orbit of Mars. About 1500 have been discovered. One of them, Eros, due to its eccentric orbit, comes closer to the earth than either Mars or Venus. To the astronomer, Eros is an important body,—for one reason it affords the most accurate method of calculating the distance from the earth to the sun. Eros will make a very close approach to the earth early next year, when it will be easily visible through a small telescope. Vesta, the brightest of these minor planets, is now in good position for observation with a small telescope. Last year an Austrian astronomer named a newly discovered asteroid *Hooveria* in recognition of Mr. Hoover's relief work in connection with the World War.

Jupiter is the next major planet outside of Mars, and it is also outside of the asteroids. It is the largest of the planets, and requires nearly twelve years to go round the sun. It rotates on its axis in a little less than ten hours. It has four large satellites and at least five small ones. The four large moons were discovered in 1610 by Galileo. The observed variations in the times of the eclipses of Io (one of the Galilean satellites) with the varying distance of the earth from Jupiter led Roemer in 1675 to make the first determination of the velocity of light. Jupiter presents only an outer surface of cloud, and definite bands in these surface clouds can be seen easily through a small telescope. The surface of Jupiter is cold, the thermocouple indicating approximately 100 degrees below zero Centigrade. Jupiter is now a conspicuous evening star not far from the Pleiades in the constellation Taurus.

Saturn, the sixth planet, is considered by some to be the most beautiful telescopic



A CHART OF A REGION OF THE SKY

Showing the position of the new planet on March 17, 1930. It will be noted that Neptune is near the first magnitude star, Regulus, in Leo; and that Vesta, the brightest of the asteroids, is near the beautiful star-cluster, Præsepe (the Bee-hive), in Cancer. Prepared by H. S. Rice

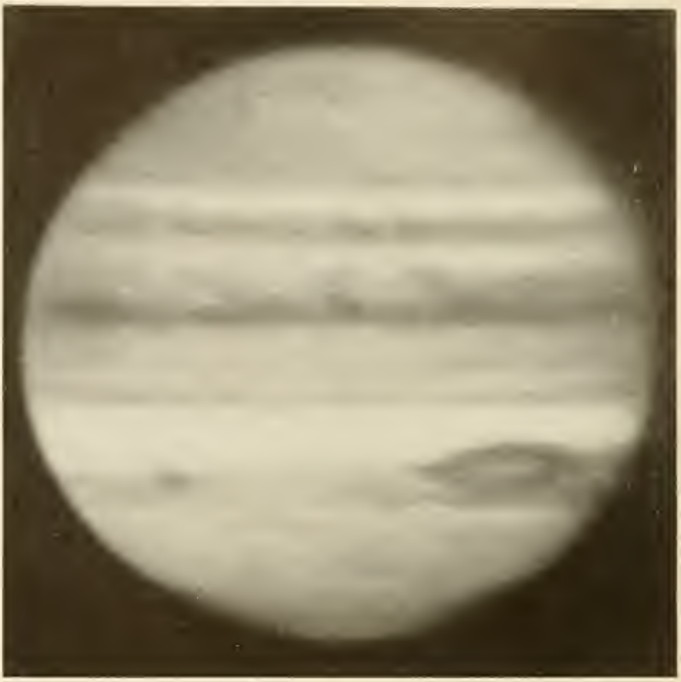
JUPITER

These three exposures on a small scale show changes in positions of the four Galilean satellites, due to their revolution around the planet. Photographed with the 10-inch Bruce Refractor at Yerkes Observatory

object in the sky, due to the rings, which were formerly referred to as "the fiery rings" of Saturn. Now it is known that these rings are composed of myriads of small solid bodies or moons, and that they are cold. Besides the rings, Saturn has eight relatively large satellites and one or two small ones. Saturn is so far from the sun that it takes nearly thirty years to go round the sun. Saturn is now a morning star in the constellation Sagittarius.

Uranus, the seventh planet from the sun, was discovered in 1781 by Sir William Herschel. He saw it as a hazy disc, slowly moving among the stars, and at first thought it to be a comet, and announced it as such to the Royal Society. Very soon, however, its planetary character was established, and Herschel named it Georgium Sidus in honor of the King of England. The name, "The Georgian," was used in the *Nautical Almanac* up to 1850, but it was disliked outside of England. Lalande proposed the name, "Herschel," which is found in some of the old books. Bode proposed the name Uranus. The planet has a revolution period of 84 years. Uranus has four satellites, the orbits of which are inclined to the plane of the planet's orbit and to the ecliptic more than 90 degrees, so that the motion of the satellites is really retrograde. Uranus is a telescopic object in the constellation Pisces.

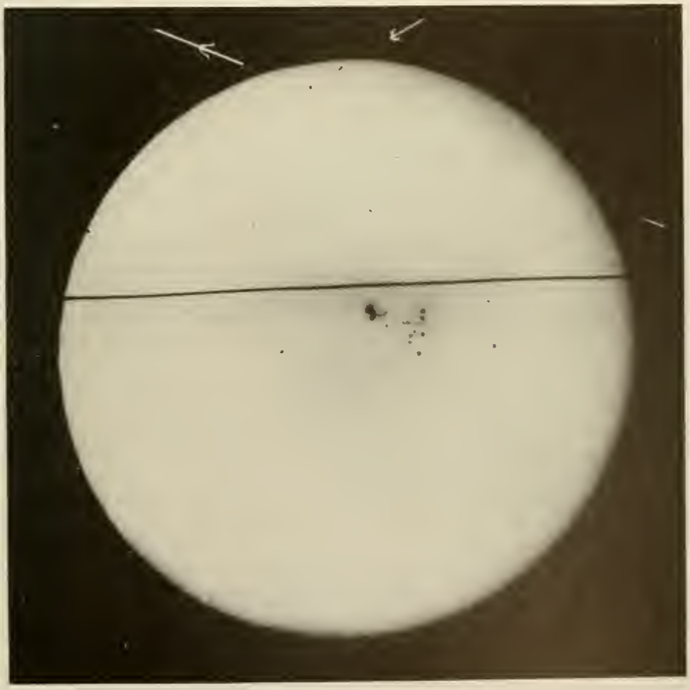
Neptune, the eighth major planet in order from the sun, was discovered in 1846, after its elements had been computed independently by Adams and Leverrier, the story of its discovery probably being the most dramatic event in the history of astronomy up to that time. The planet was found almost exactly where these two astronomers had calculated that it should be, from irregularities in the orbit of Uranus. Arago suggested that the planet be called Leverrier, and this name is found in some of the books published soon after its discovery, but the name was re-



JUPITER
Photographed by ultra-violet light, showing bands in the atmosphere. Courtesy of Yerkes Observatory

ceived with so little favor outside of France, that Arago withdrew it, proposing that of Neptune instead. Neptune requires nearly 165 years to complete one revolution around the sun. It has gone only about half way around the sun since its discovery. Neptune has one satellite, the orbit of which is inclined to the ecliptic 145°. Hence the revolution of this satellite is definitely retrograde. Neptune is a telescopic object near the first magnitude star, Regulus, in the constellation Leo.

On March 13, 1930, the scientific world and the general public were thrilled by the announcement of the discovery of a ninth major planet. On January 21st preceding, it had been "sighted" on a photographic plate as a faint spot, by Clyde Tombaugh, using a stereo-comparator. After this its motion was observed for more than seven weeks before public announcement was made of the discovery. Had it been a comet, it would have been observed to be moving rapidly toward or from the sun. The possibility of its being a comet was soon ruled out. By studying its motion, making allowance for the motion of



TRANSIT OF MERCURY, NOVEMBER 14, 1907

The planet is here shown near the top of the disc of the sun. Photograph by Fox with the 12-inch refractor at Yerkes Observatory the earth in its orbit, the revolution period of the new planet was approximately determined. Then its distance from the sun could be calculated from its period. This distance considered with its magnitude made possible the calculation of its size.

The new planet was found in the constellation, the Heavenly Twins, near the third magnitude star, Delta Geminorum. At Lowell Observatory it was estimated to be 15th magnitude. Since that time at Harvard Observatory it has been estimated to be 16th magnitude. It is probably about the size of the earth, at any rate much smaller than Neptune. Its distance from the sun is approximately 4,000,000,000 miles. Its period of revolution around the sun is estimated to be between 300 and 500 years.

Light, which travels 186,000 miles a second, or 11,000,000 miles a minute, takes more than six hours to come from the new planet to us. The sun's disc, if viewed from the new planet, would be about as Jupiter is to us on the earth.

Using thirty and forty-five astronomical units, respectively, for the distances of Neptune and the new planet, Neptune receives 1/900 as much sunlight as the earth, and the new planet receives about 1/2000 as much as the earth, but full moonlight of the earth is about 1/500,000 of sunlight. Therefore the sunlight received by the new planet is about 250 times as much light as our full moon gives us.

Judging from the experience in the cases of Uranus and Neptune, it seems probable that it will be given some mythological name in keeping with the custom which is so far universal.

The discovery of this new trans-Neptunian planet was soon corroborated by Yerkes and by Harvard, and doubtless ere this time by many observatories. It was a great triumph for the scientific approach, the existence of such a body having been indicated by certain unexplained irregularities in the orbit of Uranus. Doctor Slipher and his associates deserve the highest praise for carrying to completion a dramatic project.

VENUS IN THE CRESCENT PHASE
Photograph by Barnard with 40-inch refractor at Yerkes Observatory

A symbolic dance of the Marquesans, representing conquerors and captives

THE DISAPPEARING PEOPLES OF THE SOUTH SEAS

A Racial Survey of the Peoples of Polynesia by the Bishop Museum of Honolulu and the American Museum of Natural History—The Influence of Contact with Europeans on their Traits, Habits, and Social Organizations

By H. L. SHAPIRO
Assistant Curator of Physical Anthropology, American Museum

THE tradition of the romantic South Sea Islands was the inevitable result of the classic descriptions of Cook, Melville, and Stevenson. Any one who reads these protagonists of the Pacific scene absorbs forever something of the sunlight and color of those magic islands. And if the taste for such reading is once acquired, the modern writings of Calderon, Hall, Nordhoff, and Frisbie serve only to intensify the glamorous quality of the "fortunate islands." But the Tahiti of Cook and the Marquesas of Melville, except for their vitality in certain printed pages, are dead. Although it is depressing to see the disappearance of that heroic age, there are compensations in the charm of the reality. To appreciate that intangible characteristic one has only to see Tahiti defining itself in the dawn, Moorea wrapped in a blue moon, or the cliffs of the Marquesas rising in superb indifference to the foaming sea.

In such a setting one expects to find a consistent people. The first comers did,—Wallis in 1767, Bougainville in 1768, and Cook in 1769. The beauty of the Polynesian, his hospitality, and his natural physical and social grace created in the minds of the early navigators an impression of a race favored by the gods. To the subtlized sophistication and mannered artificiality of the Eighteenth Century, the natives of the South Seas were at the same time an anachronism and an ideal. Rousseau's "Natural Man" was

COAST LINE OF HIVA OA

The Marquesas are high volcanic islands with a precipitous shore. The sharp ridges which come down to the sea form deep bays which once sheltered weathered whalers

largely influenced by the accounts of the Tahitians brought back by his countryman, Bougainville, and by Cook. The interest in these people was so great that when Omai, a native of Tahiti, was brought back to England by Cook, he was lionized by London society eager to see a representative of those advertised people. Boswell gives, in the following passage, Johnson's impression of Omai.

Sir, he had passed his time, while in England, only in the best company; so that all that he had acquired of our manners was genteel. As a proof of this, Sir, Lord Mulgrave and he dined one day at Streatham. They sat with their backs to the light fronting us, so that I could not see distinctly; and there was so little of the savage in Omai, that I was afraid to speak to either, lest I should mistake one for the other.

Cook described the Polynesians of his day in glowing terms.

As to the people, they are of the largest size of Europeans. The men are tall, strong, well-limbed, and finely shaped. . . . The women of the superior rank are also in general above our middle stature, but those of the inferior class are rather below it, and some of them are very small. . . . Their natural complexion is that kind of clear olive, or brunette, which many people in Europe prefer to the finest white and red. In those that are exposed to the wind and sun, it is considerably deepened, but in others that live under shelter, especially the superior class of women, it continues its native hue, and the skin is most delicately smooth and soft; they have no tint in their cheeks which we distinguish by the name of color. The shape of the face is comely, the cheek-bones are not high, neither are the eyes hollow, nor the brow prominent; the only feature that does not correspond with our ideas of beauty is the nose, which, in general, is somewhat flat; their eyes, especially those of the women, are full of expression, sometimes sparkling with fire. and sometimes melting with softness; their teeth also are, almost without exception, most beautifully even and white, and their breath perfectly without taint.

Throughout this widely scattered area each group of islands seemed teeming with happy and vigorous people. And yet these discoverers would have been the last to conceive themselves as the bearers of destruction for the very people they praised so highly. Yet that was to be the result. During the period of discovery, contact with Europeans was of a slight nature, sufficient only to acquaint the islanders with the reality of another world and arouse their imagination with the products of Europe. At the end of the Eighteenth Century the natives were essentially in the same condition in which they were found, except for the ravages of several European diseases which had been introduced. But in the next period —the period of missionary influence— which began about 1800, when the London Missionary Society sent out the "Duff" to Tahiti, native customs were broken down and irretrievably destroyed. As a result of the sincere activities of the missionaries, the natives lost their own mores but were not able or willing to adopt a complete new set. They were in a position to fall easy prey to the increasing influence of the whalers and traders. During the middle of the last century, great numbers of whaling expeditions called at the Society Islands and the Marquesas, and frequently spent a season in some sheltered valley. At Taiohae in Nukuhiva as many as a dozen whalers, anchored at one time, was not unusual. Considering the character of the whaling crews of that time and of the Polynesians themselves, it is doubtful whether the natives would have been able to resist the threat even if they were in their pristine condition. At any rate the inevitable consequence was the great increase of a half-caste population and the rapid decimation of the natives.

The question of depopulation in these islands is a difficult problem. The extent of this phenomenon is easily appreciated when one considers the changes which have ensued during the course of a little more than a century. Cook, who observed the preparation of a war party in 1774, writes of the population in Tahiti:

> We shall find by the estimate that the whole island can raise and equip 1,720 war canoes, and 68,000 able men, allowing forty men to each

MISSION BUILDINGS ON RAROIA
Catholic missionaries constructed these buildings about 1872. Previously the natives were pagan; they still are fundamentally. The French provincial touch is obvious in the architecture

THE VALLEY OF "TYPEE"
In this Marquesan Valley, Melville lived. Even now its fascination is still potent. One can easily reconstruct the gay river scenes and bands of maidens that Melville loved

VILLAGE STREET ON A CORAL ATOLL
The principal street in Takaroa, one of the Tuamotus. This island was once important in the pre-European history of the Tuamotu Islands. Now it basks in the sun

TAIPIVAI, MARQUESAS

Along these shores Melville was once pursued by Marquesan cannibals who were loath to part with his company. The peace of this almost land-locked bay is now never disturbed

TARO PIT AT KATIU

In the old days in the Tuamotus, pits were constructed for the cultivation of the moisture-loving taro, a tuberous vegetable. Now the pits are found abandoned on many of the coral islands

A TUAMOTUAN LAGOON

These bodies of water surrounded by a narrow circle of coral reef are extraordinarily beautiful. In the shallow water the coral floor is visible to the eye. The variegated tints of the water are due to these coral structures

canoe; and as these cannot amount to above one-third part of the number of both sexes, children included, the whole island cannot contain less than 204,000 inhabitants; a number which at first sight exceeded my belief. But when I came to reflect on the vast swarms which appeared whenever we came, I was convinced that this estimate was not much if at all too great.

Arii Taimai, the mother of the present Queen Marau of Tahiti, was able, from native sources, to say in her memoirs that this figure is not at all exaggerated as some writers have insisted. Contrast this figure, even if slightly overestimated, with the latest census return of 9,072 for Tahiti and Moorea, which is given by Roberts.

Even more striking are the figures for the Marquesas. In 1773 the population was figured as 100,000. This number has decreased steadily and rapidly to the latest estimate in 1920 of 1,800, given by Handy.

One could go on citing other examples of this phenomenon, but the actuality became poignantly real when in the summer of 1929 I cruised among the Marquesas in a trading schooner. There I saw fertile and verdant valleys emptied of all human occupants. Here and there in a few valleys were gathered a mere handful of survivors. The lovely valley of "Typee" where Melville lived amid a numerous brood of laughing youths is now the home of a few families, and so depleted is the population of the valley that it was with the greatest effort that we were able to gather a half dozen able-bodied men for measurements. In the Gambiers (Mangareva) the original native population is now practically extinct and is replaced by a half-caste population and immigrants from other islands.

Unfortunately for the elucidation of this perplexing problem, vital statistics for these islands are scanty and too generalized. Although the dramatic and sudden depletion which these islands have suffered is largely the result of introduced European diseases such as tuberculosis, syphilis, and measles, against which the Polynesians had no immunity, these epidemics do not tell the whole story.

In other parts of the world where new diseases have wiped out large proportions of the population, they have been able to recuperate the losses suffered. But in Polynesia, with a few exceptions there has been no recovery. We are also unable to determine for eastern Polynesia if the half-caste population is more robust and therefore increasing at the expense of the pure native strains, since there is no precise information of that variety. Furthermore, the half-caste population is constantly being increased by fresh admixtures, while the pure strains must necessarily depend on their own stock for addition to their numbers. Pitt-Rivers favors the belief that the excess of males in Polynesia is a large contributory factor to this persistent decline, but some evidence which I have gathered does not indicate a very marked differential birth rate between the sexes. It is true that families in Polynesia are small, but it is, however, dangerous to assume that this is the result of lessened fertility. Psychological causes which are sometimes adduced to explain this population decline do not seem to me to play a very important part in the problem. The natives whom I met in the Society Islands, the Marquesas and the Tuamotus do not appear to be laboring under any loss of interest in life on account of the decay of their cultural pattern.

It was this situation which led the Bishop Museum of Honolulu to initiate with the coöperation of the American Museum of Natural History a project to make a racial survey of Polynesia before the physical types were irretrievably lost through complete extinction or by race mixture. Although considerable data had been gathered since the initiation of this project, it was felt that additional material was necessary. Consequently I left America in March, 1929, to be gone a year visiting the islands of eastern Polynesia: the Society Islands, the Marquesas, and the Tuamotus.

If I had the space it would be amusing to list the various theories to account for

THE MAHINA-I-TE-PUA
For four months Doctor Shapiro cruised among the coral atolls of the Tuamotus in this cutter. The name translated means "Foam Flower"

THE CHIEF OF NAPUKA
The physical type shown above is found in Napuka and is very distinctive. Maono, the chief, is typical of his island

the origin of the Polynesian people which have had the uncritical support of various travelers and writers. We are all familiar with the traveler who can glibly account for most of the things he sees, where wiser men have labored in vain to find the solution. Unfortunately these hypotheses wander into print and become perpetuated in the bibliographies of each succeeding work.

The first voyagers to Polynseia reported that the Polynesian was one race from the Maori in New Zealand to the Hawaiian and from the Marquesan to the Samoan. To be sure, there was a certain similarity between all the Polynesians which characterized them as against the Melanesian, not only in physical type but in culture. But when more careful investigations were carried out, it became apparent that the Marquesan culture, for example, was not the same as Samoan, in spite of certain similarities due to common elements or to necessities of environment. The elaborate decorative art of the Marquesan also was seen to be distinct. Similarly, the Maori also has an individual art and social organization which have no exact counterpart anywhere else in Polynesia. Although this came to be recognized quite early in the anthropological studies of Polynesia, the physical type, partly because it had never been thoroughly studied, was considered to be homogeneous long after the culture was no longer regarded as a simple unit. Only very recently have physical anthropologists begun to recognize that the Polynesian is not a homogeneous subrace. Both Dixon and Sullivan have emphasized the heterogeneity of these people and have even attempted to isolate the elements which have contributed to the making of the Polynesian.

THE CHIEF OF HAO
Hao is one of the central Tuamotus. The chieftancy is elective, but the office is responsible to the French administrator of the Tuamotus

Part of the evidence for this belief in the heterogeneity of the Polynesian is the result of the series of studies for which the Bishop Museum and the American Museum of Natural History are responsible. It became evident that within each archipelago there were several types; that the distributions for various characters did not present a smooth curve, but that for many physical measurements there were peculiar groupings resulting in several peaks in each distribution curve. This is unlike the phenomenon which one finds in a homogeneous people where one type is the most frequent and the variations from that type are in decreasing frequency. Furthermore, when one group was compared with another, certain differences became apparent. For example, the Maori in New Zealand have a longer and much narrower head than the Society Islanders; they also have a shorter and

TUAMOTU GIRL
Polynesian-European hybrid backcrossed with Polynesian. This girl is one-eighth English. Her other ancestors were Tuamotuan

narrower nose. On the other hand, the Samoans and Tongans show marked differences from the Society Islanders in their very long faces and in the proportions of the nose. In addition, there is evidence in Tahiti and Hawaii, to mention these groups only, of a distinctive type which preceded the present dominant one.

TAHITIAN YOUTH
This young man is a native of Tautira, the southernmost district of Tahiti. He is a typical representative of the Society Islanders

For that reason it is difficult to give a true composite picture of the Polynesian type. Nevertheless, there is a residuum of common traits which generally characterizes these people. They are among the tall people of the world. The average stature is about five feet seven or eight inches, frequently considerably higher than that. The hair is black, with decided reddish-brown lights in some individuals, and may be either straight, or as is often the case, wavy. Although frizzly hair is not common, it is occasionally found. In skin color the

YACHTING IN THE SOCIETY ISLANDS

The small native outrigger canoes are very fast sailers. The village is called Uturoa, and is the principal one in Raiatea, formerly a famous religious center

HOUSING CONDITIONS IN NAPUKA

Houses of pandanus thatch are still used in this more isolated island. There are other types of thatched house—the niau—but no wooden houses here

EIANE, MARQUESAS

The cocoanut plantation shown in the foreground is the work of a Norwegian sailor who has settled in the Marquesas

CLOSE UP OF A NATIVE SAILING CANOE

The outrigger may be seen on the farther side of the canoe. It gives stability to the native canoes, which are extremely narrow

GREETING THE FRENCH
In 1929 the French cruiser "Tourville" visited Taiohae in the Marquesas. The natives, dressed in their best, are shown awaiting the landing of the ship's boats

Polynesian is light brown, often not much darker than a tanned European, although for the most part the men are more deeply pigmented by exposure to the sun. The eye is universally brown. The epicanthic or Mongoloid fold is found only occasionally, but it is not generally characteristic. The nose is medium in height but also wide. This character, together with the lips of medium thickness, gives to the Polynesian a slightly Negroid appearance, which, however, is not borne out by his other characteristics. The Polynesian also has a large, massive face, broad at the cheek bones, which is combined with a forehead narrow in width. The Polynesian generally lacks a heavy development of body hair, except on the legs; but moderate to heavy beards are not uncommon. The most recent views on the racial elements involved in the analysis of these people detect both Mongoloid and Caucasoid factors. Dixon believes that there are also Negrito and Australoid strains. Some students have tended to minimize the Caucasoid element, but in the light of material gathered during 1929 in the Tuamotus, we may have to assign a larger part to the Caucasoid element in the racial complex of some of the Polynesians.

So intimately associated are grass huts with the brown natives of the South Seas that it is a slight shock for the traveler to find Papeete, the commercial and governmental center for the French islands of eastern Polynesia, a town of wooden bungalows. The presence of these wooden houses may almost be taken as an index of the degree of contact with Europeans. On the more remote islands, native thatch huts are still to be found, but wherever traders frequent, the wooden house becomes a criterion of prosperity.

But despite such changes in his material environment the Polynesian has remained essentially the same individual that he was a hundred years ago. He has, of course, given up tapa for Birmingham *pareus* and even for European dress. His diet has been supplemented by the introduction of flour, rice, tea, coffee, and other products unknown before the Eighteenth Century. And his tools are no longer of stone. But many of the specialized developments which fitted his environment perfectly have survived. The outrigger canoe still remains the ideal craft for the multiple uses to which it is put; basketry and matting retain their original function and are even adopted by European settlers.

Their methods of fishing, which were highly evolved before the arrival of the "popaa" or white man, are still practised. One of the most absorbing sports is spearing fish. I have often watched the natives, clad in red *pareus*, dive into the lagoons in the Tuamotus with spears in their hands, which they hurl at their prey. There is something exciting about man's invading a foreign element to match his skill against his quarry. The water is so clear that one can easily see the brown bodies of the natives, distorted by refraction, as they glide through the water. This form of aquatic skill is a part of every Polynesian's life. Frequently his life depends upon it.

In the Tuamotus the natives follow the pearl-diving circuit, proceeding to those islands opened for the diving. Often as many as five thousand natives will descend on an island where in off seasons only one hundred may live, and set up a bustling village with Chinese stores and a moving-picture house. As many as a thousand will be actively diving. Both men and women dive for the pearl shells from which the lucky ones obtain the coveted pearl. The best divers are able to descend 125 feet and stay under water for one minute. The exaggerated accounts of three minutes under water have never been authenticated. As a result of working under such high pressures, these divers often suffer from the "bends," which

MARQUESAN YOUNGER GENERATION

Two outer rows of men and two inner rows of women make a typical formation for one of the Marquesan dances. The combination of European dress and grass skirt is amusing incapacitates them for further diving.

Aside from pearling, which is mainly confined to the coral atolls that make up the Tuamotu archipelago, the principal industry of the natives of the South Seas is copra making. From the sale of copra they are able to buy the necessities of life and the luxuries of candy and a silk dress for the best girl. But food is never a great problem in the volcanic islands of the Society group and the Marquesas, for there the valleys are full of bananas, oranges, and other tropical food, and the surrounding sea is always full of fish. It is, however, in the Tuamotus that food becomes more of a problem. Here the only native products which can grow easily in the coral sand are cocoanuts and pandanus. Before the introduction of the cocoanut, natives of these islands lived on the pandanus nut and fish. But at the present time the cocoanut is a universal staple. Water in these low coral islands is collected in tanks after a rain storm, but drinking water is obtained from the young cocoanut, which fizzes like champagne when first opened.

One cannot leave these people, without a word about their singing and dancing. Song plays an important part in their lives, as it always has. The old chants are still preserved in the minds of the old people, and on occasions the elderly men and women would stay up all night until the crack of dawn singing for us these interminable chants in a monotonous rhythm, broken now and then by a falsetto. But the repertoire of the young consists mainly of hymns, sung with native words, often not consistent with our associations of the tune. Even American popular songs are spread with great rapidity until remote islands are invaded by these ubiquitous lyrics. These songs of the younger generation are sung to the accompaniment of a guitar which they play with great dexterity but without the steel that the Hawaiians have made famous. Dancing also is very important among the amusements of the young people, who are called "tarearea." This term embraces all the young folk who before marriage are allowed and even encouraged to be gay. It is their period of freedom during which they are allowed to choose their mates. For, after marriage such conduct becomes unseemly, even for the still spirited young married couples. Despite the apparent laxity in the habits of unattached young Polynesians, there is nevertheless a real feeling for the "convenances."

ARUE BEACH, TAHITI
This is in the neighborhood of Cook's landing place

A Mayan Home

"TOP OF THE WORLD" IN YUCATAN

Native Life on a Small Hacienda—Hunting for Fossil Mammals in the Land of the Mayas

By MARCELLE ROIGNEAU

Staff Assistant in Comparative and Human Anatomy, American Museum

Miss Roigneau, and her husband Robert T. Hatt, recently returned from a three-months' expedition for the American Museum to Yucatan, the site of America's highest primitive civilization. In the caves of a low range of mountains they searched for fossil animals that might throw some light on the obscure ancestry of the West Indian Fauna. Their headquarters was a plantation named Yokat a Mayan word said by the inhabitants to mean "top of the world."—The Editors.

FULL of expectation we alighted from the train at the flag stop of Yokat, for here on the plantation we were to live the life of the Yucatan natives and share their food. In Merida, the capital, and in Chichen Itza, where we had spent three delightful weeks as guests of the Carnegie Institution, we had found English-speaking people; but here, in the Sierras, we would have to depend entirely on our not too extensive knowledge of Spanish and a few words of Maya.

We were met at the train by the intendant of the hacienda and a little tramvia drawn by a mule. We climbed in and in a few minutes were passing through a long alley bordered on each side by the huts of the Indian workers. Soon afterward we stopped in front of the *Casa principal*, which was to be our home until our work in the neighborhood caves was finished.

About Chichen Itza, in the beautiful forests of low trees and lianas, we had hunted and trapped living animals. In the Sierras we were to be fossil diggers and work by candle-light in dark abysses.

Señor Don Avelino Montes, the benevolent owner of many haciendas, had told us not to expect much comfort in Yokat, for he said the place was in a run-down condition. Our amazement was great, therefore, when we found that our house consisted of three large rooms—one

PLANTATION RAILWAYS

When we traveled to Ticul it was usually on these *plataformas* which an inspired mule pulled along at a rapid clip. Here, as usual, a crowd of curious children gathered around to watch the American señora who wore trousers

of them a bathroom with the luxury of a shower. Of course, when there was no wind to turn the windmill there was no water, and our shower was quite useless, but in any case we always enjoyed the sight of it. Our house also had a long, wide piazza just above the watering trough. At night toads would come to play near the water in the moonlight. If we ventured too near them, however, they would jump into the tank with a splash, only to reappear a moment later hopping on the stairs.

Our train had arrived in the late afternoon, but it took us only a few minutes to unpack our cots and then get ready for dinner. The intendant, Señor Espejo, took us to the house of his sister and her family, where he and many other Yucatecos working around the place seemed to take turns at the little table where meals were served.

Food is not plentiful in the interior of Yucatan, and our host was much relieved when we assured him that whatever was cooked for the others was good enough for us. Inadvertently I added that *frijoles* and *tortillas* sounded very good indeed! We found out afterward that *tortillas* were not very palatable, and that red beans, although always good, became rather monotonous when they appeared daily on the bill of fare. I must add, though, that, whenever possible, we were supplied with French bread (baked in banana leaves), and that most delicious *pan dulce* found all over Yucatan.

The next morning found old Barbaro, who was to be our guide, lying asleep on the steps of the piazza. He had been told to put himself at our disposal and was awaiting our pleasure. We tried to dismiss him until afternoon but in vain. There he stayed until after lunch, when, with him, and our guns ready for rabbits, we went walking through the extensive henequen fields. From time to time Barbaro made a noise with his lips resembling the whining of baby rabbits, but that day none of those soft-furred rodents could be lured across our path.

Barbaro was an old Maya, slight of figure, but, like all of his race, full of endurance. He was intelligent and clever and nothing escaped his cunning eyes. His knowledge of the country and of the people was great, and his sense of humor always a source of enjoyment. As time went on we grew very fond of him and he always was our faithful follower. We particularly enjoyed going to Ticul with him, where, as soon as he entered the village, children would flock to him, calling him "Uncle," kissing him, and following him around. He had a great love for them and was always ready to do what they wanted.

Our second morning in Yokat found us up before the sun, and the fog lay thick over the Sierras. We hurried over to eat our breakfast before the flies should wake up. We had already learned their ways and had adapted ours to theirs. In the evening we would wait until dark for our dinner, when they would be asleep. The other pests of the dining room could not be evaded so easily, for it seemed to us that fat grunting pigs, thin hungry dogs, purring cats, and cackling chickens were by some magic forever awake, and nosing around the kitchen, or scratching their ticks close to us.

After breakfast that day, finding our horses saddled and Barbaro waiting for us, we started on a tour of the caves, in order to select the one which would afford the greatest opportunity for our work. We rode that day over the Sierras for seven hours, along uneven stony trails and through thorny bushes but we saw

OUR DAILY BREAD

As this Mayan woman patted out the corn meal mush of which the tortillas were made, she clicked and clucked away in her native tongue

MAYAN REBECCAS
The modern Mayan woman comes daily to the trough that is filled by American windmills, provided the wind blows. Her predecessor caught the drip water in the caves

only two caves, Actun Lara and Actun Jih.

Of the two caves, Actun Lara offered the best chance for digging, so early the next morning we were clambering down its entrance, loaded with picks, chisels, trowels, and candles.

As we entered, the swirling mass of swallows which were flying in fancy circles and chattering loudly soon disappeared, leaving us alone with the numerous fruit bats and swarms of excitable wasps. The place we had chosen for our work was a patch of red earth almost at the bottom of the cave, behind a big bowlder. We started digging, our minds busy with a host of questions. Would we find anything? If so, would it be worth while? Perhaps this was not the best place to dig? Yet it was the only patch of red earth! What would we find first? How deep would bedrock be?

Suddenly it seemed that someone was watching us; we could feel it. We looked up but there was no one at the entrance to the cave, yet that gaze was still upon us. Finally we discovered a small round skylight in the ceiling of the cave, at which two heads were clearly outlined against the bright sunlight.

We knew Barbaro was not one of them, for we had sent him to Ticul to buy lunch. Evidently news had traveled fast. Already people knew that we were digging in caves. We shouted a friendly *buenos dias* to our visitors. The answer came back, but the two Indian faces stayed at the opening a long time.

Some time after they had disappeared, we heard footsteps. Could it be Barbaro back so soon? No, the sound was that of feet clad in shoes and Barbaro wore silent sandals. Soon a tall, thin silhouette appeared at the entrance, followed by a smaller one. These interruptions were becoming annoying. Who could it be? Perhaps an official, for on the right hip of one was the bulge of a revolver. The tall figure came down the steep incline toward us and soon we recognized the overseer of the hacienda, who had arrived the evening before and whom we had already met. So this was just a friendly visit and was a bit disappointing. The two Mayas of the skylight had stirred my imagination, and when the tall figure appeared, I was quite ready for something exciting. Our friend stayed but a few minutes and soon departed with his Indian boy. Before going, though, he asked us if we had found any gold in our diggings. Some Spanish gold, he said, had been buried in the caves, but as yet nobody had come upon it.

If our little trench did not hold any gold, it was, however, yielding specimens, and we worked steadily until Barbaro appeared with the lunch. We were hungry and wondered what he had bought. He had done quite well and we enjoyed a piece of bread and Edam cheese with some tiny French fried chicken entrails. We tried to induce Barbaro to eat with us, but it was evident that for some reason he did not want to sit down with us and share our lunch. He went out to look at the horses, and did not come back to eat until a long time after we had finished. Was the idea of caste so strong in him, that he was shocked at our invitation, or was it pride? It certainly was not servility, for Barbaro, like all the full-blooded Mayas, had dignity. Whatever his reason, it was deeply rooted, and, after another unsuccessful attempt the next day, we never asked him again.

Our small trench was becoming deeper and bones and teeth were piling up. Another pile I could not help making, although I knew that I would have to

TICUL BOULEVARD
The little thatched huts of the natives flank the streets. Behind them lie large yards where all their animals roam in muddy contentment. The tracks are not those of a street car, but a spur of a hacienda's field railways

leave it in the cave. Potsherds! We found many, some big and some small, some made of coarse clay, others of a finer kind. Some were blackened by long use on the fire; others, delicately painted, must have held only water. All were interesting for the stories they suggested of their ancient owners. Some day, perhaps, armed with a permit to collect archeological specimens, we can go back and find undisturbed those little piles of old pottery.

For several days we worked in Actun Lara, digging two trenches, the second one nearer the entrance and under a dent in a rock which an owl used as a dining perch for feasting on birds and bats, mouse opossums, shrews and mice.

Not only did we find old bones, but we also collected many bats. Usually, after lunch, we would spend a few minutes shooting bats hanging in holes too high for us to reach. Once, in a single hole of a low-ceilinged part of the cave, we caught twenty of a small carnivorous species, by applying a butterfly net at the entrance and then frightening these wonderful little mammals, which were caught in the net in their efforts to escape.

On one occasion we returned to Actun Jih, where, in a very small, low room at the end of a dark passage, one of us had seen a little red earth. One day of work was sufficient there, for the results were not very satisfying. Actun Jih was quite a distance from the hacienda and that evening as we were on our way back, we met a whole Indian family moving, each member carrying his load Maya fashion, that is on the back, with a strap across the forehead. The oldest man was in front, followed by the younger men, then the women, and finally the children, all in single file, although the road at that place was wide. The last of the long file was a tiny boy perhaps three or four years old

THE SUNKEN GARDEN

The roof fell, the sky flowed in and made a sunken garden of a dungeon; but bats and wasps, geckos and scorpions were the only creatures that lived near it

THE ENTRANCE TO MANHOLE CAVE
Big caves may have small mouths. This cave was probably the only thing in the jungle without a name, so the expedition called it "Manhole Cave"

who, like the rest, was bending under his load. Possibly they had walked all day under the hot sun, and had cut their way through thorny thickets, but they were Mayas, and the jungle was theirs.

Another day, on our way to visit a cave named Actun Has, we stopped in a clearing under which lay a cave for which the Mayas had no name. We had to enter it through a small round hole, less than a yard in diameter, by supporting the weight of the body with the hands flat on the rim, groping around with the feet to find the steep pile of rocks on which it was possible to sit down, and then jerkily slide to the bottom. It was a beautiful cave, with many chambers, but all unfit for excavation. We named it the Manhole Cave, and revisited it to get some bats.

Actun Has was really made up of two caves a distance from each other and communicating by a narrow passage not big enough for a man to go through. The first one was entered by way of a gentle slope covered with banana trees (*Has* in Maya), and was used extensively by hunters. The floor of fine sandy earth showed tracks of animals. To dig in this cave we would have had to look for its owner, and ask permission, but it did not seem worth while to lose the whole day trying to find the man, who might be anywhere in the jungle cutting wood. Furthermore, the appearance of the floor led us to believe that this cave would yield nothing of interest, so we decided to investigate the second part, and followed Barbaro along a narrow trail.

We stopped on the brink of a hole thirty feet in diameter. From the bottom of the cave rose many trees and we might not have seen the opening had not Barbaro stopped us. We went down with the aid of a rope, but afterward found that it was just as easy to go up and down by the lianas, thus freeing our-

CASA PRINCIPAL
In Spanish colonial days thousands of gateposts were built in Yucatan, no pair of which resembled any other

selves from the burden of the encumbering and heavy *riata*.

Upon entering the cave we found the complete skeleton of a horse. The poor animal had either fallen over the rim and had been held a prisoner until death, or had lain there wounded and helpless.

Having found a suitable place for a trench, we worked at it for several days, the noise of our picks accompanied by the loud chattering of brightly colored birds fluttering in the trees at the entrance. Unlike all the other caves we had visited around Yokat, this one contained no dripping water.

Our work here was drawing to a close and, although anxious to see new places, we felt that we had become a part of the life at Yokat. We had many friends there and, while not always able to take part in the conversation during the evening meal, we enjoyed hearing the old-timers speak of the Yucatan of many years ago. Often their stories started with "When Yucatan was covered with great big trees, and game plentiful. . . " Though these people claimed to have seen such forests, it was hard for us to imagine them! Did they ever exist? Why is Yucatan now covered with low, impenetrable jungle? And how could the soil, rarely more than six inches thick, feed forests of such magnificent trees? But the story teller could not explain, he would only start his next anecdote with: "When I was only a boy, and Yucatan was covered with forests of great big trees. . . . "

By now, too, we had friends in almost all the little huts bordering the road along which we passed every day to go to the Sierras. Morning and night, when the innumerable dogs would announce the approach of our horses, the women would come out to greet us. The men, when home, would also join in with friendly words. In front of one hut I often stopped, for there was a family of beautiful little girls,—five or six sisters, with a laughing and friendly mother.

To us it was a revelation when we found out how many people and beasts could live in a one-room house. It was with delight that we would watch the occupants come out of these modern Noah's arks. Father and mother with many children; several dogs and their respective families; turkeys and chickens followed by their broods; cats and kittens; pigs and piglets; and often, but not always, goats and kids. How they all lived in peace was a mystery to me!

My best Maya friend in Yokat was a woman employed by the sister of Señor Espejo. Every day she made the *tortillas.* Her skin was a beautiful warm bronze, and her eyes were full of laughter. Like all the others, she called me *niña,* but to greet me she would also put her two hands on my shoulders and laugh. She could neither speak nor understand a single word of Spanish, yet she was very talkative and always would tell me long stories in Maya. At first I thought she was trying to speak English, for a number of Mayan words sound almost like English words; finding out my mistake, I spoke to her in English, accompanying my words with many gestures.

Soon we were able to carry on a conversation, and the most amusing one to any onlooker must have been my description of a rabbit hunt at night. I am sure that she understood, because she was intelligent, and had asked me what we were doing the night before, carrying lights on our heads and guns in our hands.

At last the day came when our trunks had to be packed. For the last time we took a walk around the plantation, and in the afternoon left for Ticul, where we were to spend the night and the next day board a train which would take us farther along in the Sierras. There we would find the same people, the same pests, too, no doubt, and also that same atmosphere of tranquillity and indomitable independence which are the heritage of the Mayas.

ACTUN LARA
The toothed throat of the cave opened sharply downward, as if anxious to swallow any intruders and to add their bones to those already buried in its cavernous depths

CADDIS-FLY LARVÆ AS MASONS AND BUILDERS

Flexibility in the Case-making Behavior of Caddis-Fly Larvæ

By FRANK E. LUTZ

Curator, Department of Insect Life, American Museum

CADDIS flies, although classified as a distinct order, Trichoptera, seem to be very close relatives of primitive moths. Their larvæ are, for the most part, aquatic, and typically make cases within which they live. The simplest of these cases are merely thin silken envelopes in which silt or other foreign material may be enmeshed. However, perhaps the majority of species, certainly the majority of species whose life history has been recorded, build cases by cementing together bits of foreign material with silk.

"LOG-CABIN" TYPE OF CADDIS CASE
The fine white lines are strands of cotton which accidentally got on the case while in storage

The interesting thing about these cases is that each species has a characteristic choice of material and a definite style of architecture. The choice of material is, naturally, limited to the things found in the particular aquatic environment which the species inhabits: vegetable matter, either living or dead, and harder, unchewable substances such as sand, small pebbles, and snail-shells. The architecture, taking the group as a whole, is most diverse, ranging from mere agglomerations of almost anything to a spiral case made of fine grains of sand so neatly and regularly fitted together that it was originally described as the shell of a snail new to science. But, whatever the style of architecture or the choice of material, it is usually characteristic of a given species, sometimes even of a genus or family.

There is a correlation between the kind of case which a species makes and the swiftness of the water in which it lives. Thus, the species which make a "log cabin" case of small sticks placed crosswise, as shown on this page, lives in relatively still water such as ponds, while one that fashions a "masonry mosaic" of pebbles (page 278) lives in streams. This is usually regarded as a wonderful adaptation of behavior *to* environment, but perhaps, since we do not know whether it was environment or behavior which changed, it would be better to say that it is an adaptation *between* behavior and environment. Certainly a larva that made a log-cabin case in a stream would soon be washed down to still water. It is not quite so clear why species that make masonry cases should not live in still water and, in fact, they sometimes do, but possibly one reason for their not being abundant in such places is that pebbles are not so apt to be available.

Since the caddis flies are a relatively

old group, being well represented at least as early as the Oligocene, and since certain types of cases are also characteristic of genera or even of families based entirely on anatomical characters of adult insects, it is quite probable that a species which builds a given kind of case now has built nothing but that kind of case for thousands or even millions of years. What would a caddis larva do if it could not get material like that to which it has been accustomed and, furthermore, could it live without a case as do other aquatic insect larvæ?

The answer to the first of these questions has been partly known for some time. Larvæ dispossessed of their cases have been given bits of mica from which to make new cases in order that students might be able to watch the actions of the larvæ within the cases. Ostwald, in particular, got larvæ to build with a great variety of unusual substances. In trying to find the answer to the second of the questions, I encountered a difficulty which had probably brought failure to others who said nothing about it, but I did find a few facts which seem to have an interesting bearing on the first question. These larvæ are vegetarians and, if given vegetable matter for food, nearly all, even the masons, not only could but did

DOING WHAT IT CAN WITH WHAT IT HAS

A larva which normally makes a "log-cabin" case with sticks is here shown in a case which it made from broken shell and sea-urchin spines

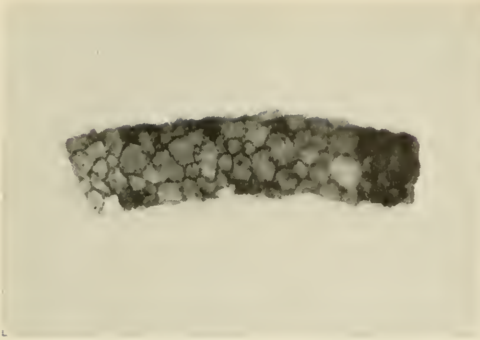
AN INSTANCE OF DELIBERATE CHOICE

A larva from a "log-cabin" case in one which it started by using pieces cut from *Utricularia* and finished, when it could get them, with sea-urchin spines

use it for making cases. Possibly by starving them sufficiently and then giving them only exceedingly small pieces of food at a time, one could force them to go without shelter rather than go hungry, or one could concentrate on the less adaptable; but, everything considered, the first question seemed to offer more interesting possibilities.

For example, four log-cabin builders were dispossessed of their cases and put into an aquarium with nothing but water and sea-sand with a little alga for food. This experiment was being carried on at the Mount Desert Island Biological Laboratory and the available sea-sand was made up largely of fine pieces of broken shells. By the next day one larva had made a nice case of shells and sea-urchin spines; one used some of these, but mostly alga; and two were still naked. The following day three had shell and spine cases, the alga that one had used having apparently been worn or eaten off, and one still had no case, but there were two partly made and then abandoned cases in the aquarium.

The material normally used by the larvæ which build the log-cabin type of case consists of more or less cylindrical pieces of soft, partly decayed twigs or, in this Maine locality, of spruce needles



A "SAND-MOSAIC" CADDIS CASE
Normally, fine grains of sand are selected by this larva to build the case

which had fallen into the water. These are placed very definitely in a transverse position, with reference to the larva's body. When I put the sea-sand into the aquarium, I did not notice that it contained a small amount of sea-urchin spines. It was, therefore, a matter of considerable interest that the larvæ sorted over the sand and picked up here and there for use such a large proportion of the relatively rare objects which came nearest to being the shape of their normal material. That this was not because they could not use the flat pieces of broken shell is shown by the fact that they did use a few of such pieces and, in the case of one larva, it started with the exceedingly thin and flexible strands of alga, although it later changed to sea-urchin spines and some broken shell.

This seeming exercise of choice, a possible evidence of real mental preference, was further illustrated in another experiment in which dispossessed log-cabin builders were first put into an aquarium with nothing but water and *Utricularia*, a delicate plant bearing curious "bladders" or pockets which entrap microscopic organisms. Nearly all of the larvæ rather quickly made cases out of pieces of the plant which they bit off.

In order to understand more fully subsequent developments it should be remembered that such a larva constructs its case by making a narrow ring through which it puts its head and then it widens the ring by adding material to the front side until the ring has become a cylinder as long as, or longer than, the larva's body. New material may occasionally be added to the side of a case but, when the case is too short or for some other reason is not satisfactory, matters are usually adjusted by adding to the front end. Possibly the fact that the cases made by log-cabin builders, when they were forced to use shells and spines, were longer than normal was due to the insects' dissatisfaction with the new cases and their attempt to make them better by continued construction.

Be that as it may, the log-cabin builders in their *Utricularia* cases did not live peacefully together. One would come up behind another and steal a bit of plant from the case of the second in order either to eat it or to add that already-cut piece to its own case instead of cutting another piece for itself. After allowing this shifting of material from the rear end of one case to the front end of another to go on for a day or two, I put sea sand into the aquarium. Each larva had at that time a reasonably good, although rather short, *Utricularia* case. However, each began picking up sea-urchin spines and

LARGE BLOCKS SUCCESSFULLY HANDLED
A case built from broken shell by a larva from a sand-mosaic case

adding them to the front of its case, occasionally, as though by mistake, fastening one to the side. The figure at the top of page 275 shows such an instance. Eventually, because the *Utricularia* was either worn or eaten off, most larvæ had complete cases of sea-urchin spines.

Possibly the scarcity of broken shell in these cases, as contrasted with those made by naked larvæ which started with nothing but sea-sand and a little alga, is to be explained by the fact that these larvæ already had fairly satisfactory cases and, so, made a more leisurely and careful selection of material. I quite realize the danger of such a suggestion with its implication that larvæ of lowly creatures think. Possibly the preference shown for spines over broken shell may have a purely mechanical explanation in the shape of the tarsal claws with which the building material is handled, but I am at present unable to suggest a purely mechanical explanation for this preference being more completely manifested when the larvæ already had cases.

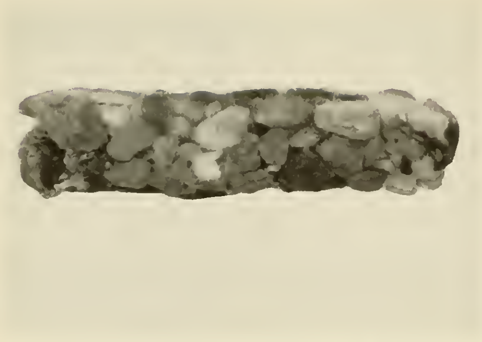
Larvæ that normally make a somewhat curved case of fine grains of sand (see figure top of page 276, in which a small bit is broken off from the hind end of the case) were dispossessed and given only the coarser bits of broken shell that had been sifted from sea-sand. In view of what has already been said, it is not surprising that they made cases of this new material. The experiment is mentioned here to show by the figure at the bottom of page 276 how well they handled the larger blocks, doing almost, if not quite, as well as a species which normally (page 278) uses relatively large pebbles, the sort of case that was referred to above as "masonry mosaic."

A more surprising result came when larvæ, dispossessed of their fine-sand cases, were given only spruce leaves and small sticks taken from log-cabin cases. Some with very little hesitation, others with more, made cases such as the one shown on this page. They did not arrange the material transversely, as do the log-cabin builders, but more or less longitudinally, as do many other species of caddis larvæ. There is no warrant for making much of the fact that this is a better arrangement of material for species which, like these sand-builders, live in relatively swift water, but we can say very definitely that what was probably the first attempt this species had ever made in constructing cases from such material resulted in a neat and apparently very satisfactory shelter of a type quite different from its previous experience but entirely normal for other species.

A SAND-BUILDER'S FIRST ATTEMPT WITH LEAVES AND STICKS

This case was made from "log-cabin" material by a larva which normally uses only sand

Masons such as the sand-builders just discussed or those that use small pebbles never cut material for their cases; they merely pick up pieces of suitable size. Therefore, the following experiment seems worth noting. On August 2, I dispossessed three sand-builders and gave them both living *Utricularia* and material taken from log-cabin cases. The next day one had made a case of spruce leaves, one used these and some fine débris, and one used spruce leaves but also pieces of *Utricularia* which it had cut off from the living plant. By August 6 this third larva had added sticks on the front of its case and



MASONIC CADDIS LARVÆ

These larvæ normally use pebbles for case-making. The head of the larva is seen at the doorway of its pebble case

Here a caddis larva is shown halfway out of a case which it made from pieces of decayed leaves cut by itself

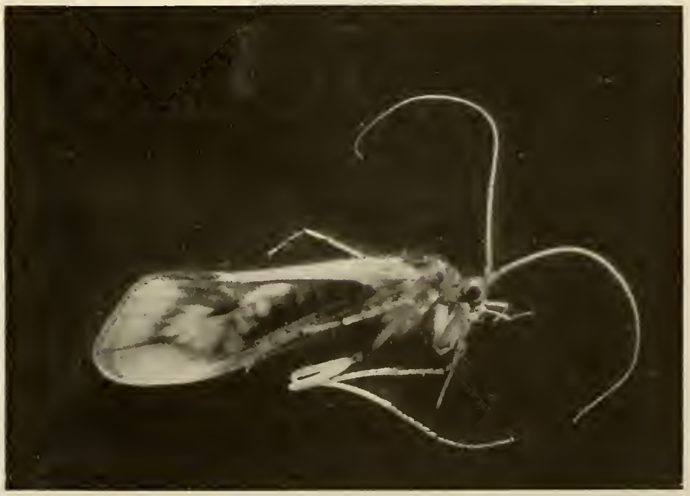
had lost most of the *Utricularia* from the rear, probably by theft. Five days later, when all three had stick cases, I dispossessed two of them and put them in a new aquarium with only *Utricularia* in the water. In the same aquarium I put two fresh sand-builders: one which I had robbed of about half of its case, leaving it in the much-too-short other half, and one which I entirely dispossessed. I do not know how things fared by the next day, but on August 13 the three which were entirely dispossessed had good cases made of pieces of *Utricularia* which they had cut from the plant; the one with a too-short case had done nothing about it. Thus matters stood for several days, but later one larva disappeared—I am not sure which one or how. There was considerable fighting and stealing of material from each other's case until, when the experiment was stopped on August 26, one larva was naked (possibly the one which had had a piece of a sand case) and the cases of the other two consisted chiefly of the silken lining with small bits of *Utricularia* and débris still attached.

Apparently cases made of material which can be eaten—gingerbread houses, as it were—are not extremely satisfactory, except to the eater, but the experiment suggests the possibility that these larvæ, although not endowed by training and probably not by instinct with the notion of using vegetable material for their cases, can not only use such material but can do the, to them, unprecedented thing of cutting the case-building material into usable lengths. So far as this experiment goes the last statement is suggested as merely a possibility, there being the other possibility that they cut off pieces from the *Utricularia* for food and then, having the pieces, used them for making a case. However, the next and, so far as these notes are concerned, last experiment to be presented, seems to make the suggestion more probable.

Larvæ that make tile-like cases of relatively large pebbles, the "masonry mosaic" type shown on this page, were dispossessed and given the usual variety of unusual material. They managed them all so well that I finally gave some freshly dispossessed ones only large decayed leaves. Certainly these soft flat objects, too large to be fastened to a case without cutting, were very different from small, hard, round stones which are not to be cut. A creature whose ancestors to remote generations had never used anything but pebbles might not be expected to "think of" ("respond by" in more technical language) using decayed leaves or to be able to use them whether it really thought about the matter or not. All that I can say is that it did cut pieces out of the leaves and from them made the case shown on page 278.

One thing that should be mentioned again has been touched upon from time to time in these notes. Not all of the individuals of any of the species which were given these tests solved the problems. Quite probably most of those in any given experiment were brothers and sisters, or at least closely related, as they were collected together, but some would be immediately successful with the new material, others were slower or less successful; some tried for hours and failed, leaving partly finished cases behind them, and some did not try. That the last fact was not due to lack of either silk or case-building urge was shown by their quickly making normal cases when given normal material. It almost looks like a variability of intelligence or ingenuity or something of the sort that many students suppose insects lack.

On the whole, without attempting to define either instinct or intelligence but selecting "behavior" as being the safer term, it seems clear that the case-building behavior of caddis-fly larvæ is at least a rather flexible affair. Other more debatable points will occur to those familiar with comparative psychology.



An adult caddis fly just emerged from the pupal skin

THE ART OF THE NORTHWEST COAST INDIANS

How Ancestral Records Were Preserved in Carvings and Paintings of Mythical or Fabulous Animal Figures

By LIEUT. G. T. EMMONS

THE "Northwest Coast" of America, known successively as the home of the sea otter, the land of the totem pole, and the salmon country, though never definitely defined as to limits, was accepted as the littoral between the Straits of Fuca and Bering Bay. Today the sea otter has vanished, the totem pole has been carried away or fallen, and the abundance of fish life is rapidly passing, but the thousands of miles of deep fiords and inland channels, shadowed by lofty snow-capped mountains, with broad glaciers reaching the water's edge, offer to future generations the scenic playground of the continent in compensation for what has been lost.

The distinctive features of the early life of this area was the artistic sense of the people as expressed in form and color, in the ornamentation of everything that they possessed, from the great communal house to the least important article of use. Their carvings, paintings, and woven fabrics, noticeably impressed the early explorers, who found it difficult to reconcile this excellence with their rude manner of life, and their primitive implements of shell and bone. Native copper they had in limited quantities, but without knowledge of its tempering it was useless for edged tools. Iron was not a product of the country and it was instantly demanded from the first traders above all else. By watching the ships' blacksmiths and armorers they became apt in manufacturing from it tools suited to their needs. With improved tools, their latent talent, which had been held in abeyance so long for a want of adequate means of expression, made rapid progress, reaching the acme of development during the first half of the Nineteenth Century, where its advance was suddenly checked by contact with our commercialized civilization, in the establishment of mining camps, salmon canneries, trading stores, and saloons, that attracted the younger generation, depopulating the native villages and destroying the old communal life. Fortunately, the art and culture of this Victorian Age have been preserved and can be enjoyed in the very complete collections in our principal museums.


House Post at Comox, Vancouver Island

Of the five linguistic stocks inhabiting this coast, the northern tribes were matriarchal in descent and those of Vancouver Island patriarchal, which difference seemed to have influenced the character of their art. The primitive cultural center was about Dixon entrance. Here the Tlingit, Tsimshian, Kwakiutl, and Haida met, and through generations of migration, intermarriage, trade, war, and extravagant peace festivities, had formulated a code of laws that was strictly observed. The unit of the social organization was the independent clan, represented by an animal totem around which their whole religious, political, and social life revolved. These clan totem animal figures were carved on the totem poles and house posts, painted on the house fronts and on interior screens, and shown on all household articles and ceremonial dress. I believe that the characteristic animal art of these people was born of this social system and was continually stimulated and developed through the intense clan jealously and rivalry of an extremely sensitive, vain, and proud people in their endeavor to outdo one another upon all ceremonial occasions, especially in the elaborate display of the crest or family totem. But this art served a useful purpose far beyond any sense of ornamentation. It was their figurative means of recording and transmitting their history, beliefs, myths, and traditions. It had come to them from a hazy past when, in the childhood of the world, human and animal life were on the same plane, and when some ancestor through sexual or beneficial relations had come in contact with the animal being which was later accepted as a guardian and honored accordingly, but this did not imply actual descent from or actual relationship with the later-day animal; it referred to something accepted but little questioned or understood.

Any notes on native art as contained in the narratives of the early explorers are naturally limited. They skirted the outer, uncharted coast, anchoring only when suitable water permitted, and met the people under the most unfavorable circumstances in their makeshift, temporary fishing camps. Even Vancouver's boat expeditions that traversed the principal inner channels saw few permanent winter villages, and those at a distance, owing to the suspicions and hostility of the inhabitants. His only mention of totem poles was at a small village in Fitzhue Sound, and of painted house fronts here and in Johnstone Straits, and while the natives claim that their villages had such ornamental features before the advent of the white man, yet they must have been of rare occurrence.

NANYAAYI VILLAGE, WRANGEL, ALASKA
A group of houses at Wrangel, southeastern Alaska. The Stikine Kwan, 1888

IN CEREMONIAL DRESS
Members of the Nanyaayi family of the Stikine tribe of Tlingit at Wrangel, arrayed in ceremonial costumes decorated with clan totem animal figures

The acquisition of iron and the accumulation of wealth from the trade in furs changed all this, and photography, that came here in the Sixties, shows an abundance of both decorative poles and house fronts. Carving was largely dependent upon painting for its best effects. While the older totem poles, house, and grave posts may show the natural wood surface, yet practically all show evidence of color even in their decay. It is a question whether painting did not antedate carving as so much simpler in labor and material. The painting of the house front of the northern people was always in the animal crest, and might present a realistically natural or highly conventional form. In either case the figure was outlined in black, while red and blue-green were introduced in decorative faces, eyes, and even foreign figures, to represent the bone structure or to fill up vacant spaces. Interior paintings were much the same, although in some cases they elaborated detail to tell some incident in the family history.

The Nootka occupied the west coast of Vancouver Island south of Quatsina Sound, and a limited area about Cape Flattery across the straits. Although they were the first of the natives of this northern seaboard to come into more personal relations with Europeans, they have ever remained the least receptive and advanced of any of the native peoples. Their country, with its ragged, rocky, storm-swept shore, was redeemed by the many deep fiords and spacious bays, that served as spawning beds for countless schools of salmon, halibut, herring, and smelt, which were closely followed inshore by whale, porpoise, and seal; and about the outer rocks and kelp fields, the sea otter congregated. This abundant food supply supported a considerable population, and the trade in furs early gave them a prominence and wealth beyond other tribes. The Spaniards, who claimed the exclusive right to navigate the North Pacific, discovered Nootka in 1774, established a post in Friendly Cove in 1789, and maintained trade for a brief period, after which these people were left to their own resources until 1860, when Sproat founded a colony at the head of Alberni Canal. From his writings we have the most authoritative story of the life of the Nootka. They were primarily sea hunters and the pursuit of the finback whale was their greatest industry. They were the only natives from the Straits of Fuca to the Aleutian Islands that hunted the whale. They were patriarchal in descent and lived in tribal communities of families holding the land in common. Marriage was restricted only in case of close relationship, and while the families possessed crests, they had little meaning and were used more as ornaments upon festival occasions. They had no totem poles originally, and the interior house carvings, figured by Cook and mentioned by all others, were rude, grotesque, and with little or no meaning. They used paintings on boards as screens upon ceremonial occasions and as decorative features against the interior back or side wall of the house over the chief's space or apartment. On these were represented mythical or fabulous monsters in animal form, and, for the prestige or gratification of the chief, around them some far-fetched story was woven. The figures principally shown were the Thunder Bird, the Lightning Snake, and the Whale, together with the Wolf.

The myth of the Thunder Bird, continent wide, while accepted by the northern tribes, plays little part in their art or ceremonies, but it is a dominant feature in the life of the southern tribes, and among the Nootkan it is associated with the Lightning Snake, "Hai-et-lik," a slave or weapon, worn around the body as a sash, that is cast down as a streak of lightning, killing the whale. The Thunder Bird is represented in the form of an eagle with possibly a slightly more

KILLER WHALE PAINTING ON A GRAVE HOUSE
This shaman's grave house bears on its front a painting representing two killer whales breaching. The killer whale was the crest of the deceased. The grave dated back to the early seventies, but the photograph was taken in 1889

INDIAN CHIEF'S HOUSE AT TUXICAN

The painting on this house at Tuxican, west coast of the Prince of Wales Island, southeastern Alaska, represents a whale. A raven's head forms the dorsal fin. 1888

OLD HOUSE OF THE NORTHERN KWAKIUTL

Over the doorway is painted a raven, and a raven figure in profile is on either side. The photograph was taken in 1889 at the deserted village of Kitasoo, Klemto Pass, British Columbia

Photograph by Maynard

A LOST LANDMARK OF SKIDGATE

The frame of Captain Gold's house on Queen Charlotte Islands stood from 1895 to 1900, but had entirely disappeared by 1912. The front of the house bore the painting of a hawk

IN THE BELLA COOLA DISTRICT

In 1902 there were no signs remaining of these houses at Kimsquit, British Columbia. The photograph was obtained from the late Doctor Powell, superintendent of Indian Agencies

CHARACTERISTIC ART OF THE NORTHWEST COAST
The central figure represents the Wolf sitting up. On either side is a yong wolf in profile. Above is a cliff and below is a stream. 1898

recurved bill at the point. The Tlingit of Alaska consider the osprey, "hahtle," as typical. "Hai-et-lik" is shown in carving and painting as a snake's body with an abnormally large wolflike head, with a characteristic pointed hook-shaped ear, and extended red tongue.

Swan, in *The Indians of Cape Flattery*, says:

> This mythological being is supposed by them to be a gigantic Indian, named, in the various dialects of the coast tribes Ka-kaitch, T'hlu-kluts, and Tu-tutsh, the latter being the Nootkan name. This giant lives on the highest mountains, and his food consists of whales. When he is in want of food, he puts on a garment consisting of a bird's head, a pair of immense wings, and a feather covering for his body. Around his waist he ties the ha-hek-to-ak or lightning fish, which bears some faint resemblance to the sea horse (*hippocampus*). This animal has a head as sharp as a knife, and a red tongue which makes the fire,

> The Thlu-kluts, having arrayed himself, spreads his wings and sails over the ocean till he sees a whale. This he kills by darting the ha-hek-to-ak down into its body, which he then seizes in his powerful claws and carries away into the mountains to eat at his leisure.

There are two paintings in the American Museum on old native split and adzed cedar boards, about 10 feet long, 6 feet high and 1 inch thick, which date back well into the middle of the last century. They were in Chief Quan-tough's house at Moohoulth, the principal village of the Opitchesaht, at the confluence of the Sproat and Somass rivers, beyond Alberni on Vancouver Island, which has long since been abandoned. These descended through Sin-set to Tatooch, whose description and story is here given. They stood against the wall at the back of the house where the chief

AN INTERIOR SCREEN
Painting on boards in the back of a house of the "Kos-ke-di" family at Sitka, Alaska, representing the legend of the Raven Creator and a shaman's medicine bowlder. 1898

HOUSE CREST REPRESENTING A HALIBUT
Painting on the front of a "Na hut de" family house at Saxman, a "Sonnah Kwan" (Cape Fox tribe) village on Tangass Narrows in 1889

and his family lived, and at potlatches and on important family occasions they were brought out and displayed. They are very finely chiselled over the front, which has been rubbed over with crushed salmon egg and oil and painted in black (charcoal ground with salmon egg and oil) and red (salmon egg and color from alder or hemlock bark). Each picture represents the fabulous Thunder Bird "Took-su-quin" with outstretched wings just rising in flight with a whale in his talons. On one side is the Lightning Snake "Hai-et-lik" and on the other side the Wolf, "Ka-natle," all of which are brought into the family story as given by Tatooch, the owner of the paintings and a direct descendant.

In the early part of the summer, many many years ago, when the His-set or Sockeye Salmon were seeking their spawning ground in Sproat Lake, Klee-Coot Sin-set, a chief of the Opitichesahts, went to visit his fish traps at Too-whilth. This is the name given by the Indians to the falls on the Sproat River over which the salmon had to pass on their way to Sproat Lake. It was the most formidable obstacle they had to overcome, and it was here that the Indians built their traps in order to capture the salmon.

AN EAGLE HOUSE CREST
In the collection of A. C. Bossom, Esq., London, England, is this carved painting on a cedar plank partition from an old Haida House, Howkan, Long Island, Southeastern Alaska

The trap was a primitive affair made of a basket woven with strips of cedar and bound together with cherry bark. It was tied to a log placed across the river for that purpose. Immediately over the falls, where it was necessary for the salmon to jump clear of the water in order to continue their journey up stream, numbers of salmon would fail to clear the brink

A RECORD FOR FUTURE GENERATIONS

Sin-set portrayed his experiences on two cedar boards. One of his descendants, Tatooch, inherited these paintings

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THE EAGLE HEADDRESS

(The Thunder Bird)

Chief Joseph John of the Nootka tribe, in ceremonial dress at Tofino, west Coast of Vancouver Island, British Columbia

KILLER WHALE CREST

Painting representing a killer whale pursuing a hair seal (its natural food) on a "Duck-clar-way de" family house at the "Hootz-na-ho" village of Angooan, Admiralty Island, Southeastern Alaska

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CHARACTERS IN SIN-SET'S ADVENTURE

The Thunder Bird is shown with the whale in his talons. On one side is the Lightning Snake, and on the other is the Wolf

of the falls in their jump and would fall back into the basket. The whole structure was very primitive and shaky, and in walking on it to gather his catch, Sin-set lost his balance and fell into the river. Down he went over the falls, at the foot of which there is a large, deep hole or pool.

When Sin-set got into the hole, he saw two whales. They came swimming to him and called him by name, then disappeared. They returned in a short time and said to him,

"Sin-set, Sin-set, follow us."

He did so, and after quite a journey, came to a place called Moo-houlth on the Stamp River, which once was a large village. Here the whales left Sin-set, telling him they would be back shortly. When they did return, they had with them two beautiful young women named Ohk-sis and Pay-tles, who were formed like mermaids, each with a shark's tail. Sin-set wanted them to run away with him, but they would not do so. They said they would come every day to swim there and would meet him, when he could have all the fun he wanted, but he must be in the water and no one would know of their meeting.

Sin-set agreed to this suggestion and, next day, when the women came to bathe, Sin-set caught the two of them in his arms and took them up the river and into the Lake. He crossed this, and came up on the far side. When he reached the far shore he heard the Thunder Bird "Took-su-quin" making a noise like thunder and calling him by name "Sin-set, Sin-set" and the two girls "Ohk-sis and Pay-tles." The Thunder Bird "Took-su-quin" directed the three of them to go to "Ka-natle," the Wolf's house and ask for something to eat. This the three of them did, and, while they were in the house, they heard someone say

"Ah kathlah has sue," "What do you people want?"

They could see no one anywhere. Sin-set began to look around and examine the interior of the house, and upon turning around, discovered that the two girls had disappeared. He then realized that he had come back to life and that he was alone in the house. "Too-su-quin" and "Hi-ee-tlick," the Serpent, appeared and told Sin-set they knew where there was a whale "Eah-toop" in the lake. "Hi-ee-tlick" said he would get "Too-su-quin" to go out and watch until the whale came to the surface, when he could tear a piece out of "Eah-toop's" back and bring it to Sin-set to eat, as he must be hungry. Sin-set then returned to his people. He related his experiences and later portrayed them in his own peculiar way on the boards in order to preserve them for future generations.

This, in brief, is the history of the two fine painted boards now in the American Museum collection.

THE MOUND BUILDERS

The Story of the Builders of the Ancient Mounds and Earthworks of the Eastern United States, as Revealed by the Pick and Shovel of the Archæologist

IN TWO PARTS—PART I

By H. C. SHETRONE
Director, The Ohio State Museum

YOU are motoring along the smooth highway, indulging your liking for the great out-of-doors. Just ahead looms a sign:

MOUND BUILDERS PARK

Curiosity aroused, you come to a stop. Within the Park confines you see a miniature hill; it reminds you of a gigantic chocolate-drop. You step nearer to read the smaller print on the tablet.

BENEATH THIS ANCIENT TOMB THERE REPOSE THE BONES OF SOME CHIEFTAIN OF THE MOUND BUILDERS—THOSE "FIRST AMERICANS" WHO, IN THE LONG AGO WERE PROUD MONARCHS OF THIS LAND WHICH WE NOW CALL OUR LAND.

"But," you ask yourself, "who were the Mound Builders?" Perhaps you have some hazy idea as to what the answer may be; in all probability you have heard the query answered in several conflicting ways. Stimulated by the concrete reminder furnished by the Mound, you determine to find enlightenment, here and now.

"Who were the Mound Builders?" you ask the plowman in the field near by.

"Well, I guess nobody knows," he replies. "My great-grandfather settled this land when there still were Indians here. That Mound, even then, had big trees growing on it, and the Indians knew nothing about it."

Appealing to the filling station attendant at the edge of the village, you elicit this response:

"They call them Indian Mounds, so I guess they must have been built by the Indians."

The village patriarch, however, ventures to disagree. "The Mound Builders," he asserts, "remain an unsolved mystery. They were a different race from the Indians. They were highly civilized, had great cities, and were ruled over by despots who enslaved their people. When I was a boy, my father plowed out from a Mound a skeleton that measured eight feet high. It was double-jointed, and had double jaw teeth all the way round."

"Verily," you conclude, "I must seek the answer to this riddle elsewhere."

Perhaps no phase of human history holds more of human interest than that

HUMAN EFFIGY TOBACCO PIPE

The head-dress of this tublar pipe forms the mouthpiece, while the bowl is beneath the feet. The specimen was found by Dr. W. C. Mills in the Adena Mound, Ross County, Ohio centering in the so-called Mound Builders. This is due in great part to the antiquity and mystery attributed to the subject, and to its romantic setting. Again, no other subject affords so fertile a theme for surmise, speculation, and fanciful theorizing. From the earliest colonization of the Mound region there has been an irresistible tendency to create an epic of an unknown people living in an unknown world of the long ago. Such illustrious persons as Thomas Jefferson of Virginia and William Henry Harrison of Ohio fell under its spell. Jefferson has been referred to as the first actual explorer of the Mounds, the scene of his activities being along the Rappahannock of his native state. Harrison, of log cabin fame, was equally active and even more eloquent in discussing the fascinating theme as it applied to his immediate territory. Each set a high goal for ambitious archæologists, by first digging Mounds and then becoming President of the United States!

Jefferson and Harrison may be said to have crystallized two early schools of thought as regards the Mound Builders—Jefferson, the cool, calculating type, reaching no conclusions except those based upon material evidence; and Harrison, permitting his fancy to picture a race and a civilization unique from anything to be found in fact. From these early beginnings the controversy flowed through the years, each school with its ardent supporters. Out of it, through individual and institutional effort there has emerged the present-day theory which, while not altogether "provable" enjoys a consensus of opinion on the part of authorities.

But the general public remains unenlightened or at least unconvinced. Who were the Mound Builders? Whence came they, and When? Why did they build Mounds? and What became of them? These five W's of American archæology remain for the average man and woman the same open queries that they were to the pioneers. The reason may be that the average person is accustomed to think in terms of concrete values and thus to demand specific answers, not realizing that in matters of antiquity and prehistory such are not always forthcoming. Again, human nature feels an inherent need for romance, mystery, and magic; and now that science has pushed back the frontiers of Fairyland so far as to leave hardly an unexplored corner for the little people of the imagination, perhaps they feel that their cherished conceptions of the Mound Builders should be retained as a last sanctuary for romantic fancies! At any rate a large percentage of the public, including teachers and educators, continue to ask "Who were the Mound Builders?" And the press, even editorially, echoes the query.

Before attempting to find answers to the questions concerning the Mound Builders, let us examine briefly the material evidences of their culture to determine whether they may be worth considering.

The area of Mound occurrence extends from the headwaters of the Mississippi and the Great Lakes southward to the Gulf, and from the tier of states bordering the Mississippi on the west, eastward into western Pennsylvania and New York and, farther south, to the Atlantic seaboard. Within this area the thousands of tumuli, ranging from hardly perceptible elevations to structures measuring close to 100 feet in height, are a veritable part of its physical geography. In addition to the Mounds proper there are numerous ancient fortifications and ceremonial structures of earth and stone, cemeteries and burial grounds, and other major prehistoric remains. It matters not whether you live in the general Mound area, or elsewhere; these mute evidences of the fact that "Hereabouts

Drawing by Arthur A. Jansson

A PREHISTORIC SCULPTOR

Many objects indicative of the high art development to which the Mound Builders attained, have been found associated with their remains in the Mounds which these "First Americans" erected as monuments to their dead. The mystery surrounding these tribes who peopled America centuries prior to the coming of the white man, affords a fertile theme for speculation

Photograph by G. S. Severent *Courtesy of W. K. Moorehead*

MONK'S MOUND, LOOKING WEST

This great central Mound of the Cahokia Group at East St. Louis, Illinois, is the largest tumulus in the Mound area. It is 100 feet in height and covers 16 acres of ground

A STONE GRAVE BURIAL OF THE HOPEWELL GROUP

The skeleton in the background occupies a pretentious stone grave and is accompanied by numerous implements and ornaments. With the skeleton in the foreground was a large shell container, a copper breastplate, and numerous beads

THE SEIP MOUND, ROSS COUNTY, OHIO

In constructing a charnel-house of logs in this Mound, the aboriginal engineer erred in figuring the stress of the timbers, and the weight of the Mound erected above it caused the structure and Mound to cave in

THE CAVED-IN PRIMARY MOUND

The apex of the Mound was later rebuilt by the primitive workmen. The man in the picture is standing upon the caved-in structure, and the restored apex is immediately behind his shoulders men used to live and die" is a perennial source of interest, especially to the traveler, tourist, and vacationist.

In the region of the Upper Mississippi Valley, particularly in Wisconsin and contiguous territory, there occur numerous so-called effigy Mounds, constructed in the images of birds, animals, and the human form. As with the commoner type of Mounds, conical in shape, these contain human burials; further, they are supposed to represent the animals and birds which, in life, served their builders as totems.

Passing southward into the lower Mississippi valley, the interesting platform Mounds, flat-topped, in the form of truncated pyramids, and indicating a different and distinct "culture" of Mound Builders, are everywhere in evidence. These truncated Mounds usually are placed at the center of a group of lesser Mounds, themselves often conical burial tumuli. The group as a whole marks the site of an ancient Mound-Builder town or settlement, as evidenced by surface débris resulting from domestic activities. Exploration reveals that the flat-topped structures, often of considerable areas, served as platforms or foundations for houses, temples, and sacred structures, and as refuges in time of high waters. Burials, if they occur, are confined to the upper levels, where interments were made on or below the floors of dwellings. During the recent great flood of the Mississippi, these elevations were in some instances the only places of refuge for the inhabitants over a wide area. Throughout the great valley, subject to frequent inundation, they are preserved by farmers as places of refuge, both for humans and for live stock.

Strangely enough, the most northerly presentation of the great flat-topped Mounds, the noted Cahokia group at

EAGLE EFFIGY PIPE
Tobacco pipes were carved in effigies of birds, animals, and human beings. This example was found in the Tremper Mound at Scioto County, Ohio

East St. Louis, Illinois, is at the same time the largest and most impressive of the entire area. The Cahokia group comprises more than eighty tumuli, a number of which are exceptionally large. The central Mound of the group, known as Monk's Mound, is one hundred feet in height and covers sixteen acres of ground. The labor necessary to construct this group under primitive conditions, with nothing better in the way of equipment than rude digging sticks, clam-shell hoes, and simple carrying baskets, affords some idea of the stupendous task of erecting the many thousands of Mounds and earthworks in the general area. The lower Mississippi region, with its many truncated Mounds, is further noted for the high development of its fictile art. Hundreds and thousands of pottery vessels of elaborate forms and decorations have accrued from exploration of its burial mounds and cemeteries. The art development of the region likewise is of a high order.

POTTERY WARE FROM SOUTHERN MISSOURI
Crosses, swastikas, and cosmic designs decorate this painted vase (Holmes, Bureau of American Ethnology)

Throughout the Tennessee-Cumberland valleys a similar and equally high cultural development is found. Flat-topped Mounds are still in evidence but less abundant, while stone-grave cemeteries are a characteristic feature, and art attainment is of a high order. The outstanding site of this region, particularly as regards artistic development, is the noted Etowah Group, near Cartersville, in northern Georgia. Southward through Georgia, the Carolinas, and Florida, other interesting and scarcely less important cultures are found.

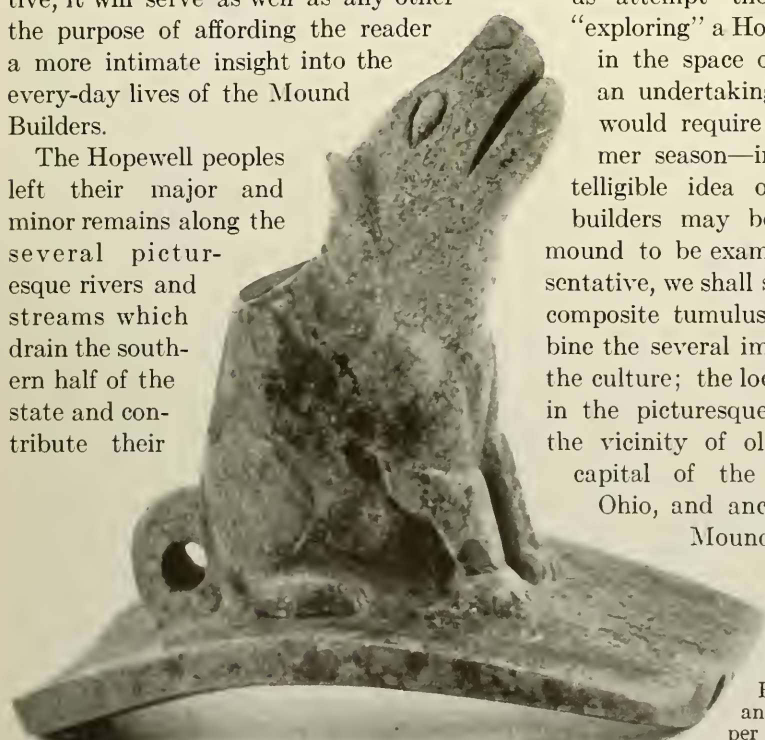
Perhaps the highest cultural development of the entire Mound area occurs in the southern half of Ohio and in contiguous territory. Here the so-called Hopewell culture of Mound-building peoples constructed ceremonial earthworks in geometric forms and carried their artistic attainments to a degree of perfection unequalled in America north of Mexico.

From this brief survey it will be noted that the Mound Builders were by no means a homogeneous people. Numerous cultures or kinds, some of them comparatively simple and others highly evolved, were comprised in the Mound Builder complex. As an illustration, it may be pointed out that in Ohio alone some half-dozen distinct cultures have been identified by their archæological remains. Of these, that known as the Fort Ancient, or Madisonville, is particularly impressive, not on the basis of high development, but because they were widely distributed, populous, and evidently a most representative and self-sufficient people. They take their name from the ancient fortification—Fort Ancient, in Warren County—the most important prehistoric redoubt in the Mound area, although it is not certain that they constructed it; and from the extensive prehistoric village- and burial-site located near Madisonville, Hamilton County. Their culture is characterized by extensive habitation sites, indicating a sedentary agricultural existence, and by the presence in connection therewith of numerous conical burial Mounds.

Although the Hopewell culture of Ohio, as noted above represented the maximum cultural attainment of the Mound area and therefore is hardly representative, it will serve as well as any other the purpose of affording the reader a more intimate insight into the every-day lives of the Mound Builders.

The Hopewell peoples left their major and minor remains along the several picturesque rivers and streams which drain the southern half of the state and contribute their waters to the Ohio River. Most striking of their contributions to archæology are the impressive ceremonial earthworks, constructed of earth in the form of geometric figures—squares, circles, crescents, octagons, and so forth. These, occurring singly or in combination, enclose areas ranging from one acre or less to as much as one hundred acres, and are supposed to have served social or religious purposes. Accompanying them, within or adjacent to the earthen enclosures, are burial mounds, usually in groups of from two to thirty or more.

Detailed examination of a Hopewell group is most fascinating. Only the merest suggestion of the procedure can be given here; sufficient, it is hoped, to encourage the reader to examine more closely the mute evidences of the lives of these interesting prehistoric peoples, and the careers of the numerous other cultures throughout the Mound area. Let us attempt the difficult task of "exploring" a Hopewell mound within the space of a few minutes—an undertaking which, in reality, would require at least a full summer season—in order that an intelligible idea of the lives of its builders may be had. That the mound to be examined may be representative, we shall select an imaginary, composite tumulus, which may combine the several important features of the culture; the location, let us say, is in the picturesque Scioto Valley, in the vicinity of old Chillicothe, first capital of the commonwealth of Ohio, and ancient capital of the Mound Builder "empire."



AN ANIMAL EFFIGY PIPE

Made in the image of a dog — the Mound Builders' only domestic animal. From the Tremper Mound, Scioto County, Ohio

Before us stands an imposing artificial hillock, in form intermediate between a cone and a hemisphere. It is approximately one hundred feet in diameter at the base and twenty-five feet in height. The field in which it stands is under cultivation, but the Mound itself, being too precipitous for farming purposes, is covered by a thicket of vegetable growth. Accentuating this are several well grown trees. The fallen remains of other trees, in ultimate decay, attest the antiquity of the Mound. An exploration party has just arrived on the scene preparatory to examination of the ancient tumulus. We secure permission to tarry awhile as interested observers. We ask innumerable questions and receive replies, although we note that these answers are terse and without elaboration. Questioning apparently has become an old story, and a somewhat tiresome one to the archæologist in charge.

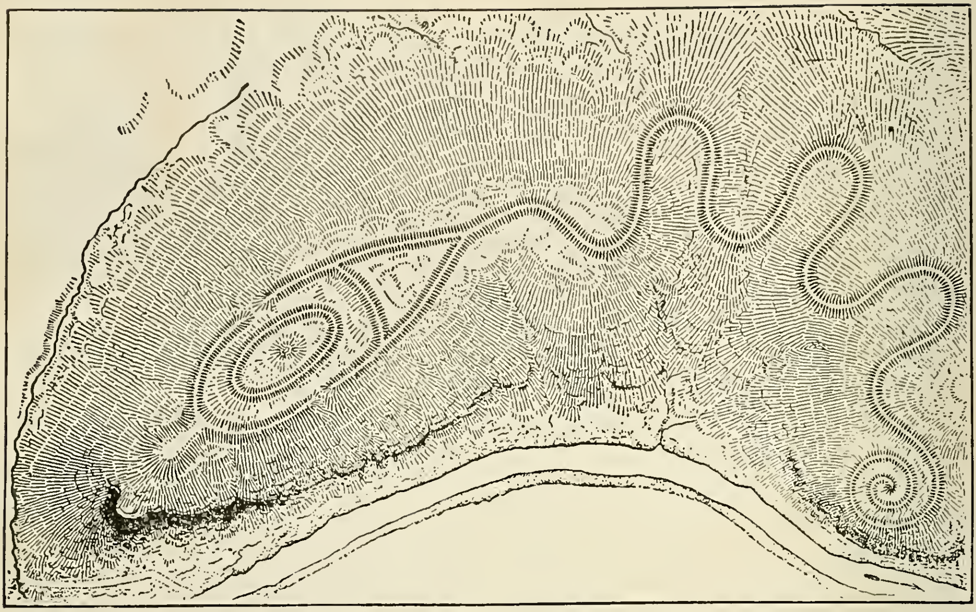
A COPPER BREASTPLATE
From the Mound City Group, Ross County, Ohio

A party of workmen with picks and shovels step to the edge of the Mound and begin to dig, throwing the loose earth well behind them. The "boss" explains the plan of attack. The entire mound, to the last cubic foot, is to be removed. It will be sliced off, as a cake might be, in five-foot sections, as deep as there is any evidence of artificial construction or disturbance. Surveying instruments, cameras, note-books, everything in readiness. Teams and scrapers waiting, too; for disposal of the dislodged earth, once examined, will be a problem in a mound of this height. An eight-foot working trench must be kept clear at all times.

The first of the five-foot slices having been removed, there appears, at the level of the surrounding field, what looks to the uninitiated like a cement floor. At the outer edge of this, and apparently following the marginal curve of the mound, appear post-holes, a foot or two apart, some of which still contain evidences of decayed posts. These phenomena, we are informed, are significant and gratifying to the explorer. They prove beyond doubt that his "diagnosis" was correct; the mound is definitely of the Hopewell culture, and doubtless will yield many things of interest.

"And why the floor and the post-molds?" we inquire. The explanation is as follows:

"When a Hopewell culture band or tribe picked a site for a new home, one of the first and most important things they did was to set aside a spot for the erection of a sacred structure—their temple, we might say. Clearing this spot of trees and brush, and even the loose top soil, they set posts into the ground, to form the walls of a circular or oval enclosed structure. Twigs and clay then were used as wattlework to render the walls more or less weatherproof. All or part of the structure was given a roof of thatch. Clay was plastered over the floor, and an inch or more of sand or gravel strewn on this as a floor covering; and lo! a sacred temple, for social, religious, and funeral purposes. Into this structure they brought their dead for the funeral ceremonies and for interment.



MAP OF THE GREAT SERPENT MOUND
From a survey made by Prof. W. H. Holmes for the Bureau of American Ethnology

The building corresponded closely in usage to the pioneer church and attendant graveyard; the Mound Builders, however buried their dead right in the church—a primitive Westminster Abbey! The structures at times are partitioned off into two or more rooms, sometimes as many as five. One may be the audience room or chapel; another, a room where the dead were cremated; a third, the compartment in which the deceased were buried; still another, a shrine room, where offerings of cherished possessions were made to the deities—the Mound Builders' method of making sacrifices."

Our attention is suddenly called to the actual work at hand. A laborer has struck his mattock into a loose spot in the face of the Mound.

"That will be a burial," the boss remarks.

And sure enough, within an hour a human skeleton lies there on the floor of the mound, all cleared off and ready to have its picture taken. "The Hopewell people," we learn, "placed their dead on rectangular earthen platforms, raised a few inches above the floor of the sacred structure. Over them they built cabin-like structures of logs, and covered these, in turn, with small primary mounds of earth. The decay of the timber structures resulted in the dropping down of the earth above them, leaving loose open arched spaces."

"But you mentioned cremation," we remind him. A second burial, a few feet removed, seems in every way like the first, excepting that instead of a skeleton there is merely a "hatful" of fragments of bone.

"Here is your cremated burial," we are informed.

And in due time there is uncovered a carefully formed rectangular basin, shaped something like an old fashioned cement horse trough, built upon and extending into the floor. It, like the floor itself, is of clay, burned to the hardness and color of soft brick.

"And here's the basin in which the body was cremated. About 70 per cent of the Hopewell burials so far unearthed have been cremated." We have thought of cremation being an innovation—something new!

The two burials so far unearthed have had little or nothing in the way of "relics"; they apparently were just "poor folks." But now comes a third. According to the authority, it promises to be a good one; the grave is large and pretentious. It proves to be a double burial, containing the skeletons of a male and a female—both young. Royalty, they must have been, judging from the barbaric splendor of their funeral dower. Helmet-shaped head-dresses of copper; breast-ornaments, beads and bracelets of the same metal; spool-shaped ear ornaments of copper, covered with thin silver foil; hundreds, yes, thousands, of fresh-water pearl beads; and remnants of a burial shroud of woven fabric, with colored designs, preserved by the chemical action of the copper breast-plate. Things are coming fast. The workmen have found another burial. This time, that of an old male; possibly a shaman, medicine man, or chief. In addition to ear ornaments, copper head-dress, and bear-teeth necklace, he is accompanied by a large copper axe and large spearheads chipped from obsidian or volcanic glass. A section of a human femur is engraved with an amazingly intricate and beautifully executed conventional design, while other designs are executed in repoussé and scroll from thin sheets of copper.

From what we have seen we try desperately to reconstruct the lives of those long-gone Mound Builders whose mortal remains we have viewed. It isn't until lunch time, however, that we succeed in getting the archæologist to symphathize with our enthusiastic search for knowledge.

"The graves you saw uncovered give a pretty fair idea of what their occupants

SERPENT MOUND PARK
A view of the anterior portion of the great serpent, looking toward the head. The men at the extreme right furnish a scale for judging the size of this greatest of all effigy earthworks. Photograph by B. E. Kelley

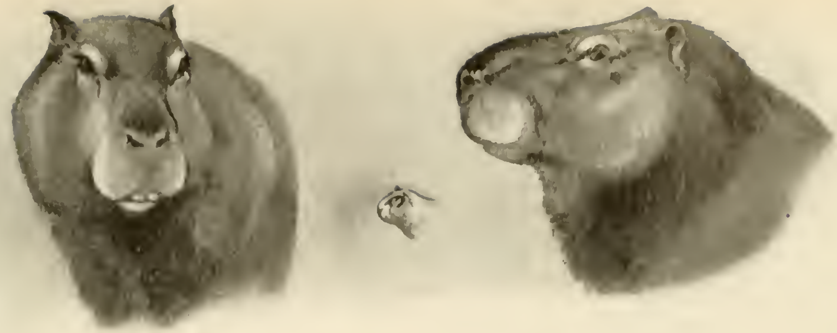
were like" he comments. "Of course we find many other things besides the relics with those three interments. They made artistic pottery ware, wove good fabric from fibers and bast; worked stone, flint, bone, shell, wood, copper, silver, and meteoric iron into implements, ornaments, and utensils. The copper and silver they secured from the Lake Superior copper region. They hadn't learned to melt it, but treated it as malleable stone, hammering and grinding it into form. They had many materials from distant sources of supply, as obsidian and grizzly-bear canines from the Rocky Mountain district; lead ore from Illinois; copper from northern Michigan; mica, quartz, and other minerals from the Lower Alleghenies; marine shells from the Gulf of Mexico. They secured these things by trade or by sending out expeditions; probably both. They must have spent a great deal of time in gathering mussels from the streams in order to secure the thousands of pearls they possessed. Pearls were a mania with them. Their artistic development is almost incredible. Yet they never advanced beyond the Stone Age period of development."

"And where did they live? Do you find the remains of their houses?"

"Like the ancient Mexicans, the Hopewell peoples and some others of the Mound Builders gave most of their attention to the dead rather than to the living. The Pueblo- and Cliff-dwellers built for the living, burying their dead, if at all, in the quickest and easiest manner. The Mound Builders built mainly for the dead. Adjacent to the Mounds we find their village or town sites, but the only evidences of dwellings are the post-molds and fireplaces showing where rude huts or tipis have stood. They were agricultural, raising maize, squash, beans, and tobacco; but they depended much on fish and on game secured in the chase."

In response to the inquiry as to what could be determined from the skeletal remains found in the Mounds, we learn that the physical anthropologist finds them to have been not strikingly dissimilar to the historic Indians, nor very different from the present-day inhabitants in so far as size or stature is concerned. One thing we can see for ourselves; they were not giants, nor did they have double jaw-teeth all the way round.

Double-headed bird design in copper. From the Mound City Group, Ross County, Ohio



Restoration of extinct capybara, compared with its living relative the guinea-pig

RODENT GIANTS

The Sizes of Living Gnawing Animals from Tiny Mice to Giant Capybaras—Extinct Rodents as Large as Bears and Hippopotamuses

By GEORGE GAYLORD SIMPSON

Associate Curator of Vertebrate Palæontology, American Museum

With Two Restorations and One Sketch by E. Rungius Fulda

RODENTS help to clothe, to feed, to amuse, to annoy, and sometimes to kill us. The humble rabbit furnishes hair for our felt hats and also appears on our tables in succulent (even if not universally appreciated) dishes. In its many disguises the pelt of this rodent provides us with furs, and the true beaver, muskrat, chinchilla, nutria, squirrel, and marmot are all rodents. The frisky squirrels, enlivening parks and forests, the gophers and woodchucks, detested by farmers, and the mice and rats, bane of the housewife, are all rodents. Rodents live in almost all situations, from salt marsh to mountain top, in all climates from the Equator to the Arctic, and in all parts of the earth from New York to Timbuctoo. Everyone knows something about them, for they are among the most widespread of creatures, and their varied ranks include some of the most harmful and some of the most useful of animals.

What part do rodents play in nature? They have enlarged front teeth and are gnawing animals; that is what the word "rodent" means. Most of them live on vegetable food. Most of them are small. It almost seems as if the rodents had a sort of working agreement with that other great group of vegetarians, the hoofed mammals, or ungulates, for the rodents are the small plant-feeders and the ungulates are the large. The living rodents range in length from three or four inches to more than three feet, with the great majority less than one foot, while living ungulates are from less than two feet to about twenty feet in length, with the majority well over three feet.

This rule of size is not too strictly observed, to be sure. The hyraxes or coneys, "feeble folk" of the Bible, are smaller than many rodents. They look much like rodents, too; some of them climb trees, and they even have gnawing teeth, but they have hoofs and their anatomy clearly shows that they are not rodents at all but a queer sort of ungulates. They are imitation rodents. In size, appearance, and habits they stand at one end of the great series of hoofed mammals which has such forms as the elephant at the other end, and our familiar pigs, sheep, cows, horses, and many wild animals somewhere in between.

In our country most of the rodents are small. The jack rabbit, woodchuck, porcupine, and beaver are the largest. The beaver, our giant among rodents, is sometimes about as large as our smallest hoofed mammal, the peccary (so-called "wild pig") of Texas and Arizona. In South America there are rodents even larger than the beaver.

South America, once totally distinct from any other part of the world in its animal life, still has many peculiar forms, including a whole series of strange and often very large rodents. Among them is that well known and long suffering servant of science, the guinea-pig (so-called, as someone has said, because it does not come from Guinea and is not a pig) and so is the chinchilla, the name of which is used more often than the fur. Other South American rodents are little known even by name, yet at least one of them is certainly worthy of lasting fame: the capybara or carpincho.

The capybara is the largest living rodent. Its length often exceeds three feet (although the tail is insignificant) and the weight may be more than one hundred pounds—a true giant when compared with its close relative the guinea pig, not to mention the tiny field mice and other more distant allies. It lives throughout most of the watered parts of South America east of the Andes, an enormous area, and is very abundant in some regions. Neither the hide nor the flesh is greatly prized by man, but the jaguar of its native haunts is less particular and takes heavy toll.

Darwin visited the home of the capybara during the voyage of the "Beagle" in 1832 (at the age of twenty-three) and has left a vivid account of this curious beast.

Courtesy N. Y. Zool. Soc.

A HYRAX

The Biblical coney is an imitation rodent. His small size and other rodent-like characters make it difficult to realize that he is really related to the hoofed mammals

RESTORATION OF EXTINCT GIANT BEAVERS

These great rodents, *Castoroides*, were as large as bears and were widespread in North America during the Ice Age. The scale is given by comparison with a more familiar rodent, a squirrel, on the tree in the foreground

"These great Rodents," he wrote, "occasionally frequent the mouth of the Plata, where the water is quite salt, but are far more abundant on the borders of fresh-water lakes and rivers . . . when viewed at a distance, from their manner of walking and color they resemble pigs: but when seated on their haunches, and attentively watching any object with one eye, they re-assume the appearance of their congeners, cavies and rabbits. Both the front and side view of their head has quite a ludicrous aspect, from the great depth of their jaw. These animals, at Maldonado, were very tame; by cautiously walking, I approached within three yards of four old ones. . . . As I approached nearer and nearer they frequently made their peculiar noise, which is a low abrupt grunt, not having much actual sound, but rather arising from the sudden expulsion of air: the only noise I know at all like it, is the first hoarse bark of a large dog. Having watched the four from almost within arm's length (and they me) for several minutes, they rushed into the water at full gallop with the greatest impetuosity, and emitted at the same time their bark. After diving a short distance they came again to the surface, but only just showed the upper part of their heads. . . . "

With their short ears, small legs, rounded rumps, and stubby tails, capybaras do resemble guinea-pigs, but they are like guinea-pigs of Brobdingnagian proportions and aldermanic portliness and gravity. Their deep jowls and long upper lips give them a vastly superior air, ludicrous in contrast to the undignified hump of their hind quarters. They eat grass, bark, and water plants, and live in groups of from three or four to more than a hundred. Although at home on land,

Courtesy N. Y. Zool. Soc.

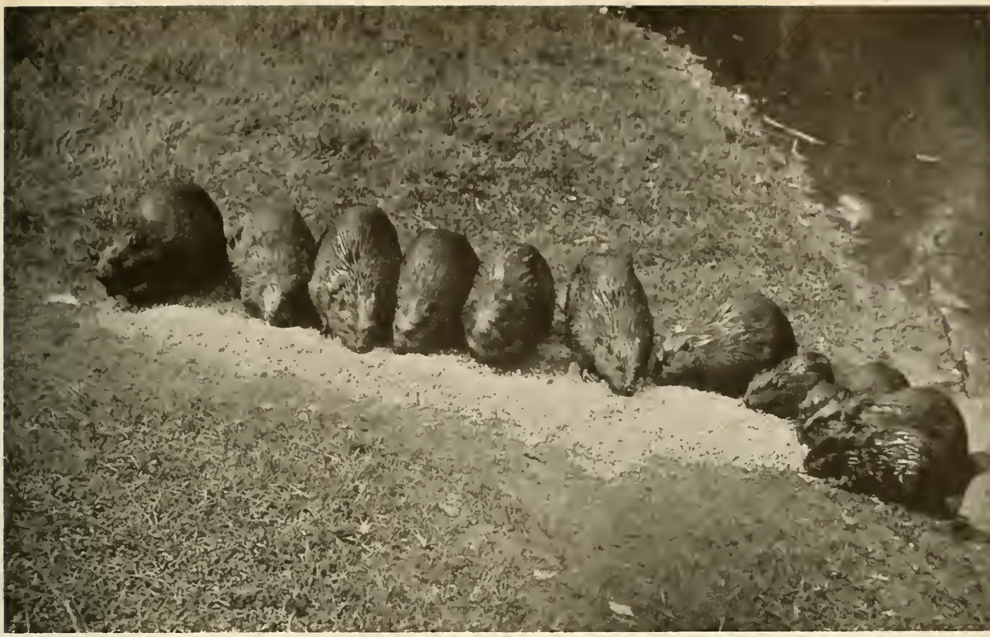
VIZCACHA

The vizcacha of South America is a small animal, but is closely related to the largest of all known rodents, the extinct *Megamys*, which reached the size of a rhinoceros

Photograph by M. C. Dickerson

A WOODCHUCK

The woodchuck or ground-hog, one of our largest and best known rodents, is hated by the farmer, in spite of his reputation as a weather prophet



Courtesy N. Y. Zool. Soc.

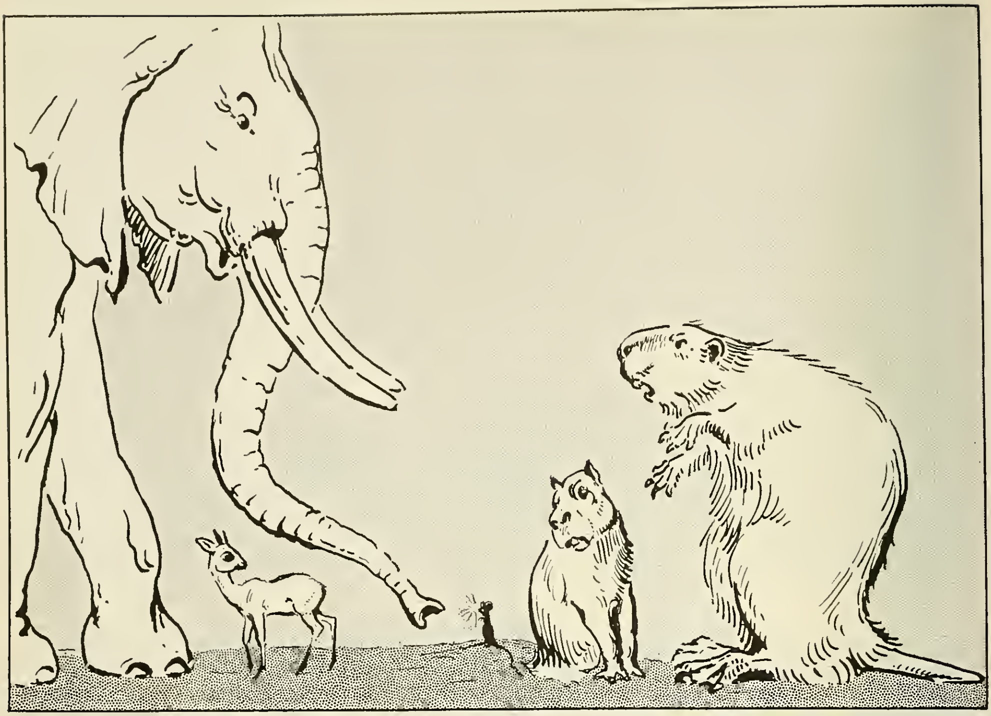
BEAVERS

The beaver, noteworthy for his industry and for his fur, is also the largest of living North American rodents. Individuals weighing nearly seventy pounds have been recorded

Courtesy N. Y. Zool. Soc.

CAPYBARA

The piglike capybara is the largest living rodent, reaching a length of three feet in spite of his very short tail



A STUDY IN SIZE

The elephant and the dik-dik antelope of Africa are near the extremes of size for living hoofed mammals, as the mouse and capybara are for living rodents. The extinct giant beaver towers above his largest living relatives and looks even the lordly elephant in the face

they are usually found near water and are good swimmers. They take to the water when frightened.

Such are the giant rodents of today, but in this group as in so many others, the largest forms are extinct.

The next time you see a mouse, imagine it multiplied in bulk some twenty thousand times. Or when you see a well fed bear at the zoo, think of a guinea-pig of equal size. That will give you some idea of the rodent giants of the past. There were only a few extinct rodents of such great size, for the gnawing animals have always been small for the most part, but these few must have been among the most impressive animals that ever lived.

The very largest of all known rodents is unquestionably that known to scientists as *Megamys*. It might be called a giant vizcacha, for it seems to be related to the living vizcacha of South America, a rodent (closely allied to the chinchilla) not unlike a capybara in general appearance, but very much smaller and with a bushy tail. Bones of this great beast were found in Argentina more than eighty years ago and described by the French naturalist Laurillard, who correctly identified them as parts of a rodent twice as large as a capybara. For years the discovery was discredited, as no one was willing to believe in the existence of such a gigantic rodent. Finally more bone fragments and teeth were found and described, leaving no doubt that Laurillard was correct.

Now several species of *Megamys* are known, and the largest appears to have been about as large as a hippopotamus—strange anomaly in a group that also includes some of the smallest known mammals! Even now not much is known about its appearance in life, except that it probably was something like a gigantic vizcacha. Only fragments and teeth are known, and contrary to the widespread opinion, scientists cannot reconstruct an entire animal from one bone or tooth. The best they can do is to conclude that it probably looked like some better known animal to which the fragments show it to be related. The accuracy of this guess depends on the reality and closeness of the supposed relationship, and it has sometimes fallen very far from the mark. In the present case, relationship to the living form is not close enough to be at all sure that *Megamys* looked very much like a vizcacha, and it must go unrestored until more of its bones have been found.

The second of these extinct giants is a North American and it is much better known. This is *Castoroides*, the giant beaver. Its remains were first discovered nearly a hundred years ago and many later discoveries show that it was once very widespread. It was most common in the upper Mississippi Valley, but also occurred throughout the central part of the United States and along the Atlantic coast from Florida to New York. In the far West its remains are rare, but a single occurrence in Oregon shows that it did cross the Rockies. This is a much more recent animal than *Megamys*, as it lived during the Ice Age (Pleistocene) and has apparently not been extinct very long, probably 25,000 years or so and possibly even less.

The recent beaver, now the largest rodent of North America, is always less than four feet in length (including the tail), and is not known to exceed seventy pounds in weight. The extinct giant beaver apparently reached a length of about seven feet and perhaps a weight of some three hundred pounds—a very respectable size and bulk for a modern bear and unheard of among recent rodents. Aside from the size, the most striking thing about the animal was its amazing front teeth. These are large in

Photograph by M. C. Dickerson

JACK RABBIT

Gullible persons from the eastern part of the United States will hear many western stories of jack rabbits as large as donkeys. This is one of our largest and fastest rodents

CHINCHILLA

The little chinchilla of South America has few claims to fame except for his highly prized fur and his relationship with rodent giants

all rodents, but in *Castoroides* they were out of all ordinary proportion. They are about an inch in width and eight inches in length along the outer face, lying in great curved sockets in upper and lower jaws. Only a third or less of the length projected beyond the bone, but (as in all rodents) these teeth grew continuously and could not be worn out. The enamel is corrugated in a peculiar way, so that even a small fragment of the incisor can be identified.

The giant beaver, unlike *Megamys*, is a well known animal. Several complete skulls have been found, and also a large part of the skeleton, so that it is possible to restore the appearance of the living animal. If you imagine a modern beaver multiplied by about two in every dimension except that the tail is not so wide and that the gnawing teeth are not twice but three times as large and are more rounded and furrowed, you will have a fairly accurate idea of the living appearance of this extraordinary beast.

If the habits of the giant beaver were at all like those of the true beaver (and the general structure is sufficiently similar so that there is no reason to believe otherwise) what trees could he not fell with his mighty cutting teeth, and what stream could he not dam! Even the prodigious labors of the modern beaver seem insignificant beside the feats possible to this titan-beaver!

There have been several other large extinct rodents, but only one other type seems truly worthy of the name giant. The giant beaver was a relative of the largest living North American rodent. The third giant is a relative of the largest living rodent of South America; it is a giant capybara. Large capybaras lived in both South and North America, but the occurrence of this animal in the North is most unexpected and interesting.

Extinct capybaras have been found in Ice Age deposits in Nicaragua, Texas, South Carolina, and Florida. Capybaras are true South American animals, having originated there during the long age of isolation. These four occurrences in the northern continent, few as they are, require little imagination to be transformed into a true epic of animal wandering. When the growth of the isthmus of Panama reunited the two continents, the capybaras moved northward, through Nicaragua, into the United States through Texas, eastward to the Atlantic coast, south once more into Florida. Their wanderings covered thousands of miles and must have taken many generations.

There were several species of these northern capybaras. Some were no larger than their recent relative, but one (*Neochœrus pinckneyi*) was gigantic. It was only last year (1929) that enough of this animal was found to show something of its true size and appearance. In a ditch bank near Bradenton (see NATURAL HISTORY, Vol. XXIX, page 511) parts of a skull were found, and study of these parts has made possible a reasonably accurate restoration of the whole skull. (See p. 305.)

The skull is very like that of the living capybara except for its greater size. The differences lie in such technical points as the proportionate width of the skull top or number of plates in the grinding teeth, and, at least to the casual eye, would make no great difference in the appearance of the living animal.

This skull is even longer than that of the giant beaver. The body is not yet known, but it must also have been very bulky, probably quite as much so as that of the giant beaver, although the tail was doubtless very short. In any event, the giant capybara now takes its place as one of the two great giants of the past rodent life of our continent.

Courtesy N. Y. Zool. Soc

A YELLOW-HAIRED PORCUPINE

Beneath his mop of hair the porcupine carries an armament of quills which makes him so nearly immune to attack that he goes his lumbersome way with an air of conscious superiority

The Beaver Group in the American Museum

THE ACCESSORY MAN AND THE MUSEUM GROUP

How the Setting for a Museum Group is Collected and Prepared

By ALBERT E. BUTLER
Department of Preparation, American Museum

The visitor to the halls of the American Museum is often puzzled when he tries to determine how the grasses and flowers, the trees and leaves and rocks and soil that he sees in the cases with the mounted animals and birds, are collected and prepared. So natural do these appear that it is often difficult to believe that wax and celluloid, plaster of Paris, and paper mache have been utilized in their construction. Furthermore, where one exhibit, as sometimes happens, displays the real with the imitation, it is generally impossible for the observer to tell which is which. In the following article Mr. Butler explains some of the methods used in the preparation of these important "accessories."—The Editors.

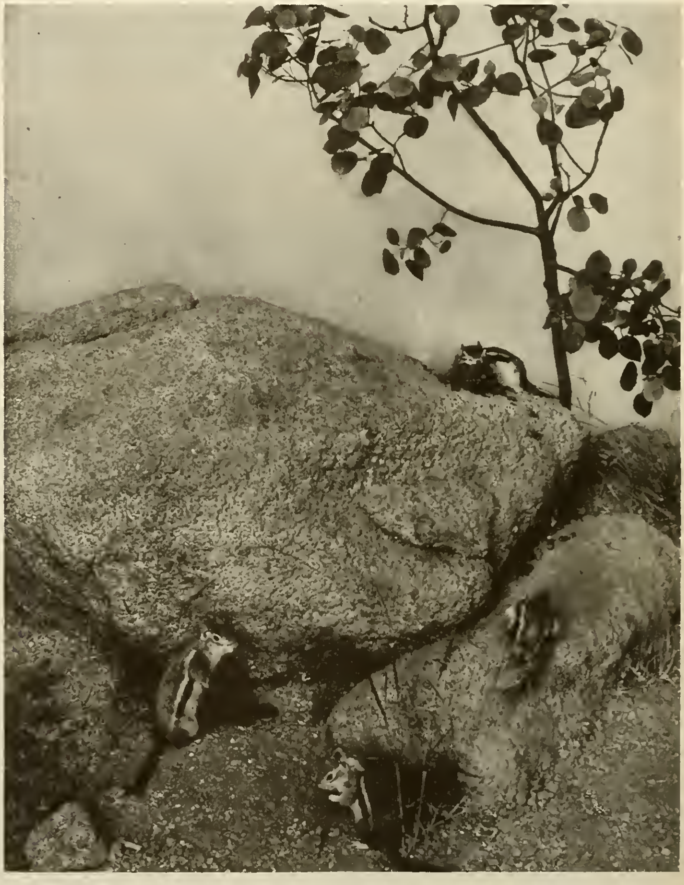
THERE are three distinct divisions in the preparation of a museum group,—mounting the animals, painting the background, and creating the foreground with all of its detail of foliage, grasses, and the like.

The last-mentioned division is commonly referred to, in museum parlance, as "accessory work."

When an expedition goes afield for the purpose of collecting the necessary material and data to reproduce accurately a background setting for an animal group, an "accessory" man is always included in the personnel. He must possesses a working knowledge of botany, and be an expert in methods of preparation; he must also be able to make all the notes necessary for guidance in reproducing the group material when it reaches the museum laboratories. He must know, when he examines any special plant, the method by which it can best be reproduced. This is a most important point, as there is always a choice of material, and so long as the forms selected are typical of the region, it is better to choose those which lend themselves readily to the ordinary methods and materials used in fabrication. For instance, it would be impractical to select a tiny-leafed acacia bush if there happened to be in the same locality another common bush with large simple leaves. The difference in time and expense saved in reproduction would be amazing, probably as great as ten to one.

The average group usually includes several forms of plant life, possibly a tree trunk with one or more leafy branches, grass, rocks, and surface earth. If a plant form is to be taken, several specimens are chosen for variety of size and form and, while still fresh, are placed in a solution of weak formalin. Extra leaves, in a range of sizes, are selected and carefully packed so as to preserve their original form in the solution. A series of plaster molds is made from other leaves and careful color notes are recorded. If there be flowers, molds or patterns are made from the fresh parts, since these lose their form in the solution. A tree branch is handled in the same manner as are plants, but the trunk may not be taken if it is very large. Usually, all or a goodly sample of the bark, together with numerous photographs from all angles, is sufficient to insure its faithful duplication in the museum workrooms. All branches intended for reproduction are cut apart and carefully strapped in burlap, and are shipped dry. Small grasses are carefully packed in cheesecloth and dropped into solution. Large grasses are packed into snug bundles and strapped with burlap to a board or other stiffener to prevent breakage or other injury during transportation. A few small rocks, sufficient to give variety of shape and color, are taken, but only plaster molds or numerous photographs of large rocks are made, for, obviously, it would be impracticable to attempt to bring back the originals. Usually a sample of earth for color and texture is sufficient, since it can readily be duplicated at home. Silt, dry leaves, sticks, etc. are scooped from the surface in sufficient quantity to cover the ground area of the proposed group. This is quite important, because these include dried parts of much of the vegetation, and if skilfully used, insure a natural finish to the groundwork.

When the collection arrives at the



DETAIL OF THE SAY'S GROUND SQUIRREL GROUP

The "rocks" are modeled in plaster over wire mesh. The small tree is natural, but the leaves are of wax. The grasses are preserved and artificially colored

AN ACCESSORY MAN AT WORK

Mr. Narahara, of the American Museum staff, is here shown engaged in making a flowering shrub, with leaves of wax and flowers of celluloid

STEEL DISCS USED IN MAKING FLOWER PARTS

These discs cut the parts shown from waxed cloth, celluloid, or paper. Later they must be carefully assembled, moulded into form, and colored

IN AN ACCESSORY LABORATORY
Members of the American Museum preparation department at work reproducing trees in wax. These trees will be installed in a new group for the African Hall

HOW A LEAF OF A PITCHER PLANT IS MADE
Carefully constructed of plaster, this two-part mold is used to form molten wax into accurate reproductions of one of Nature's most interesting plants

A PHOTOGRAPH TAKEN IN THE FIELD
From the plants shown in the foreground of this picture, the accessory workers have constructed details for a new Sambhur deer group

container springs a leak and the contents become too dry for use. The dry tree branches are immersed in hot water until relaxed and then are placed in a glycerine preserving solution which serves to retain the flexibility and permit reshaping. Molds are made from the extra leaves which were packed in solution for that purpose. The small grasses are transferred from the tank to the preserving bath, where they take up sufficient glycerine in a few hours to insure retaining their original fleshiness and quality. All preserved material must be recolored, since the color is destroyed in the process.

Several mediums are used in reproducing plants, and similar material, but the one generally used and accepted

museum, it is thoroughly inspected to insure against any loss that might occur through a leaky container or disintegration of dry material. It is very important that dry material which is to be preserved should be put into solution as soon after arrival as possible. Formalin material will remain in good condition indefinitely and therefore can be used as needed. This is true even though there may be but little moisture left in the container; for this reason the bulk of the solution is drained from the cans before leaving the field base.

The leaf molds are made in the field only to insure against total loss in case a

as most suitable is beeswax. A counter-mold is made from the mold which has been made of the surface of the leaf and this gives what is termed a "squeeze mold." Wire of sufficient strength to support the leaf is tapered by dipping it into nitric acid and then winding around it a thin film of cotton. This becomes the midrib of the leaf and the means for attaching it to the branch. The molds, mounted in a hinged clamp to insure perfect contact, are soaked with warm water to prevent the wax from sticking to the plaster, and a thin layer of cotton is placed over the counter-mold, with wire rib in place. A sufficient quantity of hot wax is poured over this and the upper mold quickly clamped down. The wax congeals instantly with the contact, and the result is a wax impression of the original leaf. When this is trimmed and colored, it is difficult, at a very short distance, to detect any difference from the original. Flowers are built in much the same manner, but obviously are more complicated. It is sometimes necessary to resort to the use of celluloid or glass in order to secure the best results.

As I have suggested, a tree trunk may be successfully duplicated or rebuilt, and this is accomplished usually either by building in mache and wire netting, or by using the real bark over a wood form. So far as possible, the original branches are used, and the wax leaves, built into tips, on wire, are attached. Rocks are built by shaping wire mesh and covering it with burlap and plaster. The texture is obtained by various means and is largely a matter of careful study and ingenuity. The color is applied usually by spattering or by air brush, in a manner which suggests detail as well as color.

Finally, all of these parts are assembled and secured to a base, which becomes the groundwork of the group. This base is built up by placing uprights at intervals corresponding to the desired contour. It is then covered with heavy wire mesh, burlap, and plaster. The surfacing to represent ground is best accomplished by using a mixture of cement and dry color, with sifted ashes, thinned with water sufficiently to permit the real earth film to settle into it and become a part of it. Right here a group can be spoiled, for the natural appearance depends much upon the skilful handling of the silt and surface débris.

Though simple in detail, the Say's Ground Squirrel Group, in the Hall of North American Mammals, represents most of the ordinary accessory operations. The grasses, for instance, are glycerine-preserved and afterward colored; the several small plants of "Oregon grape" and the leaves of the quaking aspen are of

PLANTS FOR THE SAMBHUR DEER GROUP
These wild tobacco plants, constructed of wax, duplicate those shown in the foreground of the picture on the opposite page

STEPS IN GROUP CONSTRUCTION

This and the following three pictures are of the wolf group in the American Museum. The base form is built of wood, and is covered with wire screen and plaster

BUILDING TREES

In this case the natural bark is applied to an improvised wooden form. A mache composition, textured and colored to match the bark, is is used in "pointing up" the joined and broken portion

STEPS IN GROUP CONSTRUCTION

The ground is next covered with plaster, which is then sprayed with paraffine, thus creating "snow"

THE FINISHED GROUP

Three mounted wolves, surrounded by a painted background, plaster and paraffine "snow," and trees built up of real bark over artificial forms create an atmosphere of reality

wax, while the aspen shrub is the original and has been recolored after having been in preserving solution for several weeks. Woody parts take up the solution more slowly than grasses. The rocks have been shaped in wire mesh, burlap, and plaster, and the coarse granite texture has been obtained by mixing ground cork with the finishing coat of plaster. In this case, the color was spattered on to the surface with small hand scrub-brushes, as the texture and color of the granite suggested coarse spatterwork.

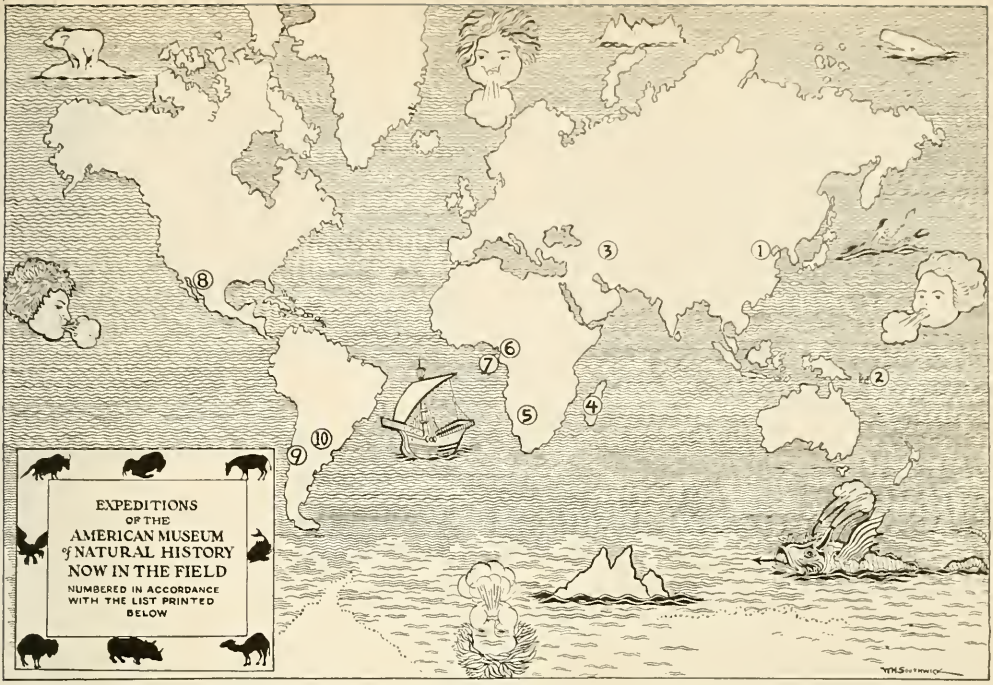
The ground effect has been obtained by applying to the base a plaster mixture of the color and tone of the actual ground and, while still wet, throwing the surface silt of granite shale, etc. into the mixture with sufficient force to insure its sticking. Rockwork made from molds of the original rock is sometimes utilized, thus reproducing Nature with the most faithful accuracy.

The accompanying pictures, showing how the base for the snow groundwork of the Wolf Group was built, present a good example of the method used, although this group was laid out more carefully than usual because of the necessity of having smooth, flowing lines for the drifted snow. In the same group two large tree trunks are shown. The bark for these was shipped to the Museum from the Colorado Rockies and, after having been treated with poison to kill any insect life which might be in it, it was applied to wooden forms as shown in the photographs. Another method of reproducing trees is shown in the Sphenodon Group in the Hall of Reptiles, at the American Museum. In this case a tree was modeled in mache over wire mesh from photographic studies of the original.

In short, the successful museum group is the product of close study, a sensitive feeling for truth, and technical ingenuity. The habitat group ranks high among the things which have done most to popularize the museum, and the part the "accessory" man plays in this important work has been little understood or appreciated.

MAKING LEAVES OF WAX AND COTTON

Mr. Butler, the author of this article, is here shown making a leaf in a "squeeze" mold. Often it is necessary to make these leaves by thousands



1.Central Asiatic; 2. Whitney South Sea, Solomon Islands, for birds; 3. Morden-Graves, Asiatic, for mammals; 4. Madagascar, for birds, mammals, and fossils; 5. Vernay, to Africa, for mammals; 6. Columbia University-American Museum, to Africa, for anatomical study; 7. Thorne-Correia, Gulf of Guinea, for birds; 8. Frick-Rak, New Mexico, for fossils; Frick-Falkenbach, Nebraska, for fossils; 9. Olson, South America, archæological reconnaissance; 10. Naumburg-Kaempfer, Southeastern Brazil, for birds

AMERICAN MUSEUM EXPEDITIONS

Edited by A. KATHERINE BERGER

It is the purpose of this department to keep readers of Natural History *informed as to the latest news of Museum expeditions in the field at the time the magazine goes to press. In many instances, however, the sources of information are so distant that it is not possible io include up-to-date data*

The Central Asiatic Expedition.—A satisfactory adjustment has finally been effected between the Cultural Society and the Commission for the Preservation of Ancient Objects officially appointed by the government of Nanking, and the American Museum, making possible the continuation of the work of the Central Asiatic Expedition in Mongolia this season. Curator Walter Granger, chief palæontologist of the expedition, Mr. Albert Thomson, assistant in palæontology, and Mr. J. McKenzie Young, head of the motor transport, left New York early in April for Peiping by the quickest route, and the expedition was equipped and ready to start north into the Gobi Desert the first of May. This harmonious outcome of negotiations which have been in progress since August, 1928, will be extremely gratifying to geologists and palæontologists all over the world, and renews the coöperative relations between the American Museum and the scientific institutions of China.

The Ottley-Anthony South American Expedition.—This expedition returned to New York on April 16, after a sojourn of six months in the field. The expedition was successful not only in securing a representation of the mammals from various localities, but more especially in carrying out reconnaissance over a very wide area, during which the party crossed the Andes no less than six times, and visited six of the South American republics. This expedition was made possible by the generosity of Mr. Gilbert Ottley, who acted as field assistant to Mr. H. E. Anthony, curator of the department of mammals at the American Museum, in charge of the expedition.

Messrs. Ottley and Anthony landed at Mollendo, Peru, in November, and after a short stop in Arequipa proceeded to Cuzco, and from there to Macchu Picchu, in the Urubamba valley. Here a collection of mammals was made, and the ancient ruins of Macchu Picchu were visited.

Returning to the main line railroad at Cuzco, the party traveled south to the shores of Lake Titicaca, where another camp was made just south of the lake and specimens of viscacha and other species of the high mountain fauna secured.

After crossing Lake Titicaca into Bolivia, headquarters were established at La Paz, and an important side trip was made to Sorata, where a pack train of mules was organized and a cross-section run from the high mountains down into the warm valleys, with camps at varying elevations. Upon the conclusion of the work in Bolivia, the expedition traveled by train from La Paz down through northwestern Argentina to Mendoza, where the Transandino or passenger train from Buenos Aires to Santiago could be boarded. At Puente del Inca, on the way to Santiago, the expedition stopped for a week in order to collect accessory material for Doctor Chapman's Aconcagua bird group. This group will show the South American condor against the background of Mt. Aconcagua, the highest of the South American peaks. A series of small mammals of the region was also secured at Puente del Inca, and on Christmas Day the party moved on to Santiago.

Here the necessary permits for collecting in Chile were obtained, after which the personnel proceeded by train to Angol, where transportation was secured for a side trip into the coast mountains of Nahuelbuta. Here a valuable collection was made in a forest of Araucaria, a conifer of ancient lineage, formerly of extensive range but found today in only a few restricted areas. Since this particular forest has been but little worked for mammals, it is quite possible that the expedition secured forms new to science there. In order to complete the observations on the Araucaria forest, the expedition moved from Angol to establish a second camp east of Curacautin in the main cordillera of the Andes, in the largest stand of Araucaria to be found in South America. At this place the collectors were also fortunate in securing some valuable small mammals. Traveling again by rail from Curacautin to Osorno, the party engaged automobiles and traveled around the western side of Lake Llanquihue, and meeting the railroad once more at Puerto Veras, proceeded to Puerto Montt, which is situated on Pacific waters. Puerto Montt served as a base for work lasting some weeks.

A small steamer was used to reach Puerto Aysen, about three hundred miles south of Puerto Montt, and by means of trucks and saddle animals, Messrs. Ottley and Anthony crossed the cordillera and arrived at Coyhaique, the headquarters of a great "estancia" comprising mroe than four hundred thousand acres which is given over to raising sheep. At Coyhaique, a camp was made in the forests of southern beech, and upon the conclusion of the work there everything was loaded into a big truck and the expedition traveled four days across the plains of Patagonia, a distance of 1250 kilometers, to Bariloche. This was a most interesting ride, during which there were good opportunities for observation of the wild life of the *pampa*, and great numbers of ducks and geese were seen, as well as guanaco, rhea, et cetera.

Bariloche is situated on the beautiful lake of Nahuel Huapi and is the Argentine terminus of the famous lake trip across into Chile. Traveling by boat, automobile, and mule, the party crossed successively Nahuel Huapi, Laguna Frias, the Chilean frontier, and the lakes of Todos Santos and Llanquihue, to arrive eventually at Puerto Montt once more. During this sojourn, camp was established on the lake of Todos Santos and small mammals were collected.

Once more, by steamer, the expedition moved south from Puerto Montt through the beautiful canals and inner waterways of Chile and through the Straits of Magellan to Punta Arenas, or, as it is now called, Magallanes, the southernmost city in the world. While awaiting steamer connections at Magallanes, Messrs. Ottley and Anthony hired an automobile and once more crossed the Andes, very low at this point, to Natales or Ultima Esperanza, which is situated on a long arm of the Pacific. At Natales they visited the famous cave of the Mylodon, where remains of the great ground sloth had been discovered, remains of the skin still retaining hair, and so fresh that many people believed that the animal was still to be found living in the wilderness of South America.

At Magallanes a steamer was secured for Buenos Aires, and en route north a number of short stops were made at practically all of the principal ports. In Buenos Aires the party stopped only long enough to arrange for steamer transportation and to visit the museum there and at La Plata near by. Ottley and Anthony then flew by airplane to Montevideo, a distance of 125 miles and about 70 minutes flying time. From Montevideo, after a short visit, they boarded the Royal Mail Steamer Almanzora for Rio de Janeiro. En route, the steamer stopped at Santos and the party had time to visit São Paulo by automobile and to make a trip to the snake farm at Butantan.

Arriving in Rio, there was time only for short trips about the city and to visit the museum there. The final and last move was by the steamer "Western Prince," which sailed from Rio on April 2, and after a short stop at Bahia and Trinidad, came directly to New York.

The chief results of the expedition are a valuable collection of small mammals, extensive notes and data to be used in the identification of material now in the department of mammals and to serve as the background for future intensive collecting in southern South America, many photographs of topography and environment, and, finally, the establishment of personal contact with the principal museums in the regions visited.

THE BACON MINER EXPEDITION TO THE BAHAMAS.— Dr. and Mrs. Roy Waldo Miner recently returned from an expedition to the Bahamas where they spent the months of March and April. During the month of March, they were the guests of Mr. and Mrs. Daniel Bacon at their camp on Pirate's Nest, Long Cay, at the entrance to Nassau Harbor. During this part of the expedition, they were engaged in securing specimens of gorgonians for the Coral Reef Group which is being built for the American Museum in the Hall of Ocean Life under the direction of Doctor Miner. Mr. Junius Spencer Morgan, Jr., coöperated in making this expedition possible.

On April 1, Doctor Miner joined the International Expedition to Andros, which has been carried on there this spring under the direction of Dr. R. M. Field, professor of geology at Princeton University. Other members of this expedition were Dr. Charles J. Fish, director of the Buffalo Museum of Science, Professor Ulric Dahlgren of Princeton University, Mr. Maurice Black of Cambridge University, England, Dr. Ernest Dixon of the British Geological Survey, Dr. Werner Bavendamm of the Technische Hochschule of Dresden, Germany, and Lieut. Joseph P. Lushene of the U. S. Coast and Geodetic Survey. This phase of the expedition was devoted to making biological studies of the sponge banks on the west coast of Andros Island and obtaining geological data on the island itself. Doctor Miner, Doctor Dahlgren, and Doctor Fish coöperated in investigating the animal life of the sponge flats by means of trawling and dredging operations. The diving helmet was used here and on the east coast of Andros and also in the neighborhood of Nassau. Motion pictures were secured at depths ranging from two to three fathoms.

THE COLUMBIA UNIVERSITY–AMERICAN MUSEUM ANATOMICAL EXPEDITION.—Leader Harry C. Raven, who is still in West Africa, has sent the following letter to the American Museum:

DJAPOSTEN, FRENCH CAMEROUN
March 5, 1930.

Here it is March and I am still far in the interior of Africa with two gorillas unshot. And uncertainty as to when they can be met. Dr. Butler's cable, which we received in Yaunde, was definite enough in saying they would be disappointed if we returned without the West African gorillas and that leave of absence had been extended. They could not be more disappointed than I.

However, the time has gone so quickly that I now realize spring will be well on before I can get home. Gorillas, wandering about like primitive man, like also the pygmies living here in the forest now, have no fixed feeding or sleeping places. No one can tell where they will be at any given time. I have had several good native hunters here who have killed many gorillas, but they all say the same thing:—the dry season is no good for hunting gorillas. The rains have commenced, we have had a few showers but not enough to make the forest muddy. There should be plenty of rain soon. . . .

Almost the only meat readily available in the forest is monkey and I have eaten a good many and have saved the skulls of most of them. . . . There are remarkably few gorilla and chimpanzee skulls to be had. Most of the white men are on the lookout for them and of course the officials and missionaries get nearly everything, through the chiefs. Perfect skulls are very rare indeed because the natives lose the teeth and hack them with knives in getting off the precious meat. I am afraid they may even try to steal some of the embalmed gorilla if they get a chance, for they are ravenous for meat of any kind.

A few days ago a native brought me a variety of chamæleon, which we had not seen before. It has no horns but long neural spines like a miniature *Dimetrodon*. McGregor would have enjoyed it. I will try to get some pictures of it. My movie camera is not much good; it jams all the time.

H. C. RAVEN.

MORDEN–GRAVES EXPEDITION.—On March 23 cable messages were received from Siberia announcing that two fine males and one female specimen of the long-haired Siberian tiger have been obtained by the Morden–Graves Expedition in the wilds of the Amur River region in Eastern Siberia. An excellent group of these rare animals is now assured for the American Museum. A number of other mammals and birds have also been collected. A confirmatory letter addressed to President Osborn has been received just as NATURAL HISTORY goes to press, in which Mr. Morden says in part:

The three tigers which this Expedition has obtained are as follows: two large males, one female.

Our first two months in the field were spent about a hundred miles north of Khabarovsk, where local reports were that tigers were plentiful. We covered a great amount of territory, but were finally forced to the conclusion that there were very few tigers in that section. We therefore came back to Khabarovsk and made arrangements to work in the district between there and Vladivostok, where tigers were said to be more numerous.

A month in this latter district showed us that although there are undoubtedly more tigers there than north of Khabarovsk, the tigers are just as impossibe to meet on foot as elsewhere, for the conditions of hunting are about the same. Mr. Graves did get on the day-old trail of one tiger, but found it quite impossible to come up with the animal. . . .

The three tigers which we have were killed, within a few miles of our camp, by gun-traps set out by local trappers, one of whom was our guide. We have sets of measurements, photographs of the animals before and after skinning, and, of course, the skins and complete skeletons. In addition, we have photographs and sufficient notes of the country to enable the department of preparation to construct a habitat group of these tigers. I feel therefore, that these specimens will make quite a complete group.

Mr. Goodwin has done excellent work in the collection of small mammals and birds, much of the time under great difficulties. The winter season, of course, is not the best for such collecting, and the specimens obtained by him do credit to his perseverance. . . .

The expedition planned to leave March 25 for Novosibirsk, from which a branch railway runs to Biisk, the portion of the Altai where Mr. Graves wished to hunt *Ovis ammon* and *Capra sibirica*. These plans had to be changed at the last moment, and the members of the expedition are now on their way back to America.

THE VERNAY-LANG KALAHARI EXPEDITION.—The latest reports from Mr. Arthur S. Vernay indicate most satisfactory results thus far, more than 200 mammals having been collected. In the Free State, groups of black wildebeest, blesbok, and springbok were secured, the springbok being quite different from those obtained by Mr. Vernay in Angola. The region never has been collected in before, save on the very edge, and hopes are high for very interesting results during the three months the expedition plans to remain in the field.

BEEBE-BARTON EXPEDITION TO NONESUCH ISLAND, BERMUDA.—William Beebe, director of the New York Zoological Society's Department of Tropical Research, left New York April 9 for Nonesuch Island in Bermuda to continue his researches begun in March, 1929, on the types of marine life from the surface of the sea down to a depth of about two miles. This is the first time a scientific group has explored the ocean depths vertically. Otis Barton, a member of the expedition, has invented and built a unique diving bell in the form of a sphere equipped with windows of fused quartz glass, through which the expedition members plan to study the life that exists at the various depths.

THE EIGHTH BERNHEIMER EXPEDITION.—The rugged and archæologically unknown Carrizo Mountain region in northeastern Arizona will be visited late in May and early in June by the Eighth Bernheimer Expedition. For this archæological reconnaissance, Mr. Charles L. Bernheimer, who leads and finances these expeditions, will be accompanied by Mr. Earl H. Morris, of the Carnegie Institution of Washington, which is coöperating with the American Museum in this undertaking.

PICTOGRAPH STUDY IN SOUTHWESTERN UNITED STATES.—The successful first season of study of the pictographs or rock paintings in Southwestern United States undertaken by Mrs. Ann Axtell Morris for the department of anthropology has led Mr. Charles L. Bernheimer, who initiated the project, to seek further financial support for its continuation. To this end there has been issued a small pamphlet describing the work of 1929 in Cañon del Muerto, Arizona, and reproducing some of the copies of these paintings by Mrs. Morris, the originals of which are on exhibition in the Museum. The American Museum is now able to announce that the investigation will continue for another year and it is expected that Mrs. Morris will visit and study those sites reported to have pictographs in southeastern Utah, in the vicinity of Carlsbad Cave in New Mexico, and between Farmington and Shiprock, as well as in Cañon del Muerto in Arizona.

THE BUSH NEGRO OF DUTCH GUIANA.—Dr. Morton C. Kahn, of the department of hygiene, Cornell University Medical College, who has made several journeys to Dutch Guiana to study the Bush Negro groups dwelling there, expects to return to Dutch Guiana this summer, as in the past, under the patronage of Mr. Myron I. Granger. The study of these Negro groups has been carried on with the coöperation of the department of anthropology of the American Museum, where Doctor Kahn has deposited his ethnological collections and the data on their culture. The forthcoming expedition will be to the Boni tribe of Bush Negroes living on the Tapanahony and Lawa rivers.

THE VINCENT ASTOR GALÁPAGOS EXPEDITION.—On May 2 a party of explorers and scientists returned to New York from a six weeks' cruise to the Galápagos Islands on Commodore Vincent Astor's yacht, "Nourmahal." The personnel of the expedition included Vincent Astor; Kermit Roosevelt; Dr. Eugene Pool, of the New York Hospital; Clarence L. Hay, of the American Museum; Dr. Charles H. Townsend, director of the New York Aquarium; Dr. James P. Chapin, of the American Museum; Dr. H. K. Svenson, of the Brooklyn Botanical Garden; Wilford A. Bronson; and E. R. Sanborn, of the New York Zoological Society. Doctor Townsend acted as scientific director of the expedition.

The island studied most thoroughly was Indefatigable, where the giant land tortoise, *Testudo porteri*, was the principal object of interest. No specimens had been seen for many years, but it was believed to survive, and several examples were among the prizes brought back. These will be sent to the tortoise colonies which Doctor Townsend has established in Arizona, Florida, and Texas.

Two hundred remarkably beautiful fish were kept alive throughout the homeward trip, and these are now on exhibition at the New York Aquarium. Besides iguanas of two species, a few penguins and flightless cormorants and some other birds characteristic of these strange islands were also secured for the New York Zoological Society.

Collections of insects, crustacea, land-shells and other mollusks, rodents, and birds were made for the American Museum of Natural History, while Doctor Svenson made a careful investigation of the flora, especially of Indefatigable Island. There, with Messrs. Roosevelt, Cutting, and Hay, he climbed to 2100 feet, and thus was able to make the first botanical collection from the higher and humid part of the island.

Other islands visited were Albemarle, Narborough, Charles, and Tower. No evidence of prehistoric occupation was discovered by Mr. Hay.

NOTES

ASTRONOMY

The Amateur Astronomers Association broadcasted its last Saturday afternoon radio talk for the season on May 31. Mr. O. H. Caldwell, a member of the Federal Radio Commission, spoke on "Where the Orbits of Radio and Astronomy Meet." Station WOR has generously invited the Association to resume its broadcasts in the fall.

The regular meetings of the Amateur Astronomers Association, held on the first and third Wednesdays of each month, will be discontinued during the summer, as in the last two years. The fall reunion will take place on Wednesday evening, September 10, 1930.

BIRDS

A New Member of the Department of Birds.—The bird department of the American Museum has recently welcomed to its staff Mr. John T. Zimmer, who has been appointed to the position of associate curator of birds of the western hemisphere. Mr. Zimmer comes to the American Museum from the staff of the Field Museum of Chicago.

Condor Collides with Airplane at 17,000 Feet.—The pilot of a commercial airplane route between Buenos Aires, Argentina, and Santiago, Chile, according to an interview published in the New York *Times*, reports that when crossing the Andes, at an elevation of 17,000 feet, his plane collided with and presumably killed a condor. Although there is no reason to doubt that this great vulture ascends to this, and even greater heights, it is interesting to have this belief confirmed by a definite observation.

The barometric pressure at an altitude of 17,000 feet is less than 16 inches, or about one-half of the atmospheric pressure at sea level. Nevertheless, the bird seems to fly under these conditions without undue exertion, and I have seen condors sailing over the slopes of Mt. Chimborazo in Ecuador, at 15,000 feet, with apparently as much ease as those observed in southern Patagonia at sea level.

Assuming that condors cannot become a menace to aërial navigation over the Andes, it is hoped that this incident may be interpreted as an evidence of their return to their normal abundance in a region where their numbers have been greatly reduced.

It was in September, 1916, when visiting the Natural History Museum in Mendoza, Argentina, that I was introduced by its director and founder, Carlos K. Reed, to an Italian named Pernando Porta, who had been a professional collector of condors. Chiefly through his own efforts as a trapper, but also by purchase from native hunters, he stated that he had secured in recent years 16,000 condors! Only the feathers of the wings and tail were preserved, and these were sold to milliners in Paris from whom he had received twenty dollars for the feathers of each bird.

At the time mentioned the price, due to the World War, had fallen to ten dollars per bird and, in a dramatic voice, the collector exclaimed, "I refuse to take part in the destruction of such a noble bird for such a low price."—F. M. C.

CONSERVATION

International Wild Life Protection.—In recent years there has been an increasing interest in wild life conservation not only in this country but throughout the world. The danger to the very existence of certain animals particularly in Africa has been brought home to us by such people as Major Frederick R. Burnham, U. S. A. and Mr. C. W. Hobley on his recent visit to America on behalf of the British Society for the Preservation of the Fauna of the Empire. Mr. Madison Grant speaks of this in an excellent article in the March–April number of Natural History. As an illustration of our sympathy with the work the "Fauna Society" is doing, nearly ten thousand dollars was raised here in a short time and put at their disposal for conservation purposes.

For a number of years there has been an International Office for Nature Protection established at Brussels by representatives of several continental nations under the auspices of the Union Internationale Des Sciences Biologiques. This office is increasing in importance day by day, but at present serves mainly as a library of information on all subjects of conservation, and has done much to interest foreign countries in establishing reserves and national parks modeled on some of our own. It has been supported in part by funds from private individuals in this country.

Already there are numerous American activities in international conservation. Among them for example is the important work that Dr. T. Gilbert Pearson, president of the National Association of Audubon Societies, has done toward organizing the International Committee for Bird Preservation. Professor Osborn, Dr. John C. Merriam, and Mrs. Mary L. Jobe Akeley, are members of the American Committee for the Parc National Albert in the Belgian Congo, Mr. E. D. Merrill, University of California, and Dr. P. S. Smith, U. S. Geological Survey, were appointed at the Fourth Pacific Science Congress in Java (May, 1923) as representative members for this country on a standing committee for the Protection of Nature In and Around the Pacific. Dr. Remington Kellog of the Smithsonian is representing the American Mammalogical Society at the April Congress in Berlin that has to do with Whale Conservation. From time to time a number of organizations and institutions in this country have sent resolutions with regard to the necessity for certain kinds of conservation by foreign governments—particularly with regard to legislation protecting animals found in their colonies that are fast becoming extinct.

Every day the sentiment for International Conservation is increasing in America, and individuals are asking how they can help this cause. There seems to be a great need for a central organization to represent this country in dealing with foreign nations and helping them if they ask for it on matters of wild life conservation. It is also important in some cases to subsidize certain existing agencies for the protection of animal, bird, and plant life before it is too late to save certain disappearing forms.

To meet this need an American Committee for International Wild Life Protection is being formed of representatives of the most important institutions and organizations in the United States particularly concerned with these matters. It is hoped that this committee will be given the strongest kind of backing by people in America interested in and wishing to support conservation in a world-wide application of its principles.

Any inquiries with respect to this committee should be sent to the Secretary of the Executive Committee.

The Executive Committee as appointed by Madison Grant, president of the Boone and Crockett Club, is made up as follows:

Dr. John C. Phillips, for the Boone and Crockett Club
Mr. George D. Pratt, for the American Museum of Natural History
Mr. Kermit Roosevelt, for the New York Zoological Society
Mr. Harold J. Coolidge, Jr., Secretary
Address—Museum of Comparative Zoology, Cambridge, Massachusetts

The Society for the Preservation of the Fauna of the British Empire.—Contributions amounting to $9,550 have already been received from American subscribers to the Society for the Preservation of the Fauna of the British Empire, and have been transmitted by Madison Grant to Lord Onslow, president of the Society in London. The donors are:

Boone and Crockett Club (donated by Madison Grant)	$1,000
New York Zoological Society	2,000
American Museum of Natural History (donated by Daniel E. Pomeroy—$1,000; Childs Frick—$500; George D. Pratt—$500)	2,000
Mrs. Grace Rainey Rogers (in memory of the late Paul Rainey)	1,000
Field Museum of Natural History, Chicago (donated by Stanley Field)	1,000
American Nature Association (donated by Arthur N. Pack)	1,000
Henry W. DeForest, New York City	500
Herbert Hope, Philadelphia	50
The Wilderness Club of Philadelphia	1,000
Total	$9,550

It has been suggested that the subscribers be elected to suitable classes of membership in the Society for the Preservation of the Fauna of the Empire in order that their interest may be permanently retained. Also that the amounts subscribed be spent during the next two years for the purposes of the Society, instead of being held as a reserve fund.

Lord Onslow, in acknowledging the contributions, said that the Society had, during the last few weeks, arranged for an expert to proceed on a tour through the East African group of colonies to confer with the local governments and also with the growing communities of colonists, as the Society desires to induce a uniformity of policy regarding game preservation and to push forward the creation of permanent sanctuaries before it is too late. The Society is also hoping to take similar action in other parts of the world.

The Charles Sheldon Antelope Refuge.—Through the activity of the National Association of Audubon Societies and the cooperation of the Boone and Crockett Club, a sanctuary for the prong-horned antelope and the sage hen is to be established in northwestern Nevada. Mr. T. Gilbert Pearson, president of the Audubon Association, discovered territory exceptionally well suited for such a sanctuary in the summer of 1928, and at once took option for the Audubon Association on private holdings containing all the water holes within a radius of about a hundred square miles. Since then the Boone and Crockett Club has agreed to share half of the expense of $20,000 for acquiring additional territory, improving water holes, and building fences; and President Hoover withdrew from public entry much of the public property immediately surrounding these scattered holdings. Between five and six hundred acres still must be acquired from private owners. Altogether this will make an area of about 30,000 acres. It is reported that on this territory there exist from 800 to 2500 antelopes, according to the season of the year.

This sanctuary will be known as the Charles Sheldon Antelope Refuge, being named for the late Charles Sheldon, who was chairman of the Boone and Crockett Club's committee on conservation.

TO PROTECT THE BALD EAGLE.—The campaign which bird lovers have long been waging to prevent the possible extermination of the American eagle in the United States has been carried to Congress by the introduction of bills in the Senate and House providing a heavy fine for anyone that kills a bald eagle, "within the continental United States, Alaska, Porto Rico, or Hawaii."

This bill, which originated with the National Association of Audubon Societies, is sponsored in the Senate by Peter S. Norbeck of North Dakota and in the House by Congressman August H. Andresen of Minnesota, and has the endorsement of the National Committee on Wild-Life Legislation.

In a statement recently coming from the offices of the Audubon Society, Doctor Pearson says:

> The prejudice which has long existed on the part of the public generally, and Game Commissions particularly with respect to hawks and owls is well reflected in the legislation, or lack of legislation, pertaining to this class of birds. Careful researches have shown that most hawks and owls are more beneficial than harmful, although it has been exceedingly difficult to secure protection for them.
>
> One of the most picturesque and interesting of this group of birds, is the snowy owl, a few individuals of which migrate from the far North, each winter, into our northern tier of states. Occasionally, however, unusually large migrations occur, and at such times, these majestic birds are often killed in large numbers.
>
> The striking appearance, and the almost innocent demeanor of this owl, with respect to the ways of civilization, renders it an easy mark to that still considerable number of persons who like to shoot every large and unusual bird which comes their way.
>
> Careful studies of their food made during these periodic winter visitations have shown the snowy owl to be not destructive to any extent to game birds and animals and, therefore, deserving of complete protection.
>
> The National Association of Audubon Societies is endeavoring to secure the enactment of a law protecting hawks and owls in those States in which they are winter visitors, and where they are not now protected. Towards this end, efforts are being made in the re-codification of the Game Laws of Massachusetts and Rhode Island to place the snowy owl in the list of protected birds.

CONSERVATION OF RURAL SCENERY.—The New Jersey State Committee for Restriction of Outdoor Advertising is renewing the fight for legislation which was begun last year, and has reintroduced a bill for licensing and taxing billboards in New Jersey.

THE MAMMOTH CAVE NATIONAL PARK.—The governor of Kentucky recently signed a bill appropriating $1,500,000 for the purchase of lands around Mammoth Cave to be turned over to the Federal Government as a National Park.

EVERGLADES NATIONAL PARK.—Negotiations are under way for the establishment by the United States Government of a National Park in the Everglades of Florida to preserve for all time the remarkable deposits of fossil material and geological records that have not yet fallen under the advance of commercialism in that state. An exhaustive study of the entire region has recently been made by a committee who utilized a blimp in making the reconnaissance.

EDUCATION

FREE CULTURAL COURSES FOR TEACHERS.—For the season beginning October 21, 1930, and ending March 17, 1931, two special lecture courses will be available in the department of education at the American Museum, viz: (1) A Museum course in geography for teachers of the elementary schools, and (2) A Museum course for teachers in high schools and colleges.

The first, under the direction of Mrs. Grace Fisher Ramsey, associate curator of the department of education, is entitled "Man's Adjustment to His Environment," and is divided into three sections,

(1) Adjustment of Primitive Peoples
(2) Culture of Early Tribes and Nations
(3) Achievements of the Present

The second course, "Man and His Environment" will be under the direction of Dr. Clyde Fisher, curator of visual education, and will cover such subjects as astronomy, geology, palæontology, lower invertebrates, and insects. Each lecture period will be one and one-half hours in length, and will include both classroom discussions and laboratory work.

The laboratory work in the Museum's halls is such an integral part of each lecture period that it has been found advisable to keep the numbers registering small enough to insure individual assistance in the study of special exhibits relating to the topic of each lecture. Therefore the registration in these courses is limited to one hundred teachers desiring the thirty hours' credit by the Board of Education. An additional three hundred teachers may register providing they wish to attend the lectures and carry on unsupervised laboratory work but do not desire official credit for the course. Registrations will be accepted in the order received and should be made before October 14, either by letter or in person, at the administration office, Room 306, School Service Building of the American Museum.

A third course of thirty lectures, "Backgrounds for Progressive School Units," has been planned by the American Museum in coöperation with the Metropolitan Museum of Art to meet the special needs of teachers of progressive schools, both public and private, who are carrying on experiments from which will develop new methods and material in education. The lectures will definitely correlate the rich resources of both museums with certain units now being worked out in schools of the newer type. Miss Marion E. Miller, instructor at the Metropolitan Museum, will present lectures covering present-day life and life in other days, and Dr. Margaret Mead, assistant curator of ethnology at the American Museum, will lecture on primitive life of North America. African, Australian, and Polynesian types will then be discussed and compared with the foregoing. This course begins October 2 and ends May 21. Thirty hours credit will be granted by the Board of Education, and two points credit by Teachers College if registration is made at the College.

Full information concerning any of these courses may be obtained from Dr. George H. Sherwood, curator-in-chief, department of public education, the American Museum of Natural History, 77th Street and Central Park West, New York City.

UNIVERSITY EXTENSION WORK AT THE AMERICAN MUSEUM.—During the past winter the American Museum has been offering, through Director George H. Sherwood, curator-in-chief of public education, special note-taking facilities on its unrivalled collections from all parts of the world, to highly qualified students in the following subjects: geology, mineralogy, biology, woods and forestry, zoölogy of the invertebrates, fishes, amphibians, reptiles, birds and mammals, and anthropology.

These facilities were extended in the morning hours when the Museum is comparatively free from visitors, and by special arrangement halls were partly closed off from the public.

MONTEFIORE HOSPITAL CRIPPLES VISIT THE AMERICAN MUSEUM.—April 21 was set apart by the American Museum especially for the entertainment of a group of cripples whose education is being provided by New York City in the annex of the Evander Childs High School at Montefiore Hospital. Large Museum auto trucks transported the group in their own wheel chairs from the hospital via the Speedway and Central Park to view the blossoming cherry trees and thence to the American Museum. After visiting the exhibition halls, the group was treated to a luncheon at the Museum by Mrs. Max Benswanger who is taking a keen interest in the work for the cripples. In the afternoon they were entertained with the motion picture "Nanook of the North," and then returned to the hospital by way of Riverside Drive, with a stop-over at the new Hudson River Bridge.

RECEPTION TO TRAINING SCHOOL GRADUATES.—On April 14 the department of public education of the American Museum tendered its semi-annual reception to the graduating class and the faculty of the Jamaica Training School for Teachers. The afternoon's program included brief talks on the Museum's School Service by Doctor Sherwood and Doctor Fisher, a tour of the School Service Building and some of the exhibition halls under the guidance of staff members, and concluded with a social hour in the North Bird Hall.

In June the graduating classes and the faculties of the New York Training School for Teachers and the Maxwell Training School will be entertained in the same way.

These receptions are planned to give the future teachers of Greater New York an opportunity to become acquainted with the American Museum and the facilities which it offers to the schools of the city.

MEMBERS DAY

ON April 16, the second annual visiting day for members of the American Museum, about four hundred and fifty members and their guests took advantage of the Museum's invitation to look behind the scenes and observe the great amount of work that goes into the preparation of groups and the research that follows expeditions.

Members of the Museum staff conducted the visitors through a number of the laboratories, through the preparation departments, and through the South Asiatic Hall which is not yet open to the public. Readers of NATURAL HISTORY will be interested to know that a special exhibit for this occasion showed the processes involved in the making of NATURAL HISTORY MAGAZINE. Each step necessary in preparing an article for press, from the original manuscript and photographs to the finished product, was shown in concrete form. Original NATURAL HISTORY cover paintings formed a colorful background for this display.

Following the tour of inspection, the members assembled in Education Hall of the School Service Building, where tea was served. President Henry Fairfield Osborn then addressed the visitors on the increasing popular interest of the Museum.

IBEX BRONZE
By James L. Clark
Winner of the Speyer Memorial Prize. The sculpture stands twelve inches high

HONORS

THE SPEYER MEMORIAL PRIZE.—At the 105th annual exhibition of the National Academy of Design, an ibex bronze by James L. Clark, assistant director in charge of preparation at the American Museum, was awarded the Speyer Memorial Prize for animal sculpture The inspiration for this statue came to Mr. Clark when, as a member of the famous Morden-Clark Asiatic Expedition of 1926–7, he collected a group of ibex in the Tian Shan Mountains of Central Asia. He was so impressed by the sturdy character of these animals and by their massive sweeping horns that he did not rest until he had reproduced one in bronze.

Mr. Clark, who came to the American Museum in 1902 as an animal sculptor rather than as a taxidermist, received his art training in the Rhode Island School of Design and in the designing room of the Gorham Company. He has to his credit some fifteen pieces of animal sculpture in bronze, among which are an African black rhino with tick birds, which the late Colonel Roosevelt had on his library table at Oyster Bay, and a striking African buffalo, which was chosen by the African Big Game Club as their memorial to the great African hunter, F. C. Selous.

The American Museum is fortunate in having a sculptor of such high artistic standing leading its important work of preparation.

OTHER MUSEUMS

DEDICATION OF NEW MARINE ROOM AT PEABODY MUSEUM.—At the formal opening of the John Robinson Marine Hall in the Peabody Museum of Salem, Massachusetts, on the afternoon of February 22, 1930, the American Museum of Natural History was represented by Mr. John P. Benson and Dr. Robert Cushman Murphy. The former's close association with the American Museum began when he was commissioned to paint the murals of whales and whaling which decorate the Hall of Ocean Life. The first six lunettes of this series were presented to the Museum by Messrs. George T. Bowdoin, Junius Spencer Morgan, Jr., and Oliver G. Jennings. The seventh painting, representing a bowhead whale among Arctic ice-floes and bergs, is the gift to the Museum of the artist himself.

The Marine Room at Salem is dedicated to the memory of Mr. John Robinson, who had charge of the collections for the last twenty years of his life, and whose interest in that historical institution dates from his boyhood in Salem. The hall contains a large central case housing models of famous American ships, while elsewhere are paintings, chests, furniture, and other memorabilia of the days of Salem's maritime glory.

This collection comprises many portraits of prominent Salem merchants and master mariners; models of Salem vessels of the late Eighteenth and early Nineteenth centuries; another of the frigate "Constitution"—familiarly known as "Old Ironsides"—which was given to the Museum in 1813, by her captain, Isaac Hull, when fresh from his capture of the "Guerriere"; a large collection of paintings of Essex County vessels of the late Eighteenth and early Nineteenth centuries, including examples of the work of many local and foreign artists, especially of the Roux family of Marseilles; an extensive series of nautical instruments illustrating types used in navigation from the earliest to the most recent times; a representative collection of objects used in the whaling industry; and a miscellaneous assortment of articles illustrating or associated with the life of a sailor before the mast.

Today this collection is one of the most important of its kind in the world, and the naming of this hall in honor of John Robinson is a fitting memorial.

MEETINGS OF SOCIETIES

THE SEVENTH INTERNATIONAL ORNITHOLOGICAL CONGRESS will be held at Amsterdam from June 1 to 7. Dr. Frank M. Chapman, curator-in-chief of the American Museum department of ornithology has been appointed to represent the American Museum officially at this Congress, and will present a paper on "The Origin of the Bird Life of Mounts Roraima and Duida."

THE AMERICAN ASSOCIATION OF ANATOMISTS. —The Forty-sixth Annual Meeting of the American Association of Anatomists was held, April 17-19, at the University of Virginia, Charlottesville, Virginia. Three papers were presented by members of the department of herpetology and experimental biology of the American Museum, two of them in the form of demonstrations. Doctor Noble and Miss Richards showed that a hormone of the pituitary gland at the base of the brain controlled the egg laying of salamanders. By transplanting the pituitary gland from one salamander to a female of the same species, the female was induced to lay its eggs in mid-winter. This discovery made it possible to obtain eggs from species whose life history was previously unknown.

Doctor Noble and Miss Richards also showed that the large perennibranch salamander, Siren, which spends its life in the swamps of Southern United States, undergoes a metamorphosis of its skin exactly like that of land salamanders. They were able to experimentally induce this metamorphosis in very young Siren, one or more years before the change would normally occur. Such experimental studies on the problem of metamorphosis throw considerable light on the origin of the large aquatic salamanders and the nature of the changes which make one species different from another.

Doctor Noble and Mr. Brady showed by demonstration that the hatching of the marbled salamander was controlled by secretions of unicellular hatching glands which are widely distributed over the snout of the larvæ for some time before hatching. Weak solutions of pilocarpine release the secretion and cause the larvæ to hatch at once. The marbled salamander lays its eggs on land and, if they are kept fairly dry, the hatching glands do not function and the larvæ may remain more than six months within the egg capsules.

THE UNIVERSITY OF ARIZONA INAUGURATES A NEW PRESIDENT.—The American Museum was officially represented by Dr. J. C. Merriam at the inauguration of Homer LeRoy Shantz as president of the University of Arizona, which took place on April 24.

THE AMERICAN ASSOCIATION OF MUSEUMS will hold its twenty-fifth annual meeting at Buffalo, June 4–7.

THE CONVENTION OF MAMMALOGISTS.—At the time this issue of NATURAL HISTORY goes to press plans for the annual convention of the American Society of Mammalogists are too incomplete for a detailed report. The sessions will be held in the American Museum of Natural History from May 21–24. It is planned to have a symposium on the gorilla, in which most of the American authorities on this animal will detail their views as to its relationships. There is also to be a symposium on "The Possibilities of Research in Zoological Parks."

Concurrent with this convention there is to be held in Education Hall of the Museum an exhibition of live-traps for animals, animal cages, exercising wheels, ultraviolet lamps, books, and related accessories for use of those studying living animals in the laboratory. This exhibit is contributed to by individual workers, research laboratories, and manufacturing concerns, to stimulate the study of animal behavior under laboratory conditions.

SCIENCE OF MAN

NATIVE LIFE IN NEW GUINEA.—A fine series of prints depicting interesting and unusual phases of native life in New Guinea has been presented to the American Museum by Mr. E. W. P. Chinnery, government anthropologist of the mandated territory of New Guinea. Mr. Chinnery, who is now visiting the department of anthropology, has lived for more than twenty years in New Guinea, on which subject he addressed the American Ethnological Society on Monday, April 28.

ESKIMO CARVINGS FROM ST. LAWRENCE ISLAND.—Modern survivals of the use of old techniques by primitive peoples always arouse special interest. There has come to the American Museum as a gift from Miss Vivian Zinn, a teacher in the school for Eskimo on St. Lawrence Island, a small series of ivory carvings made by these Eskimo. These carvings are good illustrations of the application of an old technique to a newer use, for instead of being the old-time human and animal figures, these carvings are miniature reproductions of objects of White use and manufacture, perhaps the forerunners of the extinction of the whole carving technique. This collection contains also a waterproof *parka* or coat made from strips of seal intestine, such as is usually worn in the *umiak* or Eskimo skin boat. This particular coat is, however, designed for ceremonial use. Its chief interest lies in its construction in which may be observed some survivals of the ancient methods of skin-working prevalent in the Aleutian Islands many years ago, as demonstrated in the fragmentary skin clothing found in the burials at Fortress Island in the Aleutians by the Stoll-McCracken Expedition in 1928. In the Fortress Island examples, which are now being analyzed in the Museum, the garments have ornamental bands, consisting of very narrow strips of skin laid parallel to each other to form the width of the band. These narrow strips are sewn flat to the garment with tiny very regular stitches, and the bands are further enhanced by the introduction, at intervals, of colored strips of skin, or strips of skin with the hair adhering to it, forming a kind of fringe. One example has the beaks of birds with tufts of feathers attached at intervals to the skin strips. This ornamental motive finds an interesting parallel in the modern St. Lawrence Island coat which is reminiscent of the same general technique.

A PREHISTORIC INDIAN BURIAL.—The contents of the unusual tomb of a prehistoric Indian of Arizona, reported in a previous issue of NATURAL HISTORY, is now on exhibition in the hall for the Indians of the Southwest at the American Museum. This burial was in a cist in one of the caves of Cañon del Muerto, effectively sealed, the result being a remarkable preservation of all the mortuary offerings. The deceased was evidently a weaver of cotton, since hanks of warp, amounting to two miles of thread were found in the tomb. The probable date of the tomb is 1000 A. D.

NEW PUBLICATIONS

"On Some Recent New Light on the Origin of Mammals." By R. Broom. *Proc. Linnean Soc.* N.S.W., Vol. LIV, Part 5, 1929, pp. 688–694.

IN 1876 Sir Richard Owen, after describing the fossil "theriodont" reptiles from the Permian of South Africa, suggested that these forms may have given rise to the mammals "by secondary law, the mode of operation of which we have still to learn." In 1880 Huxley, neglecting the evidence cited by Owen and having in mind only the comparison of the anatomy of recent mammal and recent amphibians, taught that the mammalian class had been derived from the remote predecessors of the existing amphibians, the reptiles and birds being altogether off the line. The subject was discussed by Cope, Baur, Seeley, and other authorities, but it remained for Prof. Henry Fairfield Osborn in 1897 and 1898 to give the clearest exposition of the numerous mammal-like characters of the theriodont reptiles and to suggest that future discovery might well bring to light small forms of this group, containing the right combination of characters to be considered as the real ancestors of the mammals.

Since 1900 Dr. Robert Broom of South Africa has added enormously to our knowledge of these forms by discovering a multitude of new types varying in size from a rat to a hippopotamus, while he and Prof. D. M. S. Watson of London have led in the investigation of the entire problem of the origin of the mammals. A few weeks ago I received from Prof. Watson a photograph of one of his latest discoveries, a skeleton of a small "scaloposaurid" with especially mammalian characters in the limbs and certain very mammal-like features around the eye orbits; but not even this specimen was sufficiently advanced to be considered the true "missing link" between mammals and the mammal-like reptiles.

The latest discovery in this direction has been made by Dr. R. Broom, who has found in the Bloemfontein Museum in South Africa two fossil specimens which throw a flood of new light on the problem. These fossils come from the Upper Triassic red beds of South Africa.

The new animal is a small mammal-like creature about the size of a rat but with a relatively large head and a long tail. If the skull and lower jaw had been "made to order" they could not be a more perfect intermediate stage between the older "cynodonts" of the mammal-like series and the true mammals.

Thus Doctor Broom has set in place the capstone of his life work, which will be more fully described in his monograph on the entire group of mammal-like reptiles.—WILLIAM K. GREGORY.

Aquatic Mammals: Their Adaptations to Life in the Water. By A. Brazier Howell. Charles C. Thomas, Publisher. Springfield, Illinois; Baltimore, Maryland. 1930. viii + 338 pages. Frontispiece and 53 text figures.

THIS book, by a well known comparative anatomist of the Johns Hopkins University, may be safely recommended to any mature reader who happens to be interested in any one of the thousands of known facts concerning whales, sea cows, walruses, and other aquatic mammals. If we are curious to know how far down whales can dive, or how long they can resist the terrific water pressure of great depths, or if we care to know what lies beneath that great smooth mass of blubber, there is no more authoritative and carefully tested body of information on the subject than is to be found in Doctor Howell's book. Or if we are surfeited and overwhelmed by the myriad facts of cetacean anatomy and desire some explanation, some even tentative interpretation, of the intricate anatomical mazes of the most highly specialized of all mammals, then we shall find here the material for many an enjoyable hour of reflection on some of Nature's greatest miracles.

To naturalists the subject of cetacean anatomy, for two centuries past one of the reliable staples of comparative anatomy, has received a new impetus from the broad and intensive investigations of Dr. Remington Kellogg of Washington on the anatomy and classification of recent and extinct whales. The author of this book, who gladly acknowledges the inspiration he has received both from Doctor Kellogg's publications and from frequent conferences with him, has likewise contributed greatly to lift the reproach from the science of comparative anatomy that it has in the past been too largely concerned with mere recording of facts and has failed to discover both how such a complex structure as the spermaceti organ of the sperm whale is used and by what steps it has attained its present complexity from more simple and understandable beginnings.

Not that Doctor Howell would make any claim to finality about the tentative theories, hypotheses, and explanations that he puts forward, or that have been advanced by others, to account for the astonishing facts of record. He constantly reminds us that we have taken only the initial steps, that only the corner of the veil of mystery has been lifted, that we must still feel our way further by means of tentative hypotheses which can be tested by future observation or experiment. Take, for instance, the simple question: how, exactly, does the sea-otte urse his large webbed hind feet in swimming? From those who have had the opportunity of observing the facts directly, Doctor Howell could learn little or nothing, even after a diligent correspondence. So he considers the several ways in which other web-footed mammals do use their limbs and then after most careful and penetrating analysis of the arrangement and relative strength of the bones and muscles of the pelvis and hind limbs of the sea-otter, he eliminates first one method of using the feet and then another; finally he makes the tentative inference that, in swimming, the sea-otter's feet are held horizontally to the rear, one on either side of the tail, with the sole up, and that they are oscillated in the vertical plane on the same principle on which the whale uses its flukes.

After prolonged analyses of the anatomy of the whales and porpoises, he concludes that "there seems to be considerable evidence that the Cetacea could most readily and quickly have evolved from some sort of terrestrial ancestor having many of the chief bodily characteristics now occurring in the sea-otter." This of course does not imply any real relationship with the sea-otter, and Doctor Kellogg seems to incline to the opinion that the remote terrestrial ancestors of the whales were small insectivorous mammals of the Cretaceous epoch.—W. K. G.

OBSERVATIONS AND EXPERIMENTS IN INSECT LIFE.—Two of the technical papers recently published by the department of insect life at the American Museum are of popular interest. One concerns Observations on Leaf-cutting Ants (*Novitates*, No. 388) by F. E. Lutz and the other is An Analysis of a Movitone Record of a Cricket's Chirp (*Novitates*, No. 420), by F. E. Lutz and W. R. Hicks.

While at the Barro Colorado Laboratory in the Panama Canal Zone, Doctor Lutz noticed a natural "set up" for studying the burden-bearing activities of those interesting ants that cut pieces of leaves and carry them to the colony's nest for the purpose of growing on them the fungus food of the colony. Their trail was over a liana affording a variety of grades ranging from steep-down, through level, to steep-up. What effect has grade on the speed with which burdens are carried? Are the large ants more efficient than the small ones? Very small members of the colony are much given to stealing rides on the burdens carried by their larger sisters. What effect has this amusing habit on the economy of the colony? What is the signal for starting and stopping work? These are some of the questions which are discussed by means of tabulated observations that cannot conveniently be reproduced here. The object back of these studies was to gather evidence on the complicated problem as to whether insects really think or whether they are mere machines entirely governed by the laws of physics and chemistry. Although the author avoids a direct commitment, it is easy to see that he inclines toward the first of these alternatives.

The other paper grew out of a Fox Movietone Company film recording the chirping of a cricket. The cheerful males of these creatures produce their music by rubbing a "file" on one front wing against a "scraper" on the other. Sound, as we hear it, is a series of rapid vibrations of air affecting our auditory machinery. The more vibrations per second the higher is the pitch of the sound. As shown in this paper by a greatly enlarged photograph of the film, each sound vibration is represented by a line across the film's "sound-track." Knowing the speed at which the film goes through the camera and measuring under a microscope the distance between these sound lines enabled Doctor Lutz and Mr. Hicks to discover several interesting things about the chirping of our common black cricket. For example, what sounds to us like a single chirp is usually three chirps which they call "pulses." Each pulse lasts for about 0.02 second and the pulses of a chirp are separated by a quiet interval of about 0.017 second, too short an interval for our ears to notice. Usually, at least under the conditions of this experiment, each pulse starts at about the D which is just above the upper limit of a piano, rises a bit in pitch, maintains that note, and then suddenly drops nearly a full note to almost within piano range. Such a performance would, in musical terms, be called a beautifully executed "slur." The authors also give pictures of the recording apparatus and of the cricket's musical instrument.

RECENT ACCESSIONS

NEW ACCESSIONS OF IMPORTANCE.—For some time members of the scientific staff of the American Museum have needed for their use the Hispanic American section of the Millionth Map of the World, published by the American Geographical Society. This map will consist eventually of about 100 sheets, of which all published so far have now been procured by the Museum Library, the others to follow as issued. It is gratifying to know that this most up-to-date and important map is now available.

The Library also received this month the first volume of the *Encyclopædia of the Social Sciences*. This ought to prove valuable for the many students in anthropology who use the Library, as well as for our own department in that subject. The scope of the work seems to be broad, and it will doubtless prove useful in showing the relationships between anthropology and the related sciences.

Among the additions to our serials during February are the *Annales de Géologie et de Paléontologie*, Volumes 1–51, 1886–1929, twenty additional volumes of the *Edinburgh New Philosophical Journal, 1833-1854*, *Bollettino dei Musei di Zoologia e Anatomia Comparata della R. Universitá di Genova*, Volumes 2–5, 1895–1905, and *Atti del R. Accademia dei Lincei* 1882–1886.

A MEMORIAL TO STEPHEN H. TYNG.—The photographic equipment of the American Museum recently has been enriched by a most important gift from Mrs. Stephen H. Tyng, presented in memory of her husband. Through this splendid contribution the Museum comes into possession of many pieces of valuable lighting equipment and photographic apparatus, including a De Brie Professional Moving Picture Camera, a Bell and Howell Eyemo, and a studio camera with a complement of four 11×14 portrait lenses beautifully inscribed in memory of Mr. Tyng.

Mr. Stephen H. Tyng, F. R. P. S., was one of the noted amateur photographers of the Camera Club and the Royal Photographic Society of Great Britain. To establish and endow a school offering practical help to those interested in the art of photography was a cherished desire of his, and it seems particularly fitting that his splendid equipment should be given to the American Museum to aid in its educational work.

SOME "NATURAL HISTORY" CONTRIBUTORS

Henry Clyde Shetrone, author of "The Mound Builders" is a veteran of the Spanish American War, with service in Cuba, where, following the war, he was for three years superintendent of telegraph for the Cuban government. His opportunity to engage in archæological and museum work came in 1913, as assistant curator of archæology under the late Dr. William C. Mills, director of the Ohio State Museum. On the death of Doctor Mills, in 1928, he succeeded to the post of director.

Mr. Shetrone has conducted explorations of the prehistoric mounds of Ohio for the past fifteen years, and is considered one of the foremost authorities on this branch of American archæology. In addition to his official reports of explorations, and frequent contributions to magazines, he is the author of a volume entitled *The Indian in Ohio*, and an exhaustive work, *The Mound Builders*, just off the press of D. Appleton and Company. *The Mound Builders* covers the entire mound area, embracing more than twenty states, and combines human interest with scientific accuracy. The illustrations in the NATURAL HISTORY article are from this book.

Since his student days at Harvard, from which college he was graduated and received the degree of Ph.D., **Dr. H. L. Shapiro** has been interested in the origin and distribution of races and physical types, especially in race mixture. Shortly after joining the staff of the American Museum as assistant curator of physical anthropology, Doctor Shapiro visited Santo Domingo and the southwest of the United States where he did archæological work and looked for skeletal material. The trip described in "The Disappearing Peoples of the South Seas" was Doctor Shapiro's second to Polynesia, the first one being to Pitcairn and Norfolk Islands, as a Yale fellow and for the Bishop Museum of Honolulu. He is leaving New York again in July to take charge of a race-mixture study program for the University of Hawaii.

Doctor Shapiro has recently published a monograph on the descendants of the mutineers of the "Bounty," dealing with the Polynesian-English cross.

Lieut. G. T. Emmons, U.S.N., the author of "The Art of the Northwest Coast Indians," has long been an authority on the Indians of the North Pacific Coast of America. He first became interested in their ethnology while in the Navy, from which he is now retired. For more than forty years he has continued his active interest in collecting information and ethnological material from these people, and the comprehensive collections in the American Museum illustrating the North Pacific Coast cultures are largely due to his unflagging efforts and interest.

He has published many papers on various phases of their culture, some of which have appeared in NATURAL HISTORY, and has in preparation an important contribution on the Tlingit.

Marcelle Roigneau (Hatt) was born at Bordeaux, France. After coming to America to live, she took special courses at Columbia University in vertebrate zoölogy, evolution of man, and vertebrate palæontology with Profs. J. H. McGregor and William K. Gregory, who both rated her high among their students. In the department of comparative anatomy at the American Museum she is chiefly engaged in planning the installation of the series of exhibits for the Introduction to Human and Comparative Anatomy. "'Top of the World' in Yucatan" describes some of her experiences in a recent American Museum expedition.

THE COVER

"The Woolly Mammoth of the North," the cover design of this issue by **Arthur A. Jansson**, represents a summer dawn scene in northern Indiana during the period of maximum southward advance of the fourth or Wisconsin glaciation, the final attempt of the ice kings of the North to invade the United States. The three woolly mammoth bulls are browsing and grazing upon the grassy and arboreal verdure, filling their storage reservoirs of fat for the coming winter, as is indicated in their projecting foreheads. The woolly undercoating has not yet attained its autumnal or winter thickness. The shiny ivory tusks are in three stages of growth, the nearest being that of an elderly bull

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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.

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THE NEW SCHOOL SERVICE BUILDING, with the increased facilities it offers, makes it possible to augment greatly the Museum's work not only in New York City schools but also throughout the country. About thirteen million contacts were made during 1929 with boys and girls in the public schools of New York and the vicinity alone. Inquiries from all over the United States, and even from many foreign countries, are constantly coming to the School Service Department. Information is supplied to, and thousands of lantern slides are prepared at cost for distant educational institutions, and the American Museum, because of this and other phases of its work, can properly be considered not a local, but a national—even an international—institution. Through its loan collections, or "traveling museums," which are circulated locally, 557 schools were reached last year, and 1,857,729 direct contacts were made with the pupils. More than a million lantern slides were lent to the New York City schools, and 4,297 reels of the Museum's motion pictures were shown in 271 public schools and other educational institutions in Greater New York, reaching 1,725,865 children.

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

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

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

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

EXPEDITIONS from the American Museum are constantly in the field, gathering information in many odd corners of the world. During 1929 thirty expeditions visited scores of different spots in North, South, and Central America, Europe, Asia, Africa, and Polynesia, and nearly as many are now in the field continuing last year's work or beginning new studies.

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

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1930

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The Journal of The American Museum of Natural History

HAWTHORNE DANIEL
Editor

A. KATHERINE BERGER
Associate Editor

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THE GATE OF ITSUKUSHIMA TEMPLE AT EBB TIDE

This "torii," as Japanese temple gates are called, is situated at the western end of the Inland Sea, Japan. It is unique as the only "torii" built standing in water, and this spot is considered one of the three most beautiful in Japan. The temple to which this gate is an entrance is just to the left of the picture

VOLUME XXX

NATURAL HISTORY

NUMBER FOUR

JULY-AUGUST, 1930

PHOTOGRAPHING THE OSPREYS OF GARDINER'S ISLAND

Intimate Studies of the Most Dramatic of All the Sea Hawks

By CAPT. C. W. R. KNIGHT, M.C., F.R.P.S., F.Z.S.

TWENTY years ago the osprey, or fish hawk, became extinct as a British nesting species.

At one time quite a number of pairs nested annually in various parts of Scotland and aroused a good deal of interest by the beauty of their flight, the dramatic surroundings of the nest—which was usually built on an island in the midst of a loch—and by their habit of crashing into the sea and catching the fish upon which they live.

Without question their end was entirely due to the persistence of collectors, who, in Great Britain at least, are generally ready to pay large sums of money for clutches of eggs, and sometimes the skins, of *really rare* birds.

Barbed wire still drapes the trunk of an oak tree on the little island that is surrounded by the waters of Loch Arkaig in Inverness-shire. It was put there by the owner of the place in the hope of frustrating the activities of egg collectors; an admirable move but one which unhappily did not achieve its purpose, and the ospreys, weary no doubt of the futility of attempting to rear a family, betook themselves to less hazardous retreats.

By such misguided enthusiasm was the osprey—most dramatic of all the sea hawks—exterminated as a British nesting species.

In order to obtain really intimate studies of this unique bird, I spent last summer on Gardiner's Island, New York, where the most remarkable osprey colony in the world enjoys a primeval freedom. This happy state of affairs is due to the consideration and interest of Mr. Lyon Gardiner, who owns it, and of Mr. Clarence H. Mackay, who leases the island. Some 300 or 400 ospreys nest there annually, and because of ideal conditions, the birds build in the queerest situations. One sees the enormous nests at the tops of tall trees—trees that not infrequently collapse under the great weight, on bushes a few feet high, on upturned tree roots, on rocks, on walls, and even on the seashore itself.

From such a vast selection I decided—after a week's indecision—to concentrate on a nest that was admirably suited to photography. It was also the home of a comparatively amenable pair of ospreys—a most important factor. Generally speaking, the birds are nervous and wary,

CAPT. C. W. R. KNIGHT AT HOME IN ENGLAND
In the foreground are four American ospreys obtained in Clarence Mackay's bird sanctuary on Long Island, and released in Scotland in an attempt to establish them as resident breeders in place of the now extinct native ospreys. The bird on Captain Knight's hand is his tame golden eagle

and difficult to approach; in fact, I had to build a carefully camouflaged "hide" to obtain views of the birds approaching and leaving various nesting positions, such "hides" usually being set up from twenty to forty yards from the nest.

Now I made preparations for *real* photography—for the filming of the intimate family life of the osprey from egg to maturity. That close-up studies might be had, I built the hiding place only eighteen feet from the nest.

A vast amount of care and hard work was bestowed on these preliminaries. First, all sorts of wreckage found along the beach was piled in a great heap—the rough semblance of the "hide" that would one day—I trusted—conceal the camera and me. As the birds grew accustomed to the nearness of this heap to their home, the size was gradually increased. Almost every day fresh débris was piled on it. Most important, tin cans were strung on a line between two posts—their tinkling and jangling at first astonishing the female osprey but ultimately preparing her for the whirr of the movie camera. Thus the size and efficiency of the hiding place slowly developed—always with the possibility of the osprey's resentment uppermost in my mind.

At last it was completed—firmly built, roomy, and more or less waterproof. On the outside it was effectually camouflaged by seaweed, wreckage, and leafy branches. When my companion and I had fixed the camera in position and had made everything ready for photography, we retired to a distance to watch developments. We were, of course, apprehensive that our subject might turn out to be of a suspicious, worrisome disposition, and that our efforts to beguile her would be in vain. Breathlessly we watched her glide toward the nest, alight, settle down to brood her three eggs. Of our hiding place and the jangling of the tin-can music she remained in apparent oblivion. The stage was set! The great moment had arrived!

The next day I attempted close-up photographs of the family. My companion accompanied me to the hide to help outwit the parent birds. When everything was arranged, he walked away, making his departure as obvious as possible, hoping thereby to divert the attention of the birds from the fact that I still remained.

I do not know whether ospreys count or not, but things, to my relief, proceeded according to expectations, and I secured the first of my long-sought-for records.

In due course the three young ospreys hatched — little fellows covered with prettily marked brownish down, rather like young pheasants. While the female brooded them, the snowy-breasted male perched on the stick behind the nest to complete the family group. Presently he flew away to return later with a large fish—weighing probably three or four pounds. The female took this from him and distributed tiny pieces among the little ones. Her extreme gentleness as she did so can be compared only to that of the golden eagle as she feeds her young. Such a fierce-looking, wild-eyed creature, and yet so absolutely tender! During the whole of this scene the male osprey remained on the nest as though deeply interested in the proceedings.

IN STRANGE SURROUNDINGS
One of the American ospreys after arrival in England. The birds were liberated on the little island in the Scottish Loch where ospreys nested twenty years ago

APPROACHING THE NEST

An osprey at home on Gardiner's Island, New York. This and the following three pictures show the bird returning to its nest. Photographed from a blind at a distance of eighteen feet from the nest

A LITTLE NEARER TO ITS HOME

Owing to ideal conditions, the birds build in the queerest situations, and nesting sites range from the ground to the tops of tall trees. This nest was constructed on the ground

ARRIVAL AT THE NEST
The osprey above its nest, ready to settle on the edge. Generally speaking, the birds are nervous and wary, but this one seemed apparently oblivious of the photographic blind and its human observer.

AT HOME
The osprey standing at the rim of its nest, its feathers still ruffled from its flight. The size of the pile of sticks forming the structure of the nest is well shown by this photograph

FEMALE OSPREY FEEDING THE BABIES
Recently hatched young receiving bits of fish brought by the old male

Since the inhabitants of the island were Scotch, and the osprey was, originally, a Scottish bird, we christened the three young ones with Scottish names—Jamie, Jean, and Jock, all of them beautiful to look at, but Jamie rather less vivacious than the others. Jean and Jock, in fact, were so full of boisterous liveliness that, in the end, they came to blows. For a while it looked as though I was to witness a repetition of the tragedy I had filmed on the eagle's nest, when one of the young eagles had killed the other. They certainly went at it in the most determined way. The mother osprey, meanwhile, took no interest in the fact that Jean was giving Jock such a beating, and allowed the youngsters to fight it out.

From now on, Jamie, Jean and Jock spent most of the time doing physical exercises—"Upward jumping with wings flapping sideways," and so on, and were obviously ready to leave the nest at any moment. Jock was the first to leave home and on his first flight soared into the distance. A few days later the nest was empty. The young ospreys were learning to fend for themselves.

The osprey subsists entirely upon fish, and one of my main ambitions was to secure pictures of the great bird plunging into the water and emerging with the fish in its talons. I spent much time in considering the situation, in devising ways and means whereby I might achieve my purpose, and I wasted much time in trying out my conclusions.

In the end I decided to try for a picture of the birds as they hovered over the sea and crashed into the waves—for they fished far more frequently in the sea than they did in fresh water. I don't like to think how many days were spent in weary waiting, hoping that one of the birds would oblige by diving "in the picture." In the end, with the help of a

A MEAL IN SIGHT
The female osprey and the half grown young perched on the rim of the nest awaiting the arrival of the male with a fish

telephoto lens of 15 inch focus, I achieved something like success—the headlong crash into the water, the period of entire submersion, the "rouse" (as falconers say) to get rid of water-drops, and the homeward journey.

Interesting forms of life abound on this semi-tropical Island, giant grape vines that entwine themselves among the branches of the tallest trees, cacti, slow-moving tortoises, elusive butterflies, evil-looking turtles that bury their eggs in the sand, exquisite little night herons that persist in nesting in trees already occupied by ospreys—a curious phenomenon when one knows how cordially the ospreys detest the herons.

To see an osprey's "stoop" at a heron was a common enough sight. Usually the little heron shifted from the stoop, but sometimes would leave it until too late and receive such a blow from the great talons as to put it out of action—a blow that on rare occasions proved to be fatal.

In bygone days when falconry — the sport of catching various kinds of

MALE OSPREY RETURNING WITH FOOD
The male bird has just arrived with a fish which the female is about to tear into pieces and distribute to the young, whose heads can just be seen in the hollow of the nest

CROWDED QUARTERS
The three young ospreys are now too large to share the cavity of the nest with comfort, and one of them has sought more freedom on the spacious rim. The female parent is perching on an adjacent stick

game with trained hawks—was so popular in Great Britain, the osprey (according to the authority, Richard Blome) was used as a trained falcon, for taking "fish and teal." Judging by its prowess where herons were concerned, there is no reason why it should not have been.

It is difficult to understand why the night herons should have chosen to nest in such close proximity to the ospreys, and it is equally difficult to explain why certain other birds also made a point of sharing their company, unless they had secret confidence in their big neighbor.

In the foundations of an osprey's nest at the top of a tall oak tree, no fewer than five grackles' nests were built! While the female osprey was brooding her eggs, one of the grackles came home to her flat down below—as it were—and fed her family. The osprey looked down on the proceedings in quite a kindly way, although the grackle continually peered up over the edge of the nest to see how she was taking things.

One might really conclude that the

FEEDING OVER-GROWN BABIES
Although nearly as large as the parents, the young are still fed by them. In the photograph the female is shown distributing portions of a fish to the nearly full grown offspring

READY TO FLY

Young ospreys about to leave the nest on the initial flight

BEGINNING LIFE IN A NEW HOME

One of the young ospreys brought from America and released on Loch Arkaig. The bird has in its possession a fish which has been given to it

grackle had built her nest under the eye of the osprey on account of the protection such a position might afford. Certainly the osprey bore her neighbor no ill will.

In the hope of re-introducing the osprey into Scotland, I took home with me two pairs of the birds—two females and two males—all from different nests.

I liberated them on that little island in the Scottish Loch where ospreys nested twenty years ago, and where every protection will be afforded them. It is to be hoped that they will remain in that neighborhood and that they will one day nest in some situation inaccessible to the collectors.

THE FUTURE HOME OF THE COLONISTS
Island in Loch Arkaig, Inverness-shire, Scotland, where the four American ospreys were released. The large tree in the center of the island formerly held the nest of a European osprey, the last known breeding place of the species in Great Britain

A Papuan Native

WITH BRUSH AND PALETTE IN THE SOUTH SEAS

An Artist Visits the Melanesian Islands to Paint the Natives

By CAROLINE MYTINGER

On the mainland of New Guinea and on the neighboring islands, there are many different native peoples with marked physical characteristics and distinctive cultures. These people have as yet been little influenced by white contact; they preserve not only their physical type but their modes of body ornamentation, their peculiar customs such as scarification or head shaping. Most fortunately for anthropologists, Miss Caroline Mytinger realized what vivid results could be obtained by painting these people. In the face of many discouragements and difficulties, she went to New Guinea and brought back these unique portraits of primitive peoples who in a few generations will have lost their cultural identity. She has caught those traits of personality which the camera and the pen are less skilful in reproducing.—The Editors.

"WHAT did the native think of his picture?" Since there is a fairly prevalent idea among those in closest contact—the planter and government official—that there is a minimum of thought among natives, it cannot be said definitely that certain reactions observed were the result of mental functioning.

If this were wit, I should like to believe, rather, that the general hilarity produced by a "first viewing" was directed at the model and not at my work. Usually, in sophisticated villages, as soon as the painting developed to the point of being an unmistakable likeness, the crowd of villagers, both adult and children, who had assembled at the beginning of the first sitting and remained from that time on, shouted with mirth. This always affected the fifteen or twenty small yellow dogs present who added to the criticism a series of prolonged coyote-like howls. The remarks directed at the model must have been anything but gratifying, for he usually squirmed and looked harassed, and more often than not took the next rest as an opportunity to round the corner of a hut and disappear. Sometimes this absence was permanent, but if he was recaptured, even the most irresistible of bribes failed to induce him to continue the pose.

In time, in order to avoid this trial, I learned to leave the painting of the face to the very last, making headless torsos festooned in the haunted splendor of dog's teeth necklaces, and even proceeding to decorate hair and ears before the final sitting when I knew laughter would put an end to the pose. This method produced a silent and altogether satisfactory awe.

Derision is, apparently, the hardest of all crosses to bear, and with such a precedent established, it became a problem to get another native to substitute long enough to finish the painting. Consequently, many a canvas has been scrapped or, worse, carried on to another village to be continued from a model yet unaware of the torture involved in sitting for a portrait.

Furthermore, laughter and sorcery "talk-talk" are heard a long way in "the islands," and not infrequently my reputation preceded me with crushing results. An extreme case was that which occurred on Guadalcanar in the British Solomon Islands. At a village near Ruavatu on the eastern coast, I began a study of a young, rather personable mother and her overgrown baby, both of whom, at the beginning of the painting, were apparently healthy citizens. Due to the restiveness of the child, who screamed every time it woke and caught me looking at it, I was unable to make any progress during the first sitting.

Upon my return to the village the following morning, after a walk of more than three miles along an unsheltered beach, from the plantation where I was stopping,

MOROVO LAGOON FAMILY

The son, who is by far the most important member of the family, wears on his head the "dollah," a clam-shell disk covered by an intricately carved filigree of tortoise shell. These have become so rare today that they cannot be purchased from natives who still own them. The shield is for war and war dances, and its design is probably borrowed from the eastern islands. The "battle-axe," having descended in the family with the other heirlooms, was a highly prized possession

MEMORIAL CORROBOREE

Depending on the locality, any time from six months to a year following a death, a dance and feast are held at the grave to commemorate the deceased. The designs on the grave poles erected by the relatives have no special significance, though some of the patterns are the same as those used for "paper talk" and signify variously, rabbit tracks, yams, the sun, a lizard, and so on

my subjects were nowhere to be found. Lowered mats at the doors of the huts usually meant that the tenants were asleep, but a round of the village, slapping at the doors, failed to rouse even a dog. Nevertheless, I squatted under a tree and prepared for a vulturous wait. In a few minutes the heat and stillness put to sleep even the fleas on my terrier, and I was left to a not too gratifying speculation on the variability of the Melanesian temperament in its relation to art.

Minutes passed, and then, ever so slyly, the mat of a door near by was raised, and a woolly head popped out and withdrew like a clock cuckoo, a suddenly released dog barked and wakened the terrier, who, with the natural reaction of a "white man's dog" to a "black man's dog" leaped to the source of the insult. In the battle which followed and exposed the whole village, I managed to secure my model who, unable to refuse a request made directly to her, consented to continue the pose for the remainder of the morning. So far this was only a case of comfortable disinclination to work, fostered by a sympathetic village, but it grew into a superstition by the end of a sitting, made hideous by the dirge of the youngster.

Almost as I had expected, my model was missing the following morning and every morning after that. I continued to haunt the community making sketches of the huts and the dogs, learning to shoot with a bow and arrow, but in the end succeeding in making friends with only one person, the former "housekeeper" of a planter and now "public woman of the village." She confessed that in spite of this being a mission village, it was the general opinion of all that I had put "puri-puri" on the baby, whose unprecedented howls and copious tears since the first sitting could be accounted for in no way except by witchcraft. It occurred to me that the chewing gum, which had kept it preoccupied for half an hour during the first pose, might have been swallowed with uncomfortable results, but this couldn't be explained, and there was nothing to do but exit with as much satisfaction as could be wrested from my new rôle as sorceress.

Not long after this, I removed to a plantation forty or fifty miles westward up the coast. After the usual pre-

THE WEAVER

The weaving of mats on Ontong Java is done by the men, though, since the advent of the missionary and trade stores, the observance of the custom of assigning work is not so strictly marked as in the old days. The man's ornament is carved from tortoise shell. Sometimes these ornaments are so large that they must be tied back to the ear to permit passage of food to the mouth

TOBOBAU'S MARY AND PICCANINNY

Before the natives enjoyed government protection, it was necessary, for safety, for the men to escort their women to and from the gardens, which were often a distance from the villages. This custom persists though the cause of it has long since been obliterated, and early in the morning, on the roads leading to Rabaul, where there is market every day, one encounters a procession composed of groups like the above. An idly fondled hibiscus has taken the place of the spear, face paint is applied to attract the attention of the opposite sex, and the hair assumes shapes and colors which could only be the result of opulent leisure. The gentleman above has bleached his hair with peroxide

liminary of being escorted to the nearest village by my host who explained to the natives what I wanted, I advanced, one sweltering morning, on the unsuspicious community with my unfinished canvas of Mother-and-Child. A new matron was induced to pose with her baby, but the following day when I returned, the "head man" greeted me with the expression of a disturbed symphony conductor. He was a mission "boy," he said, and as such he "savvied pi-lenty along white master and missus." He was quite as well aware of the fact that the government did not believe in nor tolerate sorcery, and yet here (indicating my picture) was the most complete case of unpunished crime which had ever come to his attention. At that time, the most that could be said for my pidgin English was that it was correct, but I eventually interpreted his jargon to mean that the village had long ago heard of me and my behavior in eastern Guadalcanar, but, not connecting such conduct with one of my social standing at Tanakombo, had actually exposed one of their number to my questionable influence. The old gentleman was a not inconsider-

MAIDEN AND SORCERESS

The girl is being dressed for the dance—rubbed with shredded coconut meat, and decked with heirlooms, franjapani blossoms, and certain remunerative herbs. The figure to the right is a "garden sorceress," who also happens to be the local tatoo artist

THE WIFE OF CHARLIE, H. M. S.

The natives of Rossel Island, in the Louisiade Archipelago, have long been notorious for cannibalism, the eating of human flesh having been ascribed to ritual respecting the memory of an important chief at his death. But even Sir Hubert Murray, the present governor of Papua, an ardent protector of native customs, admits that the disappearance of three hundred Chinese, wrecked on the coast of Rossel Island some years ago, is hard to account for with pious ceremony

HEAD OF WEDAU BOY

At Hanuabada, near Port Moresby, the most fashionable headdresses are those which rise to almost ten inches above the face and cover the whole of the back of the neck. Though the "boys" claim that protection from the sun and not vanity is the cause for the extravagance, much thought is devoted to its decoration. The Wedau boy resorts to a live butterfly which is discarded the moment it ceases to flutter

BUSH BOY AND SALT WATER BOY

Natives of Malaita are preferred for labor on the plantations because of a tenacity of character that is lacking in the residents of the surrounding islands. Therefore, few of the coast or "salt water boys" have escaped indenture. In a period of generations, this has produced an attitude of superiority on their part toward the "bush" natives

able character, and work at Tanakombo would have been stopped, but for some atheistic plantation families whose only superstition was the shilling.

From the foregoing experiences, it can be seen that the community has a decided influence on the attitude of the sitter toward his portrait. Because of this, the ideal situation in which to work is as far from the settlement as possible. Since there is no isolated village building accessible to a woman in the Melanesian Islands, the best circumstances to be hoped for, in order to produce a natural expression and to observe natural reactions, is the veranda of a plantation house or the doorway of a copra shed. To a "studio" painter no humbler working conditions can be imagined than those which throw a flickering top light and constantly shifting reflections over both model and canvas, but these and the minor ordeals of insects, sun blindness, and sudden monsoon blows and rains, fade into insignificance before the problem of holding a model, either alseep or inhumanly bullied, until the completion of a study.

Under the calming influence of an isolated copra shed or rubber house, I have seen the native expand to an active interest in his picture. Squatting, in island fashion, on the heels, he gazes, his head a little to one side like a Victor dog, for possibly as long as five minutes, then still expressionless, he tips back off his heels on to his seat, closes his eyes and, . . . sleeps.

Criticisms of adornments, undoubtedly made in the same spirit which prompts a small European sitter to ask, "Where is the anchor on my sailor suit?" were not infrequent where the model was a native who had been emboldened by familiar contact with the

KAI-KAI

Kai-Kai is the native word for food or the verb "to eat." Magnificent parrot fish and lobsters, speared among the reefs of the Torres Straits Islands, are the principal diet of the islanders. Fish, especially the colorful parrot fish which deteriorates rapidly out of water, is eaten raw and without salt "white master." The length of a dog-tooth necklace, still valuable currency in some localities, exactness of a tattooed or keloid pattern, where the model was familiar with his appearance through possession of a "trade" mirror, and size, color, and cut of the hair were vanities subject to correction.

There is a belief current among the European residents of these islands to the effect that a native does not recognize himself in a snapshot unless he holds the picture upside down. I have seen this demonstrated only once in an experience with two men who came into a dimly lit hut where I had retired from a storm and sat with the painting of one of their number propped *upside down* against the wall beside me. Though one of the men still blocked the light coming through the doorway, the first, much to my astonishment, immediately recognized and named the model for the study. His only comment was "Missus, he savvy too much,"—the commonest form of native flattery in the islands. The shrewd "salt water boy" had discovered, further, that by adding a few clucks meant to convey the extreme of amazement, tobacco and even leniency are forthcoming. I am convinced, however, that there is a minimum of worship bestowed on the proven race. Surprise is often expressed that something never before seen by a native should rouse in him so little awe, but a similar indifference to miracles may be found in our own casual acceptance of Nature.

TAUPARAUPI, HEAD-HUNTER

The significance of Semitic features appears more important after one has experienced the dignity and intelligence of such a personage as Tauparaupi, who, unable to communicate except by sign language, indicated quite plainly that at his home, far away, he had two children, a boy and a girl, for whom he was very homesick. He demonstrated this emotion by measuring off two heights and, with tears in his eyes, hugging a passing dog

Since the first trading and recruiting European, the "white master" has been obligingly performing miracles for the wonderment of "primitive" man; he made pebbles appear and disappear, took out his eye—if he happened to have a glass one—removed his leg, or his teeth, or struck fire from a small stick with one wave of his hand.

Apropos of native sophistication, a short

AHUIA IN DANCE REGALIA

A dance costume of "long time before." Only a few of these remain, due to the activities of the missions, who claimed that the bird-of-paradise feathers and the tail feathers on special sticks in the center of the headdress embodied sexual significance, which, as an article of clothing, was unbecoming to a Christian convert

MOTU SMOKERS

Tobacco was in use in these islands when the first Europeans of history landed. Cigarette holders and pipes are popular among the "town boys," but the bamboo tube—filled with smoke and then passed from hand to hand—is still the favorite cool smoke of the village native

HOHUA-TO-TAHAPANGO
A Polynesian family group from North Island, New Zealand

time preceding my arrival in the Solomon Islands, a seaplane, flying from Sydney, had arrived in the islands, "landing" in Tulagi Harbor, where it proceeded to emit human beings—or at least this is the romantic way we like to think it impressed the native. Certainly, it was enough of an event to interest even the most blasé, for a certain "house boy," long noted for his taciturnity in the face of any incredibility, came to his employer with the following:

"Master, me lookem long time before this fella steamer. He go; him he gottem sail. By and by me lookem this fella cart. He no gottem horse; he go. Now me lookem this fella he fly along sky all the same pigeon. He no gottem wing. Him he go. My word, white master, he savvy everything. Now, master, boy he die finish but boy he no savvy which way he go. Which way white master he go for die all the time?"

Beside this credited knowledge of immortality, what poor performances are the gramaphone, movies, and oil portraits, which develop without mystery before the eye!

The attitude toward portraits and picture painting becomes a little more amusing, though no less trying, in localities where the native is unaccustomed to the ingenuity of our race. The relief of employing unsophisticated subjects is tempered by the new nightmare of genuine superstition, shyness, and indifference to popular bribes. Ordinarily, one stick of trade tobacco is a considerable inducement to any native, regardless of sex or age, and this cannot be considered mean wages for a morning's sitting, in view of the fact that the average return for a year's labor on a plantation is only about twenty-five dollars, and perhaps a hundred sticks of tobacco. However, in a territory where there are no trade stores, and no money with which to buy tobacco if there were stores, the weed is grown in the gardens, cultivated by the women, thereby losing proportionately in value.

Unprocurable stock, such as beads, safety pins, cigarette tins, the tops of which are used for mirrors and razors, increase in value, and such things as a large pearl button or a film tin, which can be worn in the ear, are kept locked in a treasure box for particularly stubborn cases.

A most highly prized remuneration from this box was paid to "Dirivo," who posed for the canvas by that name. She was chosen not so much for her physical beauty, as for her deformities, which were the particularly vicious keloids on her upper body and arms. She was a "bush-Mary true" from Kiwai Island at the mouth of the Fly River, Papua, and she objected to posing because she objected to bathing, and one necessitated the other. She sulked and complained, rose rheumatically from the poses and walked about like a cripple during the rests, until her husband, the "boss rubber boy" who had just paid a couple of pigs for her, refused to force her into posing any longer lest her claim that I was laming her prove authentic. At this point the "bokkis" was unlocked and from its depths was extracted the most ornate cast-off garter girdle (with four tinkling garters) as ever graced a refuse barrel.

With the belt hung over her grass

A MANUS INTERIOR
Manus is the largest of the islands known as the Admiralty Group

SEPIK RIVER BOY WITH NAKANAI SHIELD

A typical "bush" native from the north of New Guinea mainland, where a surprisingly decorative effect is obtained by scarification. Designs employed have none other than pictorial significance, and often represent a bird's foot, a scorpion, or a lizard. A long-pronged wooden comb is carried by these people for the purpose of scratching the head under the hat, which, as far as could be determined, is never removed

OLD WOMAN

The subject of this crayon drawing was one of those who caused considerable consternation by disappearing in the middle of a morning's work and remaining absent until marched back by the village "head man"

A VILLAGE COUNCILLOR

An experiment in native self-government is being tried with some success at Hanuabada under the guidance of the Administration. Old villagers, such as the subject of the accompanying picture, meet periodically to settle such common village crimes as theft and adultery. If an agreement cannot be reached, the matter is passed on to the Port Moresby Court, but so great is the responsibility felt by those appointed for the Council, that very few cases are released without a decision

BEAU

The boys, as as the well girls, of these dark-skinned people are sometimes quite beautiful, being well proportioned and of a rich purplish-brown color. By contrast, the "white" of the eyes seems to possess less of the Melanesian "tone," appearing more nearly similar to that of the eyes of our American negro petticoat, she posed uncomplainingly for two days, then, as a direct result of having defied conventions by permitting me to capture her "shadow," she developed a yaw in her nostril, and I was forced to finish the study from a most reprehensible old character who was serving as "cook" for six of the plantation boys. She, in turn, developed a real or imaginary sleeping sickness, which incapacitated her for her legitimate use, and which placed me in a most questionable position for the following six weeks preceding my departure. Nothing the treasure "bokkis" contained held any weight against public opinion and again I had to content myself with architecture and philosophy.

Though all "primitives" seem to have an unexpectedly well developed commercial sense, I encountered only a few instances where money was preferred over "trade goods" as payment for posing. The latter fell into disuse in the Polynesian islands many years ago; nevertheless, it was startling to be asked by a Maori gentleman living in a dugout several miles from civilization, for fees equivalent to those paid to the most popular New York models!

Natives often pose unusually well, partly because they are natural "sitters" and partly because they sit naturally—so natural, in fact, that keeping them awake proved almost as great an obstruction to accomplishment as getting them to pose. Not infrequently a small boy was employed for the double duty of shooing flies and slapping the model awake with the same palm frond. A "boy" chosen for his fine carriage and muscular development usually sank into a characterless lump of brown fat, which

DIRIVO

The carved and painted figure used as a background is similar to that erected in an enclosure in the ceremony employed to promote the fertility of the gardens—a ceremony which cannot be disassociated from certain women in the village would unfold only under an appeal to his vanity. By fiercely thrusting out my own chin and hissing "Big fella too much" the model could be coerced into assuming that expression of savage nobility poetically ascribed to primitive peoples, which they not infrequently do possess when in action.

SING-SING

The above illustrates the dance at the initiation of the young boys of the community into a secret society. These affairs are never witnessed by women or young children, and this painting was only made possible because of the assistance of the Rabaul Museum, which lent the mask

The finest model, either European or native, I have ever had was the Papuan Tauparaupi, who posed for the picture on page 357. He was one of forty leaders of a head-hunting raid, which took the party down the Fly River to within a few miles of civilization. When I painted him, he was "in jail" at the government station of Daru, being taught, in the kindly British fashion, the rudiments of a common language and the gastronomic refinements of rice over human flesh. Probably only a portrait painter can understand the gratification with which I saw him assume the difficult pose of poised bow and arrow, returning after each rest—which he took, without suggestion, when tired—to the marks chalked for his feet, pointing his arrow to exactly the same place and with the same realistic intent which marked the first pose. Tauparaupi, the primitive, with whom I had no means of communication except by sign language, and to whom a picture of any sort must have been a mystery, is still the unexplained marvel of my experience. And though he posed with inspiration, the painting of himself, being in profile, left him unmoved. His friends, on the other hand, when brought to view it, whistled and clucked with excitement. Later, when the canvas was taken up to the Pink Lagoon for a background, the people of Tauparaupi's village saw it from the bank on the after deck of the schooner, and became so interested that one of their number was invited on board to examine it. He did so reluctantly, and had to be forced to touch it. Finding it quite harmless, he examined it back and front, then through, shouting staccato remarks back to those on the bank. In the end, our guest had to be invited ashore, as ours was the first visit of Europeans to this locality since the removal of Tauparaupi and his friends, and the government escort on board was not at all sure it was safe to permit so great an interest in the missing villagers.

Working with natives can always be made easier by assistance from the government, as each village maintains a "head man," appointed by the District Officer, whose duties are similar to those of an alderman. He is generally chosen for his strong personality, and not infrequently is a former head-hunter or raider. As his word carries considerable weight in the village, it is well to present yourself to him with "papers" of authority or, better, to be introduced by a proper government officer.

Probably there are few places in the world, fiction to the contrary, where one may saunter more freely about, lightly plucking citizens for whatever use. Much of my early disappointment might have been avoided had I been aware of and observed certain ethical lumber in use in even the most remote localities, which in this country is referred to as "red tape."

The heads of northern Bouganville babies are bound almost immediately after birth. Lengths of strong fiber cloth are used, and the bands are tightened from time to time until the cranium has grown into the desired shape. The wrappings are then removed.

The hair of the boy children, which is allowed to grow long, is forced, during the initiation ceremony, into a hat similar to the one here shown on the older boy. This hat is worn during the several months involved in the rites, after which it is removed and burnt

BIG-BUKA BROTHERS

ARAUCARIAS ON A WIND-SWEPT KNOLL

CAMPING IN A PREHISTORIC FOREST

Araucarias, South American Trees that Trace Their Ancestry Back 200,000,000 Years Provide an Interesting Camp Site for an American Museum Expedition

By H. E. ANTHONY

Curator, Mammals of the World, American Museum

PHOTOGRAPHS BY THE OTTLEY-ANTHONY SOUTH AMERICAN EXPEDITION

The Ottley-Anthony South American Expedition, just recently returned from the field, traveled more than 20,000 miles and visited many sections of the southern continent. Notes regarding the purpose and accomplishments of the expedition appeared in NATURAL HISTORY *for September–October, 1929, page 533, and May–June, 1930, page 323. Of all their camps, from the Urubamba Valley of Peru to the pampa of Patagonia, the members of the expedition are agreed that the most interesting were the two in the Araucaria forests of Chile.*

The Araucaria is a coniferous tree, called a pine by South Americans, but only distantly related to the true pines. The tree, which took its name from the district of Arauco, Chile, is one of the few relicts of a type of forest formerly distributed throughout the world. Only about a dozen species exist today, which are confined to very restricted areas in Chile, Brazil, Australia, and a few of the Pacific islands to New Guinea. The fossil records show that forests of the Araucaria type probably existed in Palæozoic times and were widely distributed and comparatively abundant during the Mesozoic era. During the Jurassic, these trees flourished in what is now Great Britain, France, India, and southern Africa, among other localities. In the Cretaceous, they were growing in the Western Hemisphere from New Jersey and the Dakotas to Patagonia.

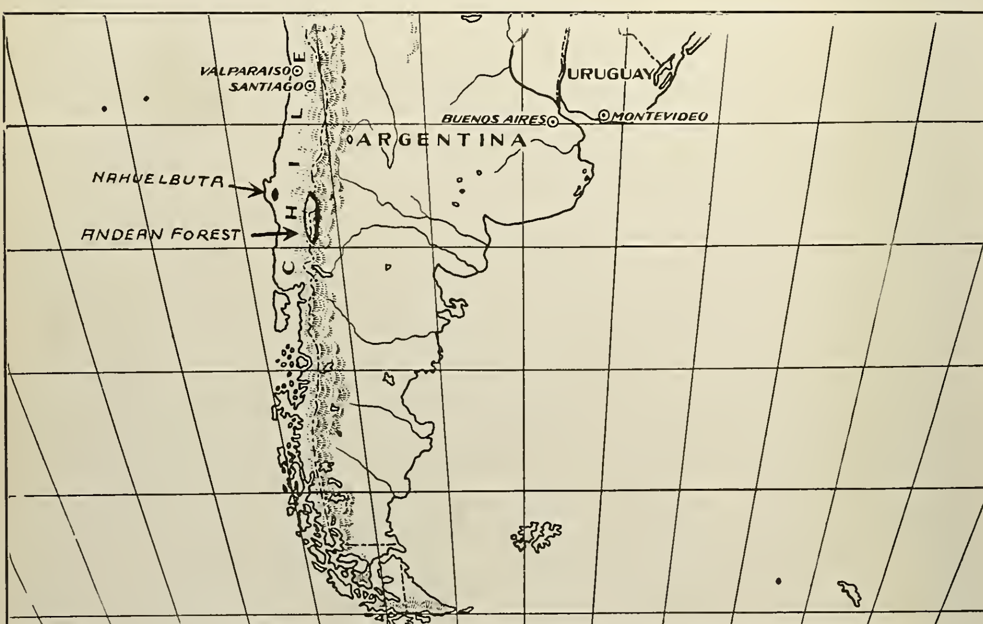
—THE EDITORS.

THE Chilean Araucaria (*Araucaria imbricata*) looks like something out of the past, at least to northern eyes. At a distance the fully grown trees appear to be large palms, with all the limbs confined to a crown carried on a straight columnar trunk. This is the species known to the nurseryman and florist as the monkey-puzzle. Before visiting Chile I had supposed that the feature which puzzled the monkey was the close arrangement of the limbs, a not particularly disturbing tangle for an active animal like the monkey. Inquiry in the region where the trees grow provided another explanation. The monkey is puzzled because of the stiff, spiny character of the foliage which tips upward. The monkey might climb the tree without pricking itself, but would be in a quandary when descending against such an array of points. This foliage is stiff enough to pierce clothing and draw blood if one carelessly brushes against it.

The Araucaria forest in Chile is restricted to a small area in the Nahuelbuta range (a coast range), about 37° south latitude, and to a rather larger stand in the main cordillera of the Andes between 37° 30′ and 40° south, where it occurs in a narrow strip of little more than 100 kilometers wide and between the altitudes of 600 and 2000 meters above sea level. The expedition camped and collected mammals in both forests.

The Araucarias in the Nahuelbuta mountains were reached by way of Angol. At this little town we were the guests of Mr. Dillman S. Bullock, the manager of a large farm, where apples, peaches, cherries, and other temperate fruits flourish in company with figs, oranges, and similar tropical products. One day of travel from this valley, where snow is unknown, brought us into the mountains to the westward where the winter snows lie deep.

The road from Angol up into the mountains is not an automobile road as we understand the term in the States. It is traveled principally by ox carts and is deeply rutted and sidling in places. From the valley up over the first foothills, the road is bad, and from the summit on it becomes worse. Our truck, a Chevrolet, negotiated the first rises and some of the distance toward the second and last ridge, although it was temporarily hung up on high spots in the center of the road which caught on the axle or differential. Finally the road became so bad that we had to concede it would be



MAP SHOWING ARAUCARIA FORESTS IN CHILE

The two locations indicated by arrows were visited by the Ottley-Anthony Expedition

CAMP IN THE MAIN CORDILLERA OF THE ANDES
In the forest east of Curacautin. An ideal camp site was found in a forest of mixed Araucaria and beech

impossible to go farther with the truck, so we let the driver return to town after getting his promise to meet us at this place on our return trip a week later. We were fortunate enough to secure an ox cart for the rest of the distance, and, after divers delays, our equipment reached a camp site at 8:30 P.M. We had begun our move at 5:30 that morning.

Our tent was pitched in a small grove of Araucaria atop a low hill. There was considerable similarity to a pine forest in the vista of clean, rough-barked trunks, in the litter of needles underfoot, and in the noise of the wind through the tree-tops. But there was a vicious note to the soughing of the wind, a cutting quality to the rush of the air through the keen foliage overhead, that seemed more in keeping with the rugged character of the trees themselves. The Araucarias did not give pliantly to the breeze, like pines; their stiff foliage cut the wind and let it whistle past, and one might imagine that to these survivors of more strenuous epochs a little wind was nothing,—in the struggle for existence the species had seen millions of years of winds.

We set out traps and hunted for mammals, building up a collection to learn the faunal associations of the Araucaria forest. Large mammals are scarce. Mountain lions, or pumas, are said to occur there, and they seemed to be feared by the natives, but with little apparent cause, for we could not learn that the lions had ever hurt any people in the Nahuelbutas. Deer, the huemul of Chilean vernacular, are found along the ridges. We saw their tracks, but nothing of the animals themselves. Early in the forenoon, while we were hunting in a dark, quiet glade, we encountered a small fox that lives among the Araucarias. It saw us from a distance and slipped off among the trees as noiselessly as a shadow before we could raise our guns. Near the tent I surprised a fox at night, when I was hunting with a headlight. It returned with us to the Museum as a specimen.

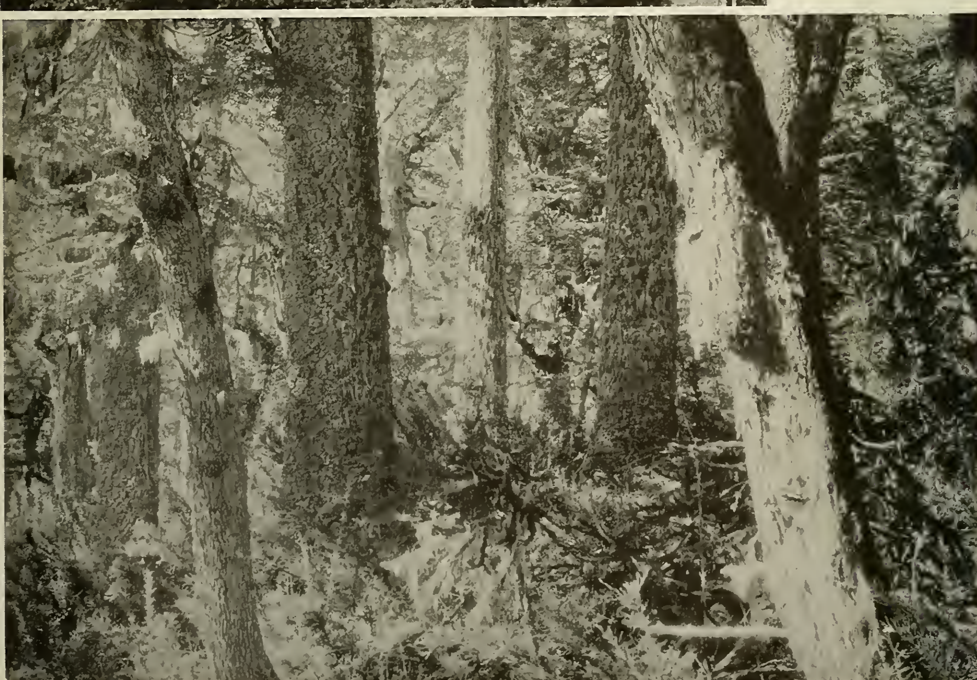
Small mammals were also rather scarce, but in greater variety than the large species, and interesting because we were likely to encounter forms new to science in this little-worked patch of forest. The most interesting of the small species

ARAUCARIA FOREST

A scene along the upper ridges of the Nahuelbuta range. As the Araucaria reaches maturity the lower limbs usually die and drop off, leaving a clean, symmetrical trunk, with all the foliage concentrated in a compact crown

ARAUCARIA AND SOUTHERN BEECH

Various species of the southern beech, genus *Nothofagus*, are usually more or less closely mixed in with *Araucaria imbricata.* When the percentage of beech intermixture is very high, the forest is dark and the trees are draped with moss, for the beech with its luxuriant foliage cuts off most of the sun



ARAUCARIAS IN A CINDER PARK

The Araucaria forest above Curacautin is cut up by extensive areas of volcanic ash, the loose cinders of which are almost entirely free of vegetation. These cinder parks have been formed by the activity of near-by volcanoes and seem to be of recent deposit

A MATURE ARAUCARIA

The bark of a fully grown Araucaria is very similar to that of a pine tree, being thick and deeply fissured. It is much harder than pine bark and is grayish outside, purplish red under the surface. This trunk measured twelve feet two inches in circumference at a height of five feet above the ground

OVERLOOKING THE ARAUCARIA FOREST IN THE NAHUELBUTAS

Although the summer in the Nahuelbuta range is warm and dry, there is plenty of snow in the winter. Cattle are pastured there during the clement months of the year, but when the snow comes, it lies so deep that the cattle and their herders must move down into the valleys

was a small burrowing rodent with habits similar to those of our pocket-gophers. It spends practically its entire existence under the surface of the earth in a series of underground burrows only rarely opening into a surface runway. This creature is especially wary and suspicious of traps, and only three were captured in the large number of traps set in their workings. A few bats were noted nightly, flying about openings in the forest. One that I shot proved to be nearly identical in appearance with the hoary bat of the United States; it is a member of the same genus, and made me feel almost at home when I looked at it. However, the time was early January and there were wild strawberries in the meadows, wild flowers were blooming in the clearings, and parrakeets were calling from the Araucarias; I was in the south temperate zone.

As we hoped to secure some food for camp by hunting, we had planned our provisions accordingly. Game was scarce and our only additions to camp fare were pigeons and parrakeets, and not many of those. We knew nothing of the psittacosis scare back in the States, the parrakeets were of good size, and we were short of meat. Parrots are a common article of diet in the South American back-country, and one never hears of psittacosis there. Perhaps the birds do not have this malady until they have associated with man and the benefits of his civilization.

The forest of the Nahuelbutas is not a pure stand of Araucaria. There is a large admixture of deciduous trees, mostly varieties of the southern beech, *Nothofagus*. These beeches are fine, large trees, with thick foliage, and are often draped with long streamers of gray Spanish moss. This forest seemed to be ideal for squirrels, but these animals do not occur in the southern part of South America, for some reason not clearly understood. The Nahuelbutas are squirrelless, although the seeds of the Araucaria would be a favorable food supply. These seeds are large, much larger than those of any of our pines and are edible for humans. The Araucanian Indians in the past gathered them regularly when the cones ripened. The trunks of the Araucaria are rather too large to climb easily: one I measured near camp had a circumference of twelve feet two inches, at a height of five feet above the ground. The cone opens at maturity and the nuts fall to the ground.

Our limited time in the Nahuelbuta mountains came to a close all too quickly and we packed up for an early morning departure by ox cart. The cart had arrived at sundown the night before, much to our relief, for we dreaded the uncertainties of travel in this section and did not have too much confidence in our means of transport. Incidentally, we were using the last of our provisions, but the driver had brought eighteen eggs with him, another cause for welcome. That next morning four of us ate the eighteen eggs (some of us had five apiece, for we had not thought of scrambling them), and thus fortified by a breakfast of Easter-time proportions, we walked down to where we hoped to meet our truck, the lumbering ox cart bringing up the rear. The truck was not at the rendezvous, so we walked some more. After we had covered the greater part of the distance to Angol afoot, our truck driver met us with a small touring car and we were at least spared the humiliation of walking into town. The driver had considered the road too bad for a truck, although, when it came time to settle up, he expected and received (after much argument) the full price set for taking us all the way to the forest and back again. But this need cause no surprise to a South American

A YOUNG ARAUCARIA
The young Araucaria has a habit of growth very different from the adult tree. The limbs are evenly distributed from top to bottom in a rather stiff and formal fashion. The foliage is a bright green, and is thick with spiny tips

traveler, for, while the drivers there always hold the visitor strictly to his part of the bargain, they expect a very liberal interpretation of their own obligations.

The second visit to the Araucarias brought us into the main divide of the Andes east of Curacautin, Chile. We had traveled by train from Angol to Curacautin, and were more fortunate in our arrangements for transportation this time, needing only one day to secure a truck and an auto, a cook, and the provisions necessary for a brief camping trip. The road out of Curacautin is one of the main arteries of transportation leading into Argentina, and a railroad is projected to follow the same course. It is fair, as South American roads go. Were it not for the heavy dust and loose rock it might even be considered good. Automobiles pass regularly back and forth between Chile and Argentina, bands of sheep and cattle use the road, and we even passed an itinerant circus strung out along a quarter mile of the highway.

Our camp was situated just east of the main divide in a region almost exclusively forested by Araucaria. It was a beautiful spot, ideal for the collector, and had only one drawback. As soon as we stepped out of the auto to reconnoiter for a tent site, we were met by an enthusiastic delegation of large flies, called "tabanos" by the natives and similar in appearance to the horse-flies of North America. The "tabanos" buzzed about in clouds and alighted the instant one ceased slapping at them. People will tell you that the "tabano" does not bite, but that is a great mistake, for they live by sucking blood, and the insertion of the "tabano" proboscis is just as comfortable as that of a hot needle. A person is seldom bitten, because the approach

IN THE MAIN RANGE OF THE ANDES

The dormant volcano Tolhuaca is one of a group of snow-clad peaks overlooking the main Araucaria forest of Chile. Some of these peaks are active volcanoes and not only smoke but occasionally throw off great clouds of ash. Numerous hot springs are found in this region and are used as bathing and health resorts of the fly is so noisy that one is not taken by surprise but slaps at it. Ceaseless attacks of these flies, however, wear on the nerves. During the summer months the "tabanos" are the greatest pests in all Chile. We had been bothered somewhat by them in our other camp, but now we were to learn how bad they really could be.

A FINE STAND OF ARAUCARIA WEST OF ANGOL
The tall, straight trunk of the Araucaria makes splendid lumber and this tree is the most valuable timber in Chile. Because of the scarcity of large limbs, the Araucaria gives a very high yield per tree of merchantable lumber

Several snow-clad volcanoes were in sight from the slope where our camp was situated. The most active of these, Llaema, erupted last in 1914 and poured out lava and clouds of ashes for several days. Volcanic ash lay in great parklike openings in the forest, and vegetation had not yet established itself there. Snow was still gathered in sheltered ravines on the higher slopes about camp, some of it probably lasting throughout the summer. These upper slopes were the home of numbers of colorful wild flowers, the most beautiful of which were lilies, either belonging to the genus *Hemerocallis*, our day lily, or closely related to it. We gathered bulbs of some of these and sent them back to the New York Botanical Garden where, if all goes well, they may become established and in time find their way into northern gardens.

The ground under the Araucarias is carpeted with a loose layer of rotting leaves, and in these several varieties of small rodents find congenial homes. Their burrows run along under fallen logs, and little piles of freshly excavated humus here and there attest to the activities of these mice. They are difficult to trap because their bodies and legs are so robust that they are usually able to pull out of the only traps small enough to set down in their runways. The largest of these mice, a species of *Notiomys*, has long fore-claws especially adapted for excavating in the deep soil, and its small eyes show that much of its existence is spent underground.

Here we encountered the "tucu-tucu," another rodent of habits similar to those of our pocket-gophers and resembling the burrowing rodent of Nahuelbuta. These were twice as large and threw out large "gopher hills" at the entrances to their tunnels. The burrows that are occupied are always well plugged with earth and opened only for brief intervals when the occupant slips out to forage at the very rim of the hole. Although the animal is so like our pocket-gopher in external appearance and in its mode of subterranean life, I noted one significant difference. The hind feet of this "tucu-tucu" are very broad, broader than the forefeet and better adapted as shovels for loose earth. The reverse is true of the pocket-gopher, which has the forefeet more highly specialized than the hind. With these he scoops out the earth and pushes it ahead, also using his chest. I suspected that this "tucu-tucu" kicked the soil out of its tunnel with the scooplike hind feet, and when excavating, backed out to the entrance tail first. The fact that two that we trapped were held tail first toward the entrance tended to confirm my observations. Whether the "tucu-tucu" has adopted this practice in order to be pointed for safety if attacked while digging, it would be difficult to establish, but since the habit is the reverse of what one would expect, it calls to mind the unusual way in which the African wart hog backs into a hole to escape from pursuing enemies. This is sometimes explained as a precaution against the likelihood that the hole may be already occupied by a hyæna or some other animal with which the hog has no great desire for intimate association. The story runs that the hog is all "set" for a prompt departure from the hole in question, but the real explanation may be an intention to enter the hole with his head and weapons toward the enemy that is following.

The European hare, which has been introduced into Argentina, has within the last few years spread westward across the Andes and into Chile. We saw this hare in the Araucaria forest, an unlikely place for such an animal and illustrating its adaptibility to conditions as it finds them. It was the commonest mammal that one might expect to see, and during a walk along the road at dusk we were certain of encountering several. As there are no hares or rabbits native to this section of South America, the introduced hare, with no competition and few enemies, will spread so rapidly that it will very shortly become a serious pest for the farmer and sheep raiser of Chile.

With a feeling of real regret that we lived so far away from such a delightful region, Mr. Ottley and I departed from this camp in the bracing atmosphere of a mountain morning. We motored back to Curacautin through the tall forest of Araucaria and spreading beech, past the clear, swift-flowing waters of the Rio Cautin, a salmon-fisherman's paradise, and arrived at the railroad in plenty of time for the afternoon train. We both wished to believe that we might return again some day to this stronghold of ancient forests.

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The gate of Itsukushima Temple at high tide

SHINTO—THE WAY OF THE GODS

The Ancient Cult of the Islands of Japan—Eight Million Celestial and Terrestrial Gods and the Thousands of Temples Dedicated to Their Worship

By S. ICHIKAWA

Department of Anthropology, American Museum

IT has often been said that Japan is a "Land of Gods," for from remote times uncountable gods have been a part of the beliefs of the Japanese. When visitors to Japan are taken to any of the numerous beauty spots of the islands, they invariably find close at hand the dwelling places of some of these gods—Shinto gods—for in an effort to please their Shinto deities the Japanese have long made it a practice to erect temples in almost every place of beauty.

These Shinto temples have gateways of a type peculiar to them alone, and everyone familiar with Japan is equally familiar with the "torii" whose graceful lines impart added beauty to the scene. They differ radically from the gates of the Buddhistic temples, and though their design is immutable, its origin is not definitely known.

The visitor to one of these shrines often hears the strange, songlike prayer of a Shinto priest, accompanied by the impressive and echoing sound of a throbbing drum. Such sounds, issuing from these ancient shrines, and drifting through the age-old pines and cypresses that are so often a part of the setting, constitute one of the oustanding characteristics of old Japan.

The "Norito," or text of these prayers, is of unknown antiquity. The prayers themselves are addressed to individual gods, or to the gods in general, and every day they are repeated. Now and then the

GEKU, THE TEMPLE OF ISE

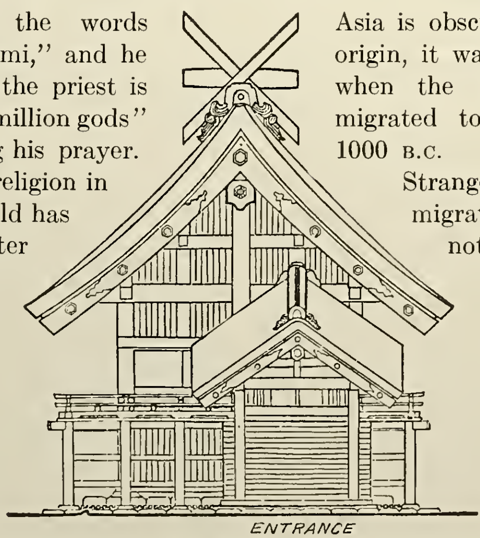
One of the oldest temples in Japan, constructed between 457 and 479 A.D., and dedicated to the earliest gods. It is the sister temple of Nai-gu, where the sun-goddess is enshrined

visitor may catch the words "Yao Yorozu no Kami," and he will realize then that the priest is calling on the "eight million gods" to whom he is offering his prayer.

Probably no other religion in the history of the world has conceived of a greater congregation of gods. Probably no other people has ever imagined a gathering of deities approaching so closely the number of the worshippers themselves. Realizing this unique fact, one naturally asks why so great a number were ever conceived.

Shinto is the ancient cult of the islands of Japan. Its origin on the mainland of Asia is obscure, but, whatever its origin, it was brought to Japan when the Japanese themselves migrated to the islands about 1000 B.C.

Strangely enough, these early migrating Japanese were not very primitive. They had a fair degree of civilization. They were an agricultural people. Already they were using implements made of iron. With a people so well advanced in the arts, it was natural that their religion, too, should be advanced. The name "Shinto,' however, was not then applied to it. It was not until Buddhism was introduced to Japan (552 A.D.)



OH-YASHIRO STYLE ROOF CONSTRUCTION

Although this structure has been modified in recent times, it still retains the main characteristics of the most ancient form, which is shown in the picture above. It is known as the Oh-yashiro style, the origin of which is unknown that the name originated, and then it was adopted in order to differentiate the older religion from the new Buddhism, or "Butsu-do."

Originating so long ago, it is natural that there should be different opinions among both Japanese and European scholars as to the origin and nature of early Shinto. One says it is pure Nature worship. Another contends that it is ancestor worship. As a matter of fact, these schools of thought are based on ancient quasi-historical works. One of these is called "Kojiki," while the other is known as "Nihongi."

These two old chronicles are the earliest written records of Japan. Kojiki was published in 712 A.D. Nihongi followed eight years later. Both give much the same account, the second being somewhat in the nature of a revised and official version of the first. In these two somewhat detailed accounts the gods mentioned are principally such deities as are usually found in well-developed religions devoted to Nature worship. There are, however, some that are definitely of the other category—gods that have originated from among the heroic ancestors of the people who ultimately deified them. It is from that side of Shinto, however, that is the more closely associated with Nature worship, that the greatest number of deities has come.

In order definitely to answer this question the student must delve deeply into the archæology and ethnology not merely of Japan but also of all those near-by countries and islands which, in the last several thousand years have had any influence on Japanese religious thought—Korea, China, Siberia, and Oceania. To

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THE ENTRANCE GATE OF ISE TEMPLE

This wooden "torii" is an example of the original form, and is extremely simple in structure. Much more intricate and complicated styles were later developed

Photograph by Roy Chapman Andrews

MAUSOLEUM OF IEYASU

A view of the second court, looking toward the steps leading to the main temple. The torii at this shrine is of bronze

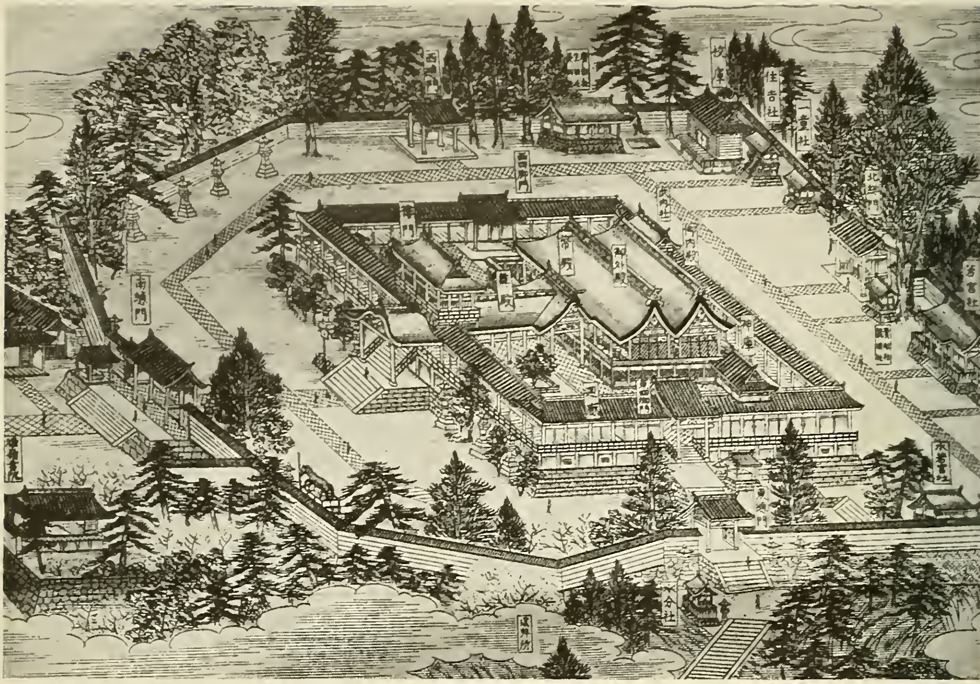
Photograph by B. M. DeCou

THE YOMEI GATE OF NIKKO SHRINE

The carvings on this inner gate are so elaborate that an observer can spend a whole day studying them without realizing the passing of the hours. It has been named the "Sunrise to Dark Gate" on this account

THE IZUMO TEMPLE, IZUMO PROVINCE
The deity of this temple is Oh-kuninushi-no Mikoto. It is the oldest temple in Japan, and is second in importance to the temples at Ise

THE SHINTO TEMPLE KASUGA
The stone lamps which line the walks of this temple have been brought by worshippers wishing to pay homage to a deity. Altogether about 1800 such lamps have accumulated in the gardens of this shrine



A BIRD'S-EYE VIEW OF OTOKOYAMA HACHIMANGU

Showing the structure and arrangement of the shrine at Kyoto. This is one of the more elaborate types

NINIGI-NO-MIKOTO

A Japanese artist's conception of one of the five principal terrestrial gods. This picture and those of the gods and goddesses on the following pages were taken from an old Japanese text book

be thorough, the investigation might also be carried to the Indians of the northwest coast of North America.

Already we know of a definite connection between the Shinto and the old Korean religion, where still are to be found deities similar to some of the Shinto gods.

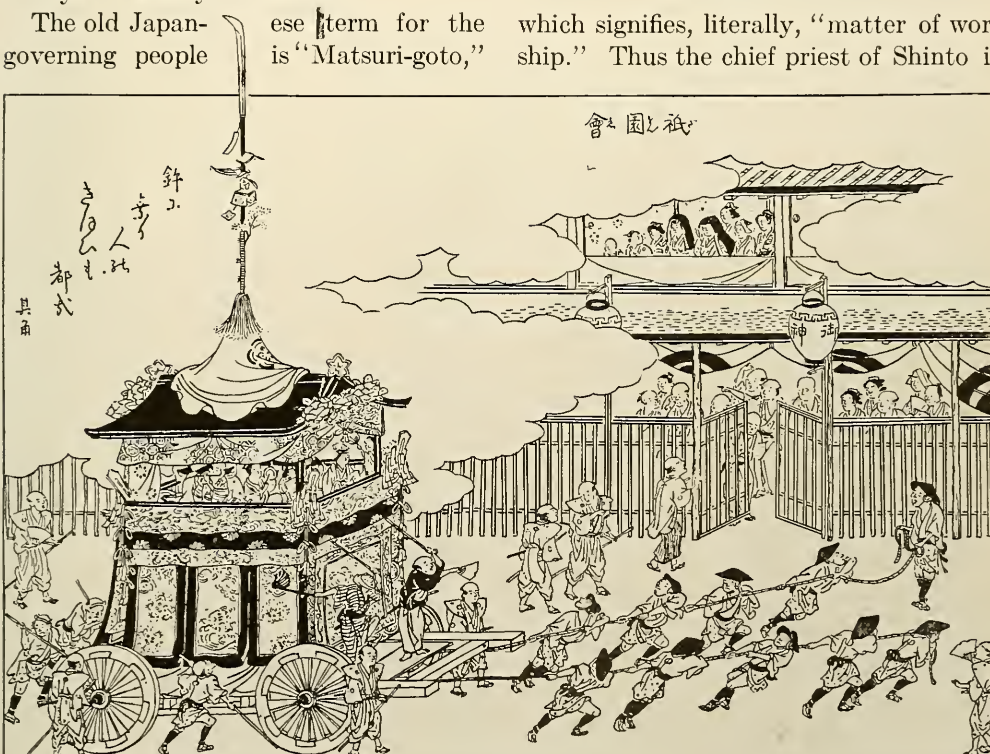
The earliest of the Shinto gods to appear in the ancient records are somewhat celestial in character. The Japanese name for "god" is "Kami," meaning "above" — obviously suggesting the celestial idea. There are, however, many terrestrial gods, which are almost more material than spiritual. They are only vaguely personified and are not at all to be likened to ghosts or spirits. The Sun Goddess, for instance—Ama-terasu Ohmikami—the ruler of the world, is visualized as occupying a place somewhere in the heavens. The name itself suggests this, for it can be translated

"Great Heaven-illuminating Goddess." Of the terrestrial gods, many are visualized as guardians of forests, streams, and many other natural spots. As closely related to the worshippers as to the more powerful celestial gods, these lesser deities might be compared to the sylvan gods of forest and stream as visualized by the ancient Greeks.

Spiritualistic conceptions were not well defined in early Shintoism, but in its development such conceptions came to have a part, which was much influenced by the introduction of Chinese culture. It was during this stage of development that departed heroes came to occupy an important place among the gods, and ultimately all those who died were imagined as becoming gods of greater or lesser degree. Thus ancestor worship came to be firmly and widely established.

AMA-TERASU OH-MIKAMI
The sun-goddess, another of the five principal terrestrial gods

The old Japanese term for the governing people is "Matsuri-goto," which signifies, literally, "matter of worship." Thus the chief priest of Shinto is



GION FESTIVAL AT KYOTO

From an old Japanese print

One of the old-style "band wagons" is being drawn through the street in celebration of festival day

HIKOHO-HODEMI-NO-MIKOTO, ONE OF THE FIVE PRINCIPAL TERRESTRIAL GODS

MASAKA-MAKATSU-KACHIHAYABI-AME-NO-OSHIOMIMI-NO-MIKOTO, A TERRESTRIAL GOD

CELESTIAL GOD AND GODDESS, IZANAGI AND IZANAMI, WHO ARE SUPPOSED TO HAVE CREATED JAPANESE ISLANDS

logically the emperor himself, as he is the chief representative of the original Japanese tribe.

From these facts it will be seen that there are three separate conceptions of gods; firstly, Nature as a god; secondly, anthropomorphic beings as gods; thirdly, spiritual emanations as gods. In addition to this the Japanese once conceived of the emperor as being a god, as the ancient Egyptians conceived their pharaohs to be. Today, however, the emperor is accepted rather as a sacred human being, though deceased emperors naturally occupy positions of importance among the gods.

There are, of course, thousands of Shinto temples to be found in Japan, but of them all the Ise shrine is the most sacred. It belongs directly to the imperial family, and is one of the oldest in the islands. Erected in the province of Ise about the beginning of the Christian era, it is still faithfully worshipped by *thousands.* The Izumo temple, which is much older, ranks next in importance to Ise. The deity of the former temple is Ama-terasu Ohmikami, the sun goddess, who is the ancestor of the emperor. The deity of the latter temple is Oh-kuninushi no Mikoto, who is the ancestor of the pioneer Japanese tribe that migrated to the north shore of the southern part of Hondo from the Asiatic mainland, passing through Korea and crossing the Sea of Japan, while the main body crossed the channel separating Korea and Japan and settled on Kyushu Island a little later in history.

From this very island the first emperor, Jin-mu, started the expedition that conquered Japan. He is deified, and his temple was erected in the province of Yamato after his death. Today it is one of the most important of Japanese shrines.

In many of the thousands of lesser temples are to be found deities which have become in part Buddhistic. This has been the result of an amalgamation of the two religions by Gyoki, the famous Buddhist priest who lived in the Eighth Century, and established a new sect called "Ryobu-Shinto."

But whether the temples are pure Shinto or whether Buddhist influences have crept in, all have periodic festivals, generally in the flowery spring or the fruitful autumn, and pilgrimages of great numbers of devout people are a common characteristic of Japanese life. At such times of festival one can recognize among the customs of the people many that reveal strange mixtures of Chinese, Korean, and sometimes even Oceanic ideas and conceptions. At the important temples stages are erected for an old traditional pantomime dance called "Kagura," which commemorates incidents of an ancient and mythical narrative.

To discuss the theological conceptions of Shintoism is instantly to plunge into a vast and complex subject, far too enormous for consideration in so small a space as that at my disposal. There is, however, this that can be said. The Shinto faith, while it may or may not be as strong as it has been in the past, is still an enormous power throughout Japan. But in its intermixture with Buddhism,

THE FIRST JAPANESE EMPEROR, JIN-MU. REPRODUCTIONS OF THIS FIGURE ARE GIVEN TO WORSHIPPERS AT THE KASHIWABARA TEMPLE

KUNITOKOTACHI-NO-KAMI, THE FIRST KNOWN CELESTIAL GOD

TSUNUGUI AND TMOIKUGUI-NO-KAMI, MALE AND FEMALE CELESTIAL DEITIES

Photograph by B. M. DeCou

THE SACRED BRIDGE

This handsome red lacquer structure, located at Nikko, Japan, is dedicated to the gods, and is known as "The Sacred Bridge"

© by E. M. Newman from Publishers Photo Service

THE PROCESSION OF THE AOI FESTIVAL

This festival, which is held every April, is a famous and ancient custom. As part of the festivities there is a horse race in which twelve horses are ridden by Shinto priests

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ITSUKUSHIMA TEMPLE

During festival times, lanterns are hung about the temple, their reflection on the water giving added color and beauty to the scene

© by E. M. Newman from Publishers Photo Service

THE ENTRANCE TO THE OSUWA TEMPLE

These gateways show the stone structure which is more common than either wood or bronze. This shrine is better known to foreigners as "The Bronze Horse Temple" many of the simple country folk believe fervently that this earth is guarded by Shinto gods, though they accept as fact the belief that the future world is ruled and guarded by the Buddhas. Thus more Buddhistic deities may still be added to the infinite variety of Shinto gods, for the conception of gods of infinite numbers still appeals strongly to the sturdy people of Japan.

Diverse religions are in this way firmly established in Japan, and many beliefs find expression among the Japanese. Yet, despite these differences, any national calamity or problem of major proportions, such as war, instantly draws the entire nation into a compact and patriotic unit, headed by the emperor and fervently supported by every stratum of society, by every sect and religion. Thus, because the emperor is also the chief priest of Shintoism, Japan, at times of stress, can be said to be all but universally Shinto, with divergences of religious opinion buried for the time being in the all-pervading influence of Shinto. With its strangely powerful adaptability and power of absorption of other ideas, Shintoism remains supreme, not by opposition to other conceptions and other beliefs, but by its ability to take to itself whatever of good and of power these others have to offer. Thus, Shintoism seems still to be the single universal religion in a land where many religions are practiced daily.

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A PAGODA AND A TORII

In the temple grounds at Nikko stands this pagoda, considered the finest in Japan, and the most peculiar in construction. It has an immense central pole, about 100 feet long, that is suspended, from the top and swings within twelve inches of the ground. The action of this pole makes the tower practically immune to the slight earthquake shocks that sometimes occur in the vicinity of Nikko

A Young "Giant Electric Bug" in a Home Aquarium

AQUATIC INSECT PETS

How to Make and Maintain an Insect Aquarium at Home for Instruction and Amusement

By FRANK E. LUTZ

Curator, Department of Insect Life, American Museum

IN the preceding issue of Natural History some features of the case-making instincts of young caddis-flies were described. Even when one does not tamper with the natural behavior of these aquatic creatures, they are fascinating to watch, and are among the easiest of insects to keep in small aquaria. However, they are by no means the only aquatic insects that amply repay the very small amount of trouble and expense required to have them as pets. Please let the fact that for many years our home has never been without at least one bowl of goldfish free me from any suspicion of narrow-mindedness when I urge that, as is shown even by the initial syllables of the words, insects are more interesting, instructive, and inexpensive.

Miall's classic *Aquatic Insects* and many other books have been written on this subject and the half has not yet been told. Let us start first with methods and then go as far as the editor permits.

Lowell truly said that there is no leaf nor blade too mean to be some happy creature's palace. In the same sense a fruit jar or a drinking glass may contain the universe of an insect; and such household objects are all that we really need for equipment. But, if you wish something that will look rather better on the living-room mantel, you might use a type of small aquarium which we have recently devised for that purpose. As it is not patented, you may make it yourself if you can.

The sides and bottom are one piece of plaster of Paris impregnated with bee's wax. The front and back are glass plates. Being a frugal soul and having a supply of spoiled 4×5 photographic plates, I clean and use them for the glass. They are clearer than window glass. The glasses should be not much, if any, more than an inch apart, because you will wish to watch some of your pets through a magnifying lens.

In order to cast the plaster sides and bottom you will need a mold. The most difficult part of the mold to make is that which represents the inside of the finished

"BACK-SWIMMERS"
When these aquatic insects stand with their feet on the ground, they resemble overturned boats, but as they swim on their backs the "boats" are then right side up

aquarium. It can be modeled in clay ("plasteline," "plastecine," etc.) but then it will have to be remodeled each time that it is used. An easier way is to make first a clay model of the sides and bottom of the finished aquarium, put on the glass front and back, and then pour plaster in the middle. When the plaster is set, take the things apart and with a knife do any trimming that may be necessary of the plaster block which will be the inside part of the mold used in casting the actual aquaria. Shellac this mold and it may be used many times. Its sides and top (what will be the bottom of the inside of the aquarium) should slightly slope toward what will be the front. This slope will not only be pleasing in the finished product but it will make it easier to get the center mold out of the cast sides and bottom.

The rest of the mold may be made either with glass plates or with plaster. Since the glass plates are simpler for the inexperienced and since the experienced will need no instruction about making plaster molds, I shall explain the use of glass plates. Lay one piece of glass flat down on a table. Set on this the inside mold which you have made. It should be upside down; that is, what will be the open top of the aquarium is now resting on the horizontal piece of glass. Place the glasses which you are going to use for the front and back in position against this mold and fasten them there either with a clamp or by placing a lump of clay against the outside. Next place a piece of glass against each side to complete the mold. Fasten these in place either with clamps, rubber bands, or string. Seal all edges, including those at the bottom with clay pressed against the outside. Now pour into this mold freshly mixed plaster, filling the mold to its top (what will be the bottom of the aquarium). The dry

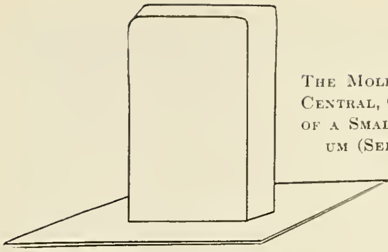
THE DAMSEL-FLIES, WHEN AT REST, HOLD THEIR WINGS VERTICALLY OVER THEIR BODIES

plaster should have been mixed with water to the consistency of real cream and, after mixing, you will have to move quickly or it will set before you can pour it. Let the plaster in the mold harden for at least half an hour before taking it out. You will find that the pieces of glass can easily be separated from the plaster. If any plaster has run between the central mold and the glasses (due to the fact that the front and back glasses did not fit tightly against the central mold) scrape it off carefully before trying to push out the central mold.

All of this may seem very complicated, but the accompanying figures will help some and experience will do the rest. By the way, the plaster central mold should be greased lightly with vaselene, lard, or something of that sort. The pieces of glass need not be greased if they are clean.

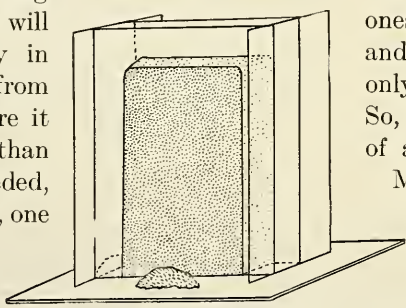
Having the plaster sides and bottom of your aquarium all in one piece, let it dry thoroughly for several days and then soak it in melted bee's wax for fifteen minutes or so. The wax may be kept melted in a double boiler or its equivalent. After taking the plaster out of the wax and allowing it to cool, brush more wax on the surfaces which will be in contact with the front and back glasses, making a fairly even layer about a sixteenth of an inch thick. Now, heat the glass plates in an oven. Let them get quite uncomfortably hot to handle with bare hands and then press them, one at a time, in place on the wax-coated plaster. They will melt the wax and, on cooling, will be firmly

THE TRUE DRAGON-FLIES HOLD THEIR WINGS OUT FLAT AT THEIR SIDES



The Mold for the Central, Open Part of a Small Aquarium (See Text)

cemented by it to the plaster which is waterproofed by the soaking in wax. Perhaps there are bubbles of air between the glass and the plaster. If not too large, these will do no harm unless they reach to the inside of the aquarium. If they do, take the glass off by heating it and try again. You will doubtless find difficulty in keeping the hot glass from sliding on the wax before it cools. Nothing more than patience is really needed, but little blocks of wood, one placed at the middle of each side, will conserve your supply of patience. A strip of surgeon's adhesive tape should be put on the outside of the sides and bottom, folding over a bit on the front and back. As a sort of finishing touch, this tape, after being put in place, may be given several coats of a waterproof varnish, any color you wish.



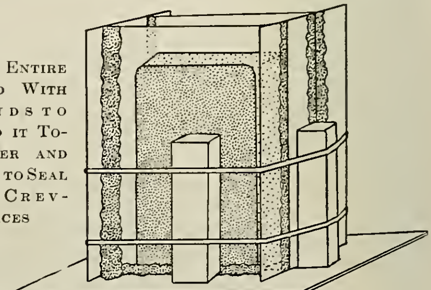
The Central Mold Surrounded By Glass Plates to Form the Sides

To warn the ingenious, I ought to say that we have experimented with various substitutes, such as liquid celluloid, tar, and varnish, for the wax, but found that they are not so good. However, do not let this warning deter you from experimenting and, above all, do not let the description of this aquarium make you forget that finger bowls, soup dishes, fruit jars, photographic developing trays, and the like are very satisfactory aquaria for insects.

Those who have kept goldfish will at once think about "balancing" their aquaria with plants or about using some other device to keep plenty of air in the water. This is important for fish and for many aquatic insects. On the other hand, it is of less importance in the case of the many kinds of aquatic insects, including mosquito larvæ, that normally come to the surface for air.

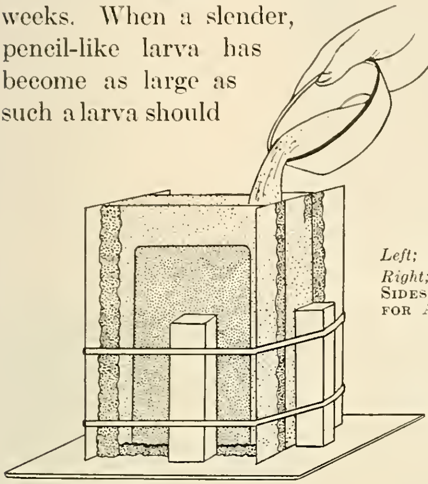
Keep mosquito larvæ in our homes? It does seem to be a queer notion; but they are both interesting themselves and they make good food for other interesting creatures. We are so used to thinking of insects as pests that we find it difficult to think of using them as pets. Furthermore, it is only the grown-up mosquitoes that bite and, of the grown-up ones, it is only certain species and, of those species, it is only the females that bite. So, do not think too harshly of all mosquitoes, even.

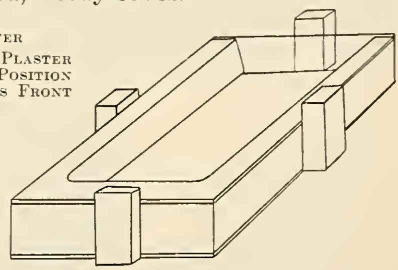
Mosquito larvæ are easy to feed because they eat the microscopic plant-life that is in the "silt" at the bottom of natural pools. Put a pinch of such débris in the aquarium and Nature will do the rest. These larvæ, "wrigglers," actively move about by twists and jerks and, as for the species you are likely to have, frequently come to the surface for a breath of air. Curiously enough, they get this air through a tube at the hind end of their body. While at the surface, members of the genus *Anopheles* lie practically level but, as a rule, the larvæ



The Entire Mold With Bands to Hold it Together and Clay to Seal the Crevices of other genera hang with the head well below the surface.

One advantage of young mosquitoes as occasional inhabitants of home aquaria is that they may pass through all of their life-history stages in a few weeks. When a slender, pencil-like larva has become as large as such a larva should be, it splits down its back and comes out of its old skin a grotesque but active pupa looking as though it might be an aquatic gnome. It has on its humped back a pair of funnel-shaped tubes and it is through these, instead of through a tube on its tail, that it now breathes. Usually not more than a few days later this, too, splits down the back, and then is when you will want to be watching it in order to see the marvelous transformation for which insects are so noted. Out of this under-water gnome steps one of the daintiest of aërial creatures. By the way, have you ever seen a male mosquito? Possibly not and this may be your chance. The male differs from the female in more ways than merely not biting. And, how does the adult mosquito breathe? Not through its mouth.





Left; Pouring the Plaster
Right; The Finished Plaster Sides and Bottom in Position for Applying the Glass Front and Back

An easy way to get live things for these small aquaria is to sweep an insect net through the vegetation and among the bottom débris of natural pools or ponds. Often a small pool yields better results than a large pond. Lakes are usually not much good for this purpose except in sheltered, weedy coves.

A Wax-impregnated Plaster Aquarium Stocked with Mosquito Larvæ and a Mosquito Pupa

Such a sweep of the net is quite likely to gather in at least one dragon-fly larva, as great an enemy of mosquito larvæ as the adult dragon-fly is of adult mosquitoes. Now, the order of dragon-flies, Odonata, consists of two suborders: damsel-flies and the true dragon-flies. In the adult stage these may be distinguished by the fact that the damsel-flies when at rest hold their wings vertically over their bodies but the true dragon-flies hold theirs out flat at their sides. In the larval stage there is a more striking difference, for a damsel-fly larva has three,

AN ADULT DRAGON-FLY COMING OUT ITS NYMPHAL SKIN

ALL OUT, AND IN POSITION FOR EXPANDING ITS WINGS

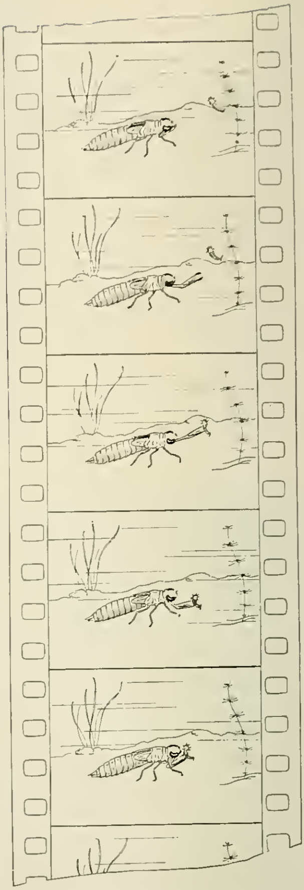
THE WINGS ARE NOW ABOUT HALF EXPANDED

HERE THE WINGS ARE NEARLY COMPLETELY EXPANDED

NOW THAT THE WINGS ARE EXPANDED, THEY NEED TO DRY

THE WINGS HAVE DRIED AND ARE READY FOR THE FIRST FLIGHT often rather pretty, finlike gills at the hind end of its body. These gills take up dissolved air from the water and pass it through fine tubes to the body. A true dragon-fly larva has no such external gills but is continually sucking water into and expelling it from the hind part of its abdomen. Dissolved air passes through the rectal walls and is then carried by fine tubes to the rest of the body. When this water is expelled forcibly, the dragon-fly larva is shot forward by the back-pressure.

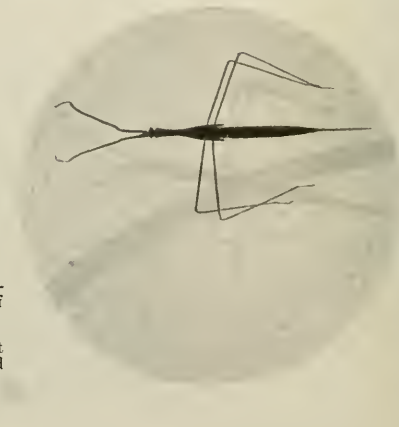
The larvæ of both dragon-flies and damsel-flies have a most curious method of catching their prey, other small aquatic creatures. I have tried to illustrate this by the drawings of two imaginary motion-picture films. The larva's highly specialized lower lip is jointed somewhat like the boy's arm and has at the end a pair of finger-like pincers. When wishing to catch something with these pincers, the larva suddenly extends its lip and is usually successful. Then it folds its lip up again and the grasped prey is automatically brought to the larva's mouth for the next part of the action.



IMAGINARY MOTION—The dragon-fly larva catches its prey with the finger-like pincers at the end of its jointed lower lip

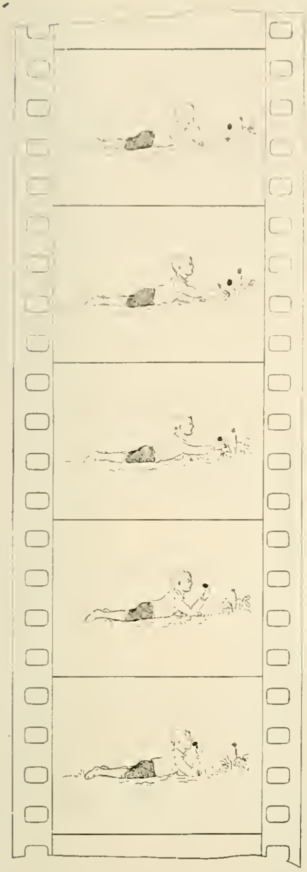
Unlike the mosquito, butterflies, beetles, and so on, but like true bugs, grasshoppers and many other insects, the dragon-fly has no real pupal stage in its life history. You will notice that larvæ which are nearly or quite full-grown have four pads on the back of the thorax. These contain the wings of the adult folded much as is a parachute strapped on the back of an aviator ready for a jump. When the proper time comes, such larvæ crawl out of the water (furnish your aquaria with a projecting stick which they can use), split down the back, unfold their wings, and fly away. The pictures on pages 394 and 395 are part of a series taken of a becoming-adult dragon-fly that had lived in a fruit-jar aquarium and had its coming-out party on the edge of the jar.

Speaking of "true bugs," there are a number



(*Above*) Larva of a stone fly. Among its distinguished characteristics are the *two* "tail filaments," and the gills at the bases of the legs

(*Right*) This "water scorpion," which is not a scorpion at all but a true bug, breathes atmospheric air through a tube at the hind end of its body



—PICTURE FILMS
The boy reaches for a berry with his fingers in much the same way that the dragon-fly uses its pincers

of lively ones for these home aquaria. True bugs are insects belonging to the order Hemiptera, suborder Heteroptera. Leaving other characters out of account and confining ourselves to aquatic insects, we may say that they are the only ones which have neither pupal stage nor chewing mouth-parts. Their mouth is a sucking beak and what they suck most of all is the body-fluid of other aquatic insects.

Of these aquatic true bugs, I prefer the lively "back-swimmers" and the equally lively "boatmen." If you wish more striking things, you will want one or two of the huge "electric-light bugs" or the grotesque "water scorpion," which is, of course, not a scorpion at all and is perfectly harmless so far as we are concerned.

If there is anything in Nature that is more like a submarine being propelled by oars than is one of those "boatmen," it probably is a "back-swimmer." As a matter of fact, these two groups of insects are closely related families, the former being Corixidæ and the latter Notonectidæ. When a Notonectid is what we might call right side up, that is, with its feet on the ground, it is shaped like an overturned boat but it swims upside down so that the boat is then in the right position. Why these things should be so is a difficult thing to explain and there may be no reason. The fact that the back of a back-swimmer is pearly-white while its ventral side is dark has been explained by pointing out that, when swimming upside down, the dark color of the ventral side will blend with the dark pond-bottom and the white will blend with sky-light, but that may not be the reason.

Variety might be given as a distinctive characteristic of insect life. Beetles, flies, moths, wasps, and other true bugs each have aquatic representatives. "Orders," such as caddis-flies, May-flies and dragon-flies, are considered distinctly aquatic because

(*Left*) A caddis-fly larva was dispossessed of its "log-cabin" case and the case was taken entirely apart. At 10:30 A. M. the larva and a supply of pieces were put in a small aquarium

(*Above*) By 3:00 that afternoon the larva had made a new case and was occupying it. The dark object at the bottom of the dish is the larva in its new case

A TRUE DRAGON-FLY LARVA

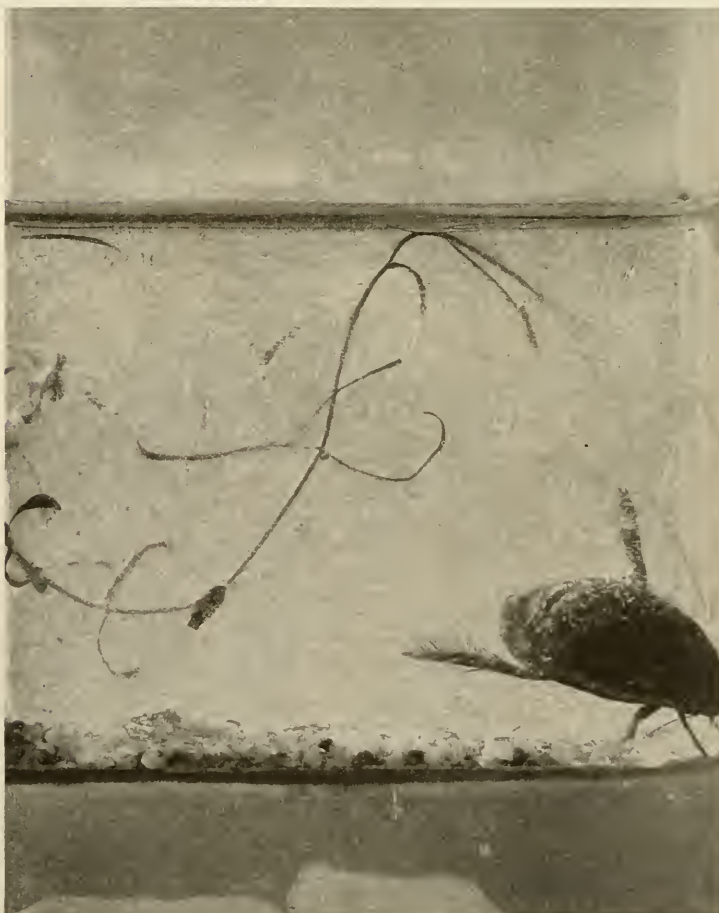
The true dragon-fly larva does not have external gills, but is continually sucking water into and expelling it from the hind part of its abdomen

A DAMSEL-FLY LARVA

It has three fin-like gills at the hind end of its body, which take up dissolved air from the water and pass it through fine tubes to the body

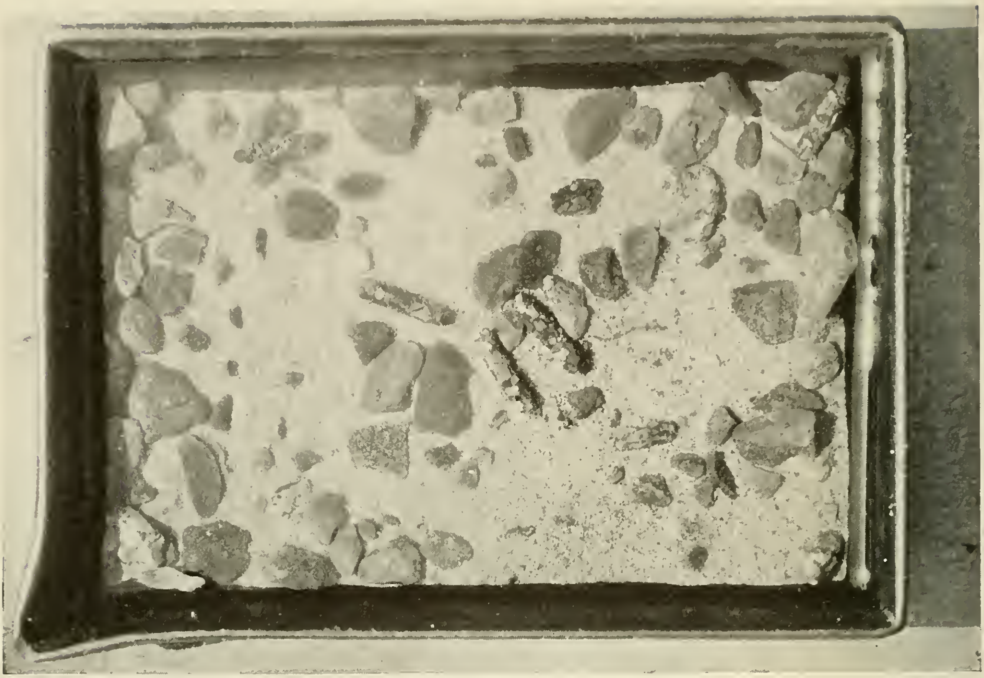
AN AQUATIC BEETLE

This male *Dytiscus* beetle is crawling out of the water by holding on to the glass back of the aquarium with the help of the "sucking discs" which males of this genus have on their front legs



EFFICIENT PROPELLERS

The long hind legs fringed with hairs act as oars for both sexes of *Dytiscus*



A PHOTOGRAPHIC TRAY AS AN "AQUARIUM"
Six caddis-fly larvæ, each in its mosaic case made of small pebbles, may be seen nesting on the bottom of this simple aquarium

all (or nearly all) of their larvæ live in the water. Now, it is a curious thing that the adults of these "distinctly aquatic" orders are very "air-minded," while, on the other hand, many of the adults of the aquatic offshoots from the largely aërial groups are almost as helpless on land as a walrus is. All of this—and there is more—has a bearing on home aquaria. There need be no sameness among your pets.

A part of the "more" just parenthetically mentioned is the fact that some aquatic larvæ leave the water to pupate even though the adults may come back to their childhood environment for the rest of their lives. This is what the large *Dytiscus* beetle does and it sets another problem for those who are having insect aquaria. The straightforward way is to make a combination aquarium-terrarium, so that the *Dytiscus* or other larva with a similar urge can crawl out of the water, burrow into the earth, make a cell there, and pupate. Such combination affairs are interesting but fussy and an amateur aquarist may be pardoned for catching a "wild," not hand-raised, adult, keeping it, and excusing the neglect of the pupa by pointing out that it is not aquatic. There is a record of an adult *Dytiscus* living for more than three years in a home aquarium. It was fed on bits of raw meat when insect-prey could not conveniently be procured.

If the merry dances of the adult Gyrinid or "whirligig" beetles are desired, the aquarium must have surface, rather than depth (a glass baking dish or even a soup plate is quite the thing), and a screen top must be provided in order to keep the dancers from leaving. Like other adult beetles, these breathe atmospheric air, each carrying down a private bubble of it when he or she dives. Therefore, it is not necessary that this aquarium be "balanced" with plants, but one or two sprigs make it prettier and give the beetles something to cling to when they are underwater.

Water-striders are curious, even for insects. Being true bugs, they have sucking mouth parts and no quiet pupal stage. The small, wingless young resemble the larger, not always winged adults. If an adult has wings it may fly from one pond or stream to another but, except for this, water-striders do not leave the water and, yet, in none of their stages are they much more truly aquatic than is a duck. Their home and hunting ground is the surface of the water, but they do not swim. Books usually say that these insects walk on the water, but their leg-motion is not that of walking. Watch it and you will agree with the little girl who thought I was calling them by the really better name, "water-sliders."

These striders or sliders weigh something, of course, and each foot which rests on the water bends down the surface of the water but not enough to break through. Why does it not break through? Because the insect's feet do not get wet. But would not the feet get wet if they did break through? Yes. And, so, am I not talking in a circle? No; it is all straight, as you may see by trying to float needles, oiled and not-oiled, on water.

The great effectiveness of this standing-on-the-water trick is shown by the fact that water-striders (or -sliders) live in mid-ocean and are the only insects that do so. But here is something else to think about. If you keep one of these insects in an aquarium you will soon find that in trying to climb out it may get its feet wet, then its whole body, and then it will sink, and drown. This is sad if you value your pet, and may be prevented by arranging a wooden or other "shore" nearly flush with the water-level. But, if a little water in the wrong place is so fatal to these creatures, what does *Halobates* do in mid-ocean during a storm? The answer seems to be, not that "it hides under the crest of a wave until the storm is over," but that it clings, half-drowned to some floating object until it has a chance to dry off again. No floating objects, no *Halobates*, for the additional reason that, like our local water-sliders, they lay their eggs on such objects.

These are just a few of the points of interest about just a few of the really great variety of insects one may keep in small home aquaria. And, remember that elaborate special equipment is not really necessary. Among the most satisfactory aquaria I have ever had were deep glass butter-dishes that I bought in a five-and-ten-cent store.

EACH DOT IS AN EGG IMBEDDED IN THE LOOP OF GELATINOUS SUBSTANCE SECRETED BY THE MOTHER. THESE EGGS HATCHED IN THIS SMALL DISH

WHEN FURNISHED WITH MATERIAL, EACH LITTLE LARVA, ENTIRELY UNTAUGHT, SET ABOUT MAKING THE KIND OF CASE THAT IS CHARACTERISTIC OF ITS SPECIES

A Caddis-fly Egg Mass

THE MOUND BUILDERS

Who Were They?—Whence Did They Come?—Why Did They Build Mounds?—What Became of Them?

IN TWO PARTS—PART II

By H. C. SHETRONE

Director, The Ohio State Museum

WITH FOUR DRAWINGS BY ARTHUR A. JANSSON

INTERESTING as may have been the participation in the exploration of a Mound, as told in Part I,[1] it has not, as yet, answered our basic queries. Since the story of a people cannot be adequately related without reference to other peoples with whom their lives have come in contact, either in time or space, let us seek the answers to the proposed queries in a roundabout way. This leads us to a brief consideration of the important subject of the peopling of America and the dispersal of human inhabitants over the continent. While many phases of American prehistory lie beyond the possibility of absolute proof, the outline here presented conforms closely to authoritative opinion.

Archæological evidences indicate the existence of human beings in Europe and some other parts of the Old World for upward of a million years. Approximately 98 per cent of this vast period of time was consumed by man in passing through the very primitive cultural stages falling within the so-called Stone Age, or Paleolithic. The remaining 2 per cent, approximately 20,000 years, is believed by anthropologists to cover the duration of the New Stone Age, or the Neolithic, from which, in a surprisingly short time, the so-called civilizations of the present have developed.

Strangely enough, the western world—the Americas—affords no such evidence of antiquity in the matter of human habitancy. Absence of unquestioned proof of the presence of human beings prior to the retreat of the most recent of the several great glacial invasions, which geologists place at something under 20,000 years, leads logically to the belief that the Americas were peopled subsequent to that event. No representation therefore of the strictly Paleolithic epoch is assumed for the western world. In fact, it may be said that no evidences indicating an antiquity greater than 10,000 or 12,000 years have been adduced.

To epitomize the subject of the peopling of America the following brief statement of what may be considered as general authoritative acceptance is offered:

The aboriginal Americans, while presenting many variations in physical type and cultural attainment, are basically homogeneous and of Asiatic Mongoloid extraction; that is, they are derived from the original Mongoloid stock from which present-day Asiatic Mongolians sprang. Of the several suggested routes of entry, that known as the Northwestern route, by way of Behring Straits, is accepted as most plausible, although other peoples, using other entry routes, may have made their contributions. Their arrival in America lies somewhere between 10,000 and 20,000 years ago. They brought with them the culture of the close of the Paleolithic or, more likely, that of the beginning of the Neolithic. Their coming was not a definite restricted occurrence, but took the form of continuous or repeated cros-

[1]See NATURAL HISTORY, May–June, 1930, Pp. 293–304.

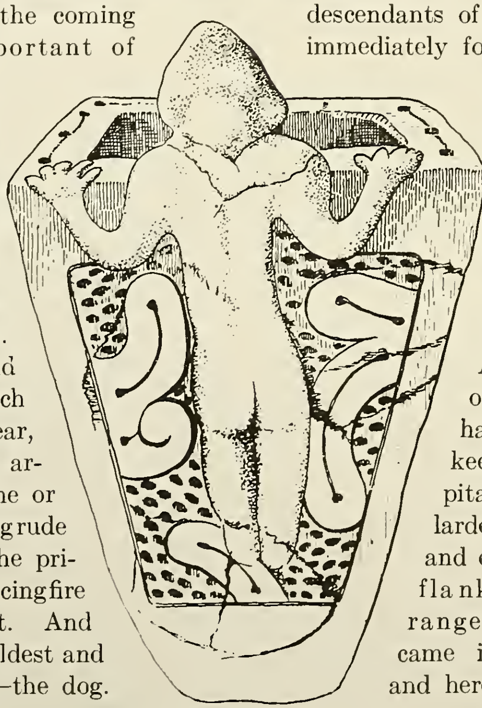
THE QUEST FOR FRESH-WATER CLAMS

SEARCHING THE STREAMS OF THE GENERAL MOUND AREA FOR MUSSELS WAS A MAJOR INDUSTRY OF THE MOUND-BUILDERS. THE MUSSELS WERE ESTEEMED AS FOOD WHILE THE SHELLS WERE MADE INTO IMPLEMENTS AND ORNAMENTS; BUT MOST IMPORTANT OF ALL WERE THE "SOLIDIFIED DROPS OF DEW," THE FRESH-WATER PEARLS—THE GEM PREEMINENT sings by bands of migrants, probably covering years or centuries. They dispersed gradually from the point of entry, eventually coming to people all habitable parts of the Western continents, evolving into more or less distinct and different cultural units as a result, to a great extent, of the varied environment in which they came to dwell.

It may not be amiss in a popular article to indulge the imagination to the extent of picturing the coming of these most important of America's first immigrants into their new home. In our mind's eye we see the straggling bands of migrants, following their chosen leaders, pushing forward into this veritable new world. Dressed in skins and furs; equipped with such simple aids as the spear, and perhaps bow and arrows, tipped with stone or flint; perhaps possessing rude basketry; certainly the primal requisites of producing fire and of chipping flint. And trailing them, man's oldest and most faithful friend—the dog. We see them pushing southward, weary and perhaps fearsomely; for what might not lie before them? Men, women, children—and dogs. Doubtless even then the saving sense of humor was in evidence. We imagine the youngsters, when not too tired or cold or hungry, indulging youthful pranks; pulling the dogs' tails, or shying snowballs at their elders!

Onward, into a virgin land; an epic occurrence even more romantic than the great Aryan invasion, in that the land now being invaded had not previously yielded to the impress of human footprints.

Some of the immigrants into this virgin land doubtless found their way eastward across the mountain barriers and through mountain passes, out onto and across the Great Plains. Logically, the historic Indian tribesmen of the greater portion of the United States and Canada may be considered as the direct descendants of those migrants who immediately found their way eastward from the aboriginal gateway.



Mound-Builder Pottery

THIS UNUSUAL POTTERY VESSEL, WITH HUMAN EFFIGY ATTACHED, IS FROM A MOUND IN CALHOUN COUNTY, FLORIDA. REDRAWN BY H. R. GOODWIN AFTER MOORE

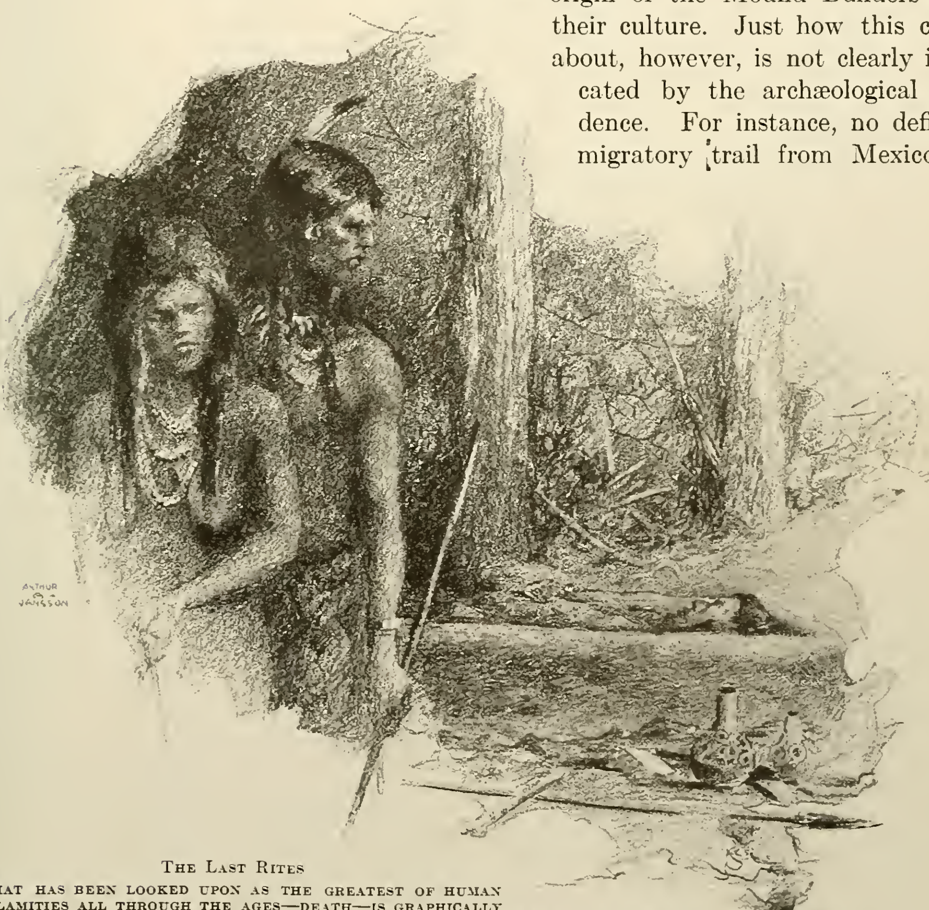
But there appears to have been another line of march, of even greater importance in so far as consideration of the Mound Builders is concerned. A considerable body of migrants appears to have trekked southward, keeping close to the hospitable Pacific, with its larder of food supplies, and deterred, on the other flank, by the mountain ranges. Eventually they came into Middle America, and here, after a long time, they were to effect a most significant accomplishment. Through the development of maize, supposedly from a native wild cereal, and the cultivation of other food plants, they became agriculturists and transformed themselves from nomadic to sedentary peoples. With the establishment of agriculture came the development of the fictile and textile arts—potteryware and fabrics—and numerous other artificial aids to existence. In the meantime the human stream had poured on into South

America to complete the peopling of the two continents.

The reader, influenced by the high standardization attending our present-day civilization, may find it difficult to comprehend the fact that there came to exist innumerable "cultures" within the wide-spread body of American aborigines. And yet, when we pause to take cognizance of the fact that under primitive conditions the vehicles which carry standardization — as communication, transportation, and literature—were of the simplest forms, and the territory concerned so vast, it will be realized that environment is a major determining factor in human culture. Thus, in great part the products of environment, we recognize numerous tribes, nations, and linguistic families; numerous "cultures," as Pueblo, Plains Indians, Woodland Indians, and Aztecs, Mayas and Incas, each culturally distinct one from another, yet all belonging to the single great race of American aborigines.

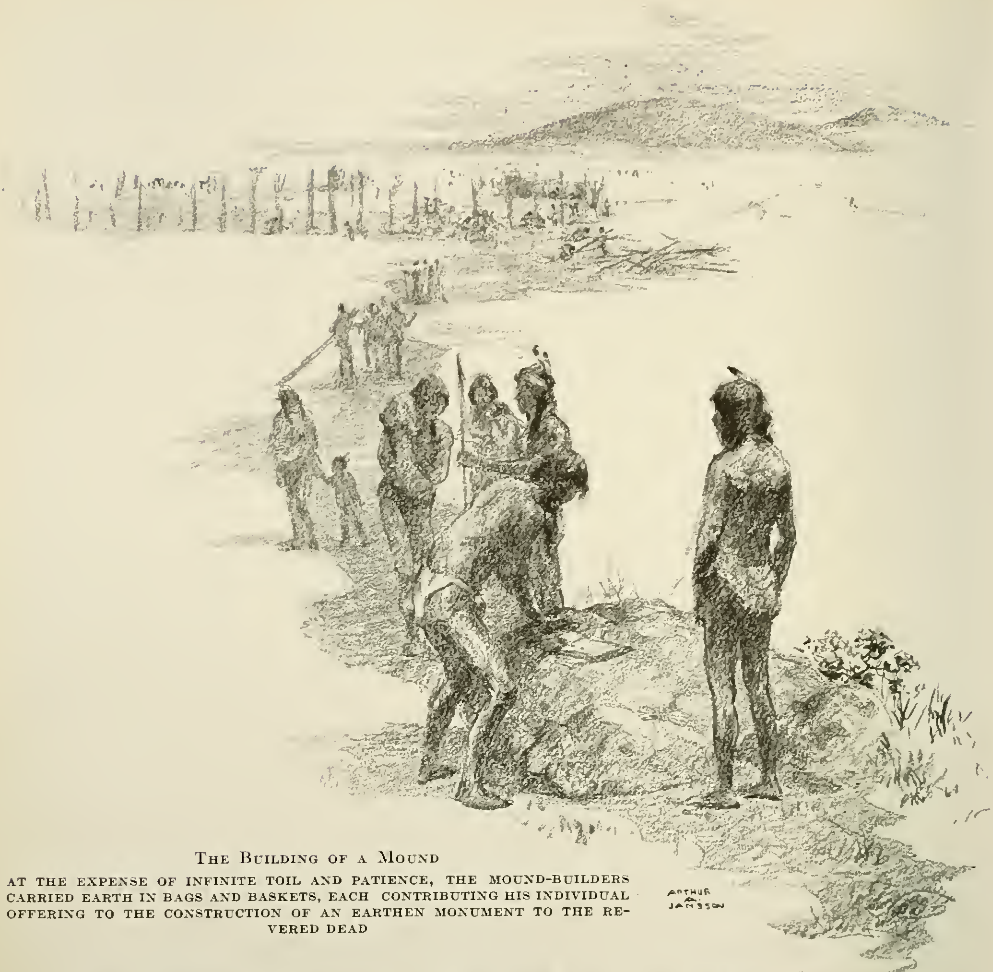
The crowning achievement, of course, of native American civilization, is to be found in the striking civilizations which developed in the nuclear area in Middle America and in the upper Andean region of South America.

To this nuclear area, probably the region of central or southern Mexico, anthropologists have come to attribute the origin of the Mound Builders and their culture. Just how this came about, however, is not clearly indicated by the archæological evidence. For instance, no definite migratory trail from Mexico to



THE LAST RITES

WHAT HAS BEEN LOOKED UPON AS THE GREATEST OF HUMAN CALAMITIES ALL THROUGH THE AGES—DEATH—IS GRAPHICALLY PORTRAYED IN THE ARTIST'S CONCEPTION OF A MOUND-BUILDER BURIAL. THE BODY IS READY FOR INCINERATION IN THE CREMATORY BASIN, WHILE PERSONAL POSSESSIONS ARE CLOSE AT HAND FOR THE INTERMENT



The Building of a Mound

AT THE EXPENSE OF INFINITE TOIL AND PATIENCE, THE MOUND-BUILDERS CARRIED EARTH IN BAGS AND BASKETS, EACH CONTRIBUTING HIS INDIVIDUAL OFFERING TO THE CONSTRUCTION OF AN EARTHEN MONUMENT TO THE REVERED DEAD

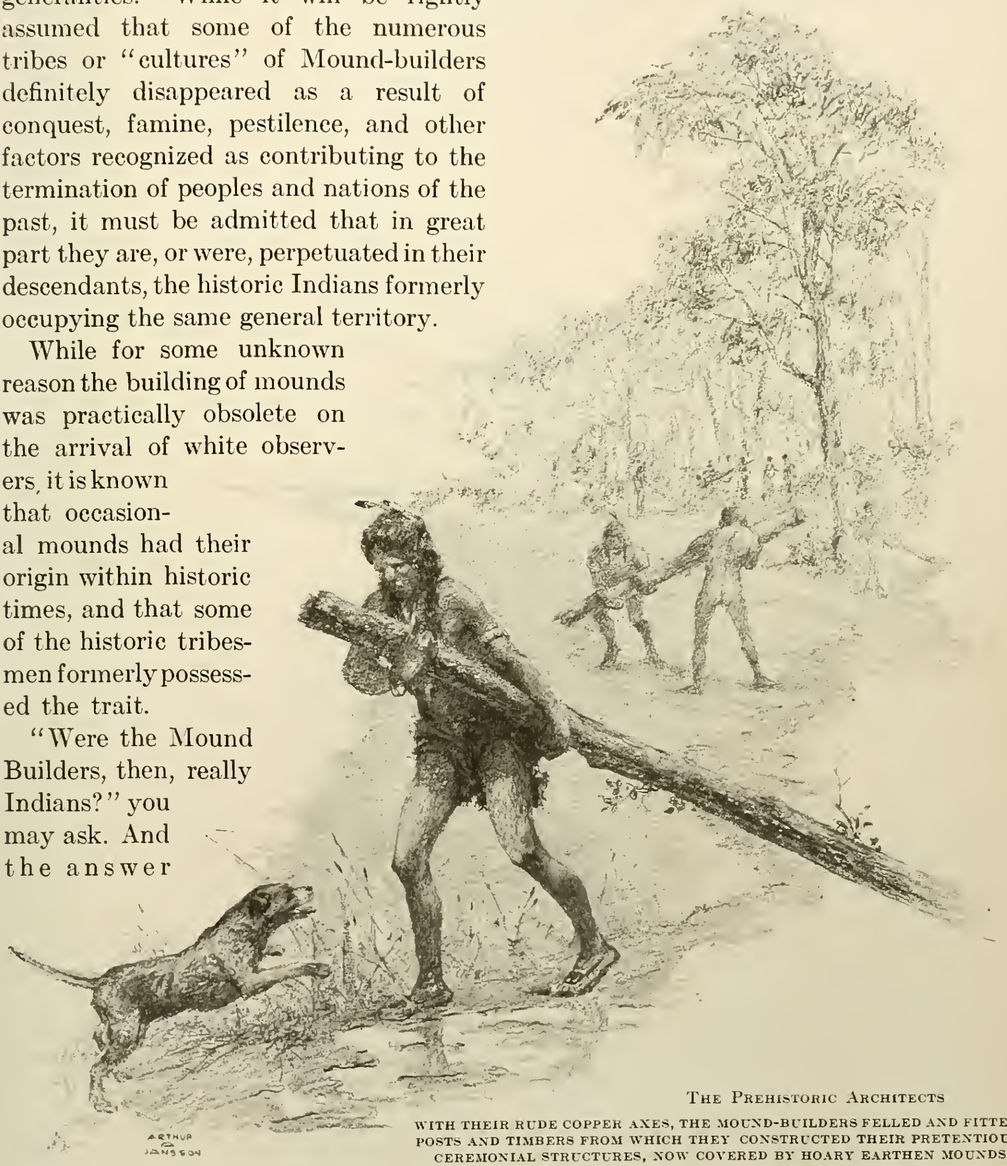
the lower Mississippi, marked by the usual material evidences of a passing people, is to be discovered. A sterile belt, extending well across Texas, in which nothing has been found indicative of either region or culture, is a most puzzling feature; and the over-water route from Mexico to the Gulf coast, sometimes suggested, hardly appears to be the solution. However, certain material resemblances, among which are the common cultivation of maize and a more than accidental or fortuitous resemblance in art and symbolism, furnish strong proof of affinity between the two areas.

Regardless of the manner in which they found their way into the lower Mississippi and the Gulf region, the peoples under consideration brought with them the germ of what was to develop into the trait of Mound-building; a trait which, back in the nuclear area was to find its analogy in the erection of great pyramids, temples, and other architectural triumphs. Pushing their way to the northward, into the valleys of the Mississippi, the Tennessee-Cumberland, and the Ohio, they doubtless met their remote kinsmen who had made the crossing by the more direct route; and to these they must have transmitted their dominant trait of building mounds. Through diffusion, or borrowing, the custom spread fan-wise to the north and northwest.

The foregoing remarks furnish the best available answers to the queries "Who were the Mound Builders? Whence came they and When? Why did they build Mounds?" The remaining question "What became of the Mound Builders?" remains to be considered. While certain specific happenings, as the Iroquoian conquest, might be cited as partial answers to the question, the really basic factors are and must continue to be generalities. While it will be rightly assumed that some of the numerous tribes or "cultures" of Mound-builders definitely disappeared as a result of conquest, famine, pestilence, and other factors recognized as contributing to the termination of peoples and nations of the past, it must be admitted that in great part they are, or were, perpetuated in their descendants, the historic Indians formerly occupying the same general territory.

While for some unknown reason the building of mounds was practically obsolete on the arrival of white observers, it is known that occasional mounds had their origin within historic times, and that some of the historic tribesmen formerly possessed the trait.

"Were the Mound Builders, then, really Indians?" you may ask. And the answer may be either "Yes" or "No." In order to understand this apparent contradiction it is necessary to consider the meanings of three troublesome words—race, culture, and Indian. The word race is a biological term, referring to physical man, and means descent from common ancestry. Culture is used to designate social development, as manners and customs, in contrast to physical attributes. The term Indian, as with race,



THE PREHISTORIC ARCHITECTS

WITH THEIR RUDE COPPER AXES, THE MOUND-BUILDERS FELLED AND FITTED POSTS AND TIMBERS FROM WHICH THEY CONSTRUCTED THEIR PRETENTIOUS CEREMONIAL STRUCTURES, NOW COVERED BY HOARY EARTHEN MOUNDS has been variously and ambiguously construed. Primarily, Indian means a native of India. The misnomer, as it applies to the aboriginal Americans, is attributable to Columbus' mistaken belief that in discovering America he had touched upon the shores of India. Anthropologists, in lieu of a better word, designate all aboriginal Americans, past and present, as American Indians, and the word appears to be ineradicably incorporated in literature on the subject. In the popular mind, however, Indian has been applied more particularly to the historic tribesmen with whom white men have come in contact. The average person has preferred to think of the Aztecs, Incas, and Mound Builders as something different.

Keeping in mind the above definitions, we may conclude that the Mound Builders and the Indians were members of the same great race and, if we choose to accept the broader definition of Indian, that the Mound Builders were Indians. If, however, we prefer to restrict the word Indian to the historic application, only such tribes as have built mounds within the historic period may be termed Indians. Culturally speaking, we may rightly assume that the Mound Builders were peoples and nations distinct from the so-called Indians. The reader may take his choice, as may best suit his fancy.

HUMAN EFFIGY PIPE OF BURNED CLAY FROM GAHAGAN, LOUISIANA

DIGGING FOR LIZARD NESTS

Collector's Luck in the Forests and Deserts of the Dominican Republic

By WILLIAM G. HASSLER
Department of Herpetology and Experimental Biology, American Museum

"MIRA! Mira, Señor! Huevos!" greeted me from nearly forty small throats, the owners of which were crowded around the door of the building that was to be "home" and headquarters during my stay at Samaná, Santo Domingo.

It was the afternoon of my second day in this little town and I had just returned from an investigation of the collecting conditions in a near-by marsh and coconut grove. I hurried upstairs, grabbed a bag of small change, several boxes and cages, and returned to the children who milled about me as soon as I had seated myself on the lower step.

I had told some, the day before, that I would buy "huevos de lagartijas," and so they had taken a chance. Grimy and sticky hands, thrust under my nose, were grasping bottles, discarded match boxes, pill boxes, in fact almost anything that would hold lizard eggs and lizards, frogs, snakes, and even centipedes and spiders.

A policeman had come to chase the children, but on their insistence that "el Americano" had said he would buy lizard eggs, he had stayed, skeptically, to see what would happen. He came to my rescue and together with my guide kept a semblance of order, while for nearly an hour I bargained for eggs and a few of the best of the other specimens. When finally the last child had gone off glowing with the knowledge of newly acquired wealth, I counted my purchases to find I had seven hundred and five lizard eggs!

Thus started a series of most interesting experiences in the Dominican Republic while I was collecting living reptiles and their eggs together with data on their habits, for the department of herpetology and experimental biology in the American Museum.

Reptile eggs and even small living lizards were sent through the mail to the Museum. Well-rotted wood, crushed and pulverized, was the best packing medium, as it supplied the necessary moisture yet was light in weight. The collections of snakes and larger lizards were sent on in cages on the S. S. "Huron" when she called every three weeks. For two or three days before each of her visits the mornings and evenings would be repetitions of the original experience, with children and even adults bringing in all sorts of creatures.

The hall of my headquarters was converted into a zoo with a row of cages suspended from a rope along the wall. It was necessary to do this because the ants made short work of the smaller animals if left on a table or the floor. One species of lizard was particularly bothered by the ants. These lizards were small ones related to the larger geckos. A local superstition says that if one of these "salamaquesa," as they are called, is found in a house, particularly a bedroom, a baby will be born there within a year. I wonder what will happen to the birth rate at Samaná, since I sent out nearly 2,000 lizards, most of which had been caught in the homes there. The houses, however, were not the only places in which we found them. Piles of coconut husks yielded these, together with any number of other animals. Big hairy spiders, small snakes, various lizards, frogs and their eggs, and even rats were caught in these places,—just about everything that most people detest. These "salamaquesa" had one habit by which we profited when other hiding places were scarce. They would lay their eggs in the intricate passages inside of termite nests which were abundant everywhere in trees and stumps. The termites or "white ants" in this way became easily secured food for both adults and young.

One day while John King, a native who was my guide, and I were out searching for specimens, we discovered on a "fig" tree three white objects about the size of large marbles clinging to the

"MIRA, SEÑOR, HUEVOS!"

These children came in flocks with small lizards and their eggs to sell. They would pour into the house whenever they could, and sometimes it seemed that the only way to get them out was to take a snake out of a cage and walk toward them. That usually was sufficient

POSING A "SALTA COCOTA"—THE FIRST STEP TOWARD INFILTRATING IT
The preliminary steps of the paraffin infiltration method were performed in the field. The later steps in the process were to be carried out in the American Museum where the specimens will be placed on exhibition. Mr. Hassler is doing this work on the porch of his headquarters at Samaná

smooth gray bark about twelve feet above the ground.

I climbed up on the root-like protuberances which make these trees so characteristic, and discovered to my astonishment that the objects were some sort of egg, fastened firmly to the smooth bark, and so thin and brittle that one cracked the moment I attempted to remove it.

John followed me up and cut out a section of the bark, but the cracked egg broke open farther and disclosed an embryo lizard nearly ready to hatch. It was the young of *Aristelliger*, the largest geckonid lizard found on the island, regarding whose eggs or young nothing was known. This gave us a clue and in the days that followed we spent many hours searching for the adults, young, and more eggs.

The lizards grow to a length of slightly more than twelve inches. They have very thin skins of a velvet-like texture, the ground color of which is brown marked with a pattern of darker blotches that in some places approach a deep black and in others a purplish hue. These colors fade or become intensified according to the mood of the animal. After careful search we found that these lizards inhabit only the one kind of tree, the strangling fig, which is so admirably suited to their needs. The bark is smooth, giving the adhesive pads on their toes admirable opportunity to cling, and a surface on which the eggs may be firmly attached. Also, who could conceive of better hiding places for these peculiar lizards, which like tree frogs, seem a very part of the tree they inhabit, than the intricate crevices, passage-ways, and hollows which abound.

The eggs we found in varying numbers sometimes attached on the sides of the trees in the open, sometimes in crevices or under loose wood on dead limbs, and sometimes even in hollows inside the trunks. The shell was milky white, granular, and often showed the marks of

TWO *ARISTELLIGER* EGGS IN A HOLLOW TREE

The natural hollow was reached by a small opening opposite the one made in order to show them. The eggs are firmly attached to the bark

REMOVING THE FIRST EGGS OF THE BIG GECKO

It was by accident that the expedition discovered the eggs of *Aristelliger lar* fastened to the side of this tree.

John King, guide of the expedition, is here removing a section of the bark with the eggs attached

THE MONARCH OF THE HILL

This large strangling fig tree was the home of a colony of *Aristelliger* which lived in its mass of aërial roots

EGGS AND YOUNG OF THE BIG DOMINICAN GECKO

The natives, when questioned, had never seen the eggs of this lizard, *Aristelliger lar*, and few recognized the adults. They usually confused them with the "Salta cocota"

GOING UP FOR A DRINK

An abundance of coconut trees saved the members of the expedition the necessity of carrying canteens. They were also excellent collecting places for the smaller species of *Anolis*

the ventral scales of the adults as they must have lain over the eggs, pressing them against the wood. One large tree on the top of a ridge near Samaná yielded the most specimens—ten in all taken on different days.

Another species of large lizard with adhesive pads on its toes, but of entirely different family relationship, was also found living in trees near Samaná, and more abundantly in the forests about Laguna, a tiny settlement about eight miles inland. It is called by the natives "salta cocota" or "jump on your throat" and is popularly considered poisonous. In reality this giant *Anolis*, of the same genus as our so-called "American chamaeleon," is one of the most wary and difficult to approach. It can inflict a severe bite, but it is devoid of poison.

From Samaná I made numerous side trips for various species. At Laguna, besides the salta cocotas, we collected numerous smaller anolies, numbers of an interesting small burrowing lizard, wormlike legless lizards, and a species of small blind snake. These latter two look much alike and were found under rotting logs. Long, slender, green tree snakes were also abundant here. They feed on lizards which, as they swallow them they paralyze with poison from fangs in the rear of the mouth. Several species of back-fanged snakes are found in the island but, because the fangs are situated so far back in the jaw, they are not considered dangerous to man. There are no other poisonous reptiles found on the island.

Next we visited Los Flechas, where tradition says that Christopher Columbus had his first hostile encounter with the Indians in the Americas. For that matter it is supposed that the Indians he took back to Spain came from the vicinity of Samaná. Here at Los Flechas, a little native settlement on the shore of the Bay of Samaná, we secured more facts about *Aristelliger* and added to our general collection. *Aristelliger*, like many other lizards, is capable of breaking off its tail very readily when grasped by this appendage, and thus often makes its escape. In time it grows a new tail. One big fellow that we had caught, broke off its tail while struggling about in the bag in which it was carried. That evening I hung the bag from a nail in the wall together with some others. The next morning I discovered a small hole in the bottom of the bag. On looking inside to see if the lizard had escaped I saw that it was there but the tail was gone! Some mouse must have dined on lizard tail during the night!

At the extreme eastern end of the peninsula the condition of the country differs somewhat. It is much more dry, streams are very few, and the volcanic rock of which that part of the island is composed breaks through the surface at frequent intervals. Here we hoped to secure a series of *Ameivas*, which are terrestrial lizards and of which there are four species found on the island. We had found a few individuals living in the grass along a roadside at Samaná and a few more on one of the small islands in the bay. These lizards were of a forest species that, though they are confined to the more humid parts of the island, are very adverse to actual dampness. Up in the dry area we hoped they might be more abundant. We searched in fields and coconut groves and along the beaches until we found an old abandoned garden where the lizards were fairly numerous. But to our disappointment we found them to be the most wary of lizards. They would lie in the sun twitching nervously, and at the slightest sign of danger, would dart under tangles of brush, vines, or other places of safety. Our plans to collect a quantity alive were decidedly unsuccessful.

Sabana de la Mar, across the bay from Samaná, was the last place I visited while in the Province of Samaná. Behind it is a strip of savanna land which is inhabited by a species of lizard not common on the other side of the bay, and a species of frog that does not occur on the other side at all. The frogs of Santo Domingo may be grouped under four heads, two of which predominate. The members of

THE ROOFS OF SAMANÁ
Christopher Columbus may have anchored in the harbor beside Carenero Island when he visited Santo Domingo in 1493

THE "SPRING PEEPER" OF SANTO DOMINGO

This little frog, *Eleutherodactylus flavescens* whistles surprisingly like our spring peeper, *Hyla crucifer*. The frogs sit on the leaves of bushes on damp nights, and their calls, blending with those of hundreds of other small frogs, make a constant volume of sound

A "SALTA COCOTA" AT BAY

These large aboreal lizards, *Anolis ricordii*, are very shy despite their native name, which means "jump-on-your-throat," but when cornered, they are vicious, raising the throat fan, hissing, and biting

A SMALL "MARIGUANA"

This specimen has been hardened and will be infilltrated with paraffin. This pretty little lizard, *Ameiva lineolata,* was previously represented in the American Museum's collections by only a few specimen but the expedition was able to secure several hundred

A "BARKING FROG"

This frog, *Eleutherodactylus inoptatus,* was traced by its call one night to where it clung in a depression in the side of a palm tree. It tried to make itself inconspicuous by crouching deeply in a hollow in the trunk

AN AUTOMATIC FERRY

Crossing the Guayubincito about sixteen miles from Monte Cristy was this odd ferry, operated by the current striking the pontoons on an angle. The section hereabouts was at one time a great cattle-raising country

these latter two, *Eleutherodactylus* and *Hyla*, are largely arboreal. In fact, *Hyla* is the same genus as our American tree frogs. However, despite similar appearances and habits of these two groups, the egg-laying habits are entirely different. The *Hylas* lay their eggs in water, where the young undergo a tadpole stage, but the *Eleutherodactylus* lay their eggs on land in little clusters in damp places such as under coconut husks and at the base of leaves, and the young, when hatched, are already miniature frogs, having passed through the tadpole stage within the egg!

The other two groups are apparently confined to one member each. They are a species of *Bufo*—a toad, and a species of *Leptodactylus*—a small terrestrial frog. The toads, like our northern ones, lay their strings of eggs in water, but the *Leptodactylus* lays its eggs in a small moist depression in the ground, surrounded by a frothlike substance to retard evaporation. It was this last form that I found at Sabana de la Mar but not on the peninsula.

Another phase of my work, besides collecting specimens to send back alive and for the regular preserved series, was to pose and harden a number of animals illustrating various striking groups to be brought back and infiltrated with paraffin. After this treatment they will be put on exhibition. This work was most interesting and occupied much of my time between trips. Living examples were observed and their postures noted. Then they, or similar ones, were anesthetized and, after being posed, were injected with a hardening solution which would "set" the colors and firmly fix the animal without shrinking it. They were kept submerged in this solution for several days and then transferred to alcohol to await subsequent treatment in the laboratories in the Museum.

After completing the work at Samaná I packed my equipment and a last batch of animals, and on the morning before Christmas boarded the "Huron." She was to take me to Monte Cristy on the north of the island, where amid entirely different conditions I intended to study several other species of reptiles, getting data on their habits and finally sending a living series of these also to the Museum.

Monte Cristy, instead of being in a rough and hilly rain-forest region like Samaná, is nearly flat and very arid. At Samaná we had rains every day or so, while at Monte Cristy there had been three rains in the past thirteen months, yet the two localities are less than ninety miles apart in a straight line. Here in this hot dry climate certain lizards were very abundant. Two species of *Ameiva*, other than the one we had tried so hard to catch at Roja Cabo, were numerous, as were two of *Leiocephalus*. Other species of lizards were also found and a number of snakes, and our days were spent tramping about over the rolling cactus-covered country probing into holes, digging out nests, and otherwise gathering facts and specimens. My headquarters here was a private home, the owner of which graciously allowed me to keep my acquisitions in the back yard. Here in boxes and cages of all kinds my zoo increased to almost a thousand lizards, snakes, and finally a small burrowing owl. Here, too, the people came to sell me specimens, but this time there were nearly as many men as children.

One particular phase of the work here was to add, if possible, to the data brought together by Mr. Gilbert C. Klingel, who visited Haiti the year before. Under the slightly different conditions, we found that habits differed somewhat and some new facts were added. Besides the *Ameiva chrysolæma* which had engaged Mr. Klingel's attention, we found a beautiful little *Ameiva lineolata* quite abundant. It is very slender with about ten thin yellow stripes on a black back, and it has a brilliant blue tail. Previously it was represented in this country by only a few preserved specimens, but we were able to add substantially to this

THE QUEST FOR LIZARD EGGS

Ridges of coral gravel were profitable collecting grounds, and it was all the expedition could do in some localities to keep from being overwhelmed by natives anxious to earn a few cents by helping to dig number. The nests and eggs of both these species were found, many adjoining each other. In some places they burrow in sandy soil or in decomposed coral, and in other places in the dry dirt under cactus patches. An interesting habit of these two species, which enabled us to collect numbers of them ever so much more readily than would otherwise have been possible, was that many were estivating in a semi-dormant state. Hillocks of sand and dirt which showed evidence of burrows were dug into and in most cases yielded specimens, which, when uncovered, would try clumsily to escape. Whether they were found only a few inches under the surface or as deep down as three feet, they were cold and drowsy when dug out. Those on the surface in the sun had a higher body temperature, in some cases nearly 30 degrees more, and were so nervous and active that they were caught only with difficulty.

My stay in Monte Cristy included a trip up the river into slightly more humid country where comparisions of the fauna were made. At another time we crossed a tributary of the river on a ferry made of two flat-bottom boats planked down and fastened by two chains and pulleys to a cable across the stream. To go across, the ferryman would simply pull one chain short, thus canting the boats to the current which, striking them at an angle, propelled the ferry across.

A word of thanks is due to those whose assistance and friendship made my work so much more pleasant than it otherwise would have been, as well as to the government officials who aided me materially.

One of the last things I did before leaving the island was to climb the Morro, that huge mound of rock and dirt that rises so sharply out of the plains by the coast. On the plateau at the top, not quite a mile in length and about 900 feet above the sea, we found the blue-tailed *Ameiva* and a species of the *Leiocephalus*, together with one kind of *Anolis*. Three wild goats broke cover in front of us and faded again into the dense woods that cover the top. We could see Monte Cristy and the bay with its island spread out below us, while the sun sent a glistening molten sheen over the ocean as it dipped in the west.

Sunset on Samaná Bay

Photograph by Roy Chapman Andrews

A scene in the Gobi Desert

DESERT ROSES

Groups of Overlapping Platelike Crystals Deposited by Ground Water in Desert Sand, which Resemble the Petals of a Rose

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

SINCE the automobile has opened up many places that only a few years ago were considered distinctly inaccessible, a number of curious and remarkable things have been added to the sum of those with which we are more or less familiar. And perhaps there is no continent where the motor car has done more in recent years to enlarge our world experiences than Africa. It is no longer considered a dangerous adventure to visit the oases of the Sahara, and one now meets the omnipresent representative of Messrs. Thomas Cook and Sons almost as frequently in Biskra as in Berlin. Travelers who have returned from these excursions into the "Garden of Allah" have brought with them certain curious objects, sand-brown in color, that at first sight almost seem to be modeled from the hardened desert sands, so closely do they resemble flower forms carved from stone. They are the "desert roses" that may be picked up from the surface of the desert in certain places, and are best seen when the low sun casts long shadows, since in color they almost exactly match the sand from which they emerge.

Many have been the speculations as to the nature and derivation of these strange and attractive "sand roses," speculations that are, for the most part, wide of the truth, since the desert of Sahara would seem to be the last place in the world where we would seek for something that had been formed through the agency of water. And yet that is exactly what has happened in the case of the Sahara desert roses. They are in reality groups or aggregates of crystals deposited by water in the midst of the desert sands, and embracing in their formation some of the sand which also surrounded them in the process of their genesis.

The ground water present in the sands of a desert filters through the various layers of sand, dissolving the mineral matter that is the most abundant and the

DESERT ROSE FROM THE SAHARA

Like veritable flowers molded in stone, this aggregate of gypsum crystals lifts its petals above the sands of the "Garden of Allah." It comes from the neighborhood of Biskra, Algeria. Presented by Mrs. Charles F. Blake

most easily soluble. It carries this dissolved matter with it, until in the course of time, evaporation causes the moisture to give up its load of dissolved matter. This forms either a crystallized mineral or, if the process has been hastened, a concretion.

In the Sahara desert formations, the dissolved matter in the ground water was calcium sulphate and the resulting crystal aggregates are groupings of gypsum crystals.

When we consider the multitude of different but related shapes that constitute the varied crystal habit of the mineral gypsum, we find conspicuous among them certain rounded plates, caused by an oscillation between several crystal forms, and displaying on two opposite edges the familiar gypsum cleavage. Such platelike crystals assembled in overlapping piles strongly resemble the petals of a rose.

A DESERT ROSE FROM OKLAHOMA

This close aggregate of sand barite crystals comes from the Great Plains of the Middle West, United States. It is one of the so-called petrified walnuts of that region. Collected by Dr. Chester A. Reeds

DESERT ROSES FROM THE BAD LANDS

Even such an unprepossessing place as the Bad Lands of South Dakota may produce stone roses. These radiating forms are composed of sand calcite crystals

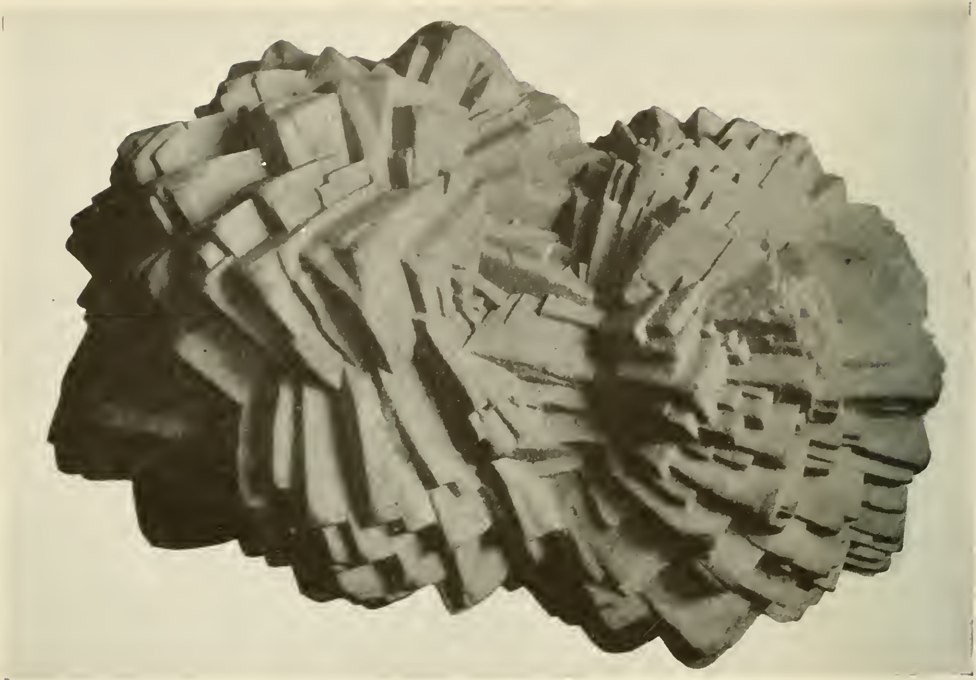
The sands of a desert such as the Sahara are never still, and as the sand shifts and travels, piling up hillocks and scooping out little valleys, the surface gradually recedes in places until the sand roses are uncovered and lie exposed.

The deserts of Central Asia also have their desert roses, of marked similarity to those of North Africa, and composed like them, of gypsum crystals. From the few specimens available to the writer, these roses of the Gobi seem to be lighter in color than the Sahara sand crystals, they appear to occur in groups of larger individuals (the petals of the roses are larger), and they are comparatively free from enclosed sand grains.

But gypsum is by no means the only mineral that forms in sand beds in shapes resembling in their crystal aggregates those of organic nature.

A DESERT ROSE FROM THE GOBI

Flower-like groups of gypsum crystals such as this, are abundant on the desert sands in the Sahara Murum region of Inner Mongolia. Collected by the Central Asiatic Expedition



A DESERT ROSE FROM FONTAINBLEAU

Composed of finely formed sand calcite crystals, this stone rose from an ancient Oligocene desert seems to have been modelled by some cubist sculptor. It comes from Bellecroix, Fontainbleau, France

The Great Plains of our own Middle West furnish some striking examples of these very interesting formations in calcite and barite. From the Permian Red Beds of Central Oklahoma come the "sand barite crystals" which are no less desert roses than the gypsum forms of the Sahara and the Gobi. Like these latter, the barite roses are composed of overlapping flat plates rounded in outline, and reddish or brownish in color; but they contain a much higher percentage of silica grains than the gypsum crystals.

Locally the Oklahoma aggregates are known as "rosettes," "petrified roses," and "petrified walnuts," the latter name being suggested by certain types in which the barite plates are so grouped as to present their rounded edges in ribbed masses resembling artichokes more nearly than walnuts. Similar barite sand crystals are found in Central Kansas. These desert roses, like those of Oklahoma, are chiefly composed of sand in rounded wind-worn grains.

By far the most interesting and suggestive of the sand crystals or "desert roses" furnished by the Tertiary beds of the area extending through western Kansas, Nebraska, and South Dakota, are found in the Bad Lands of northwest Nebraska, and Southwest Dakota, where calcite crystals enclosing a high percentage of sand have been exposed in several localities. They are especially abundant at Devil's Hill in Washington County, South Dakota. Here calcite crystals enclosing more than 60 per cent of sand occur as isolated individuals of a rounded pyramidal form, resembling blunt spindles. One can trace *through* the substance of these calcite crystals the laminations of the sand beds in which they were formed and one can readily see that they rested in the bed at various angles from the perpendicular with relation to the bedding plane. Higher up in the sand beds, which are between ten and fifteen feet thick, the sand calcite crystals are much more abundant and are grouped in loose aggregates joined at haphazard. Higher yet, radiating groups in close aggregation form veritable desert roses, and toward the top of the formation, where perhaps rapid concentration of the calcareous solutions militated against the formation of crystals, concretions and pipes represent the cryptocrystalline phase of calcite deposition. It would seem that here within a relatively small area the whole story of these highly interesting natural forms were unfolded in no uncertain terms, and that one might trace the stages in their formation with ease and certainty.

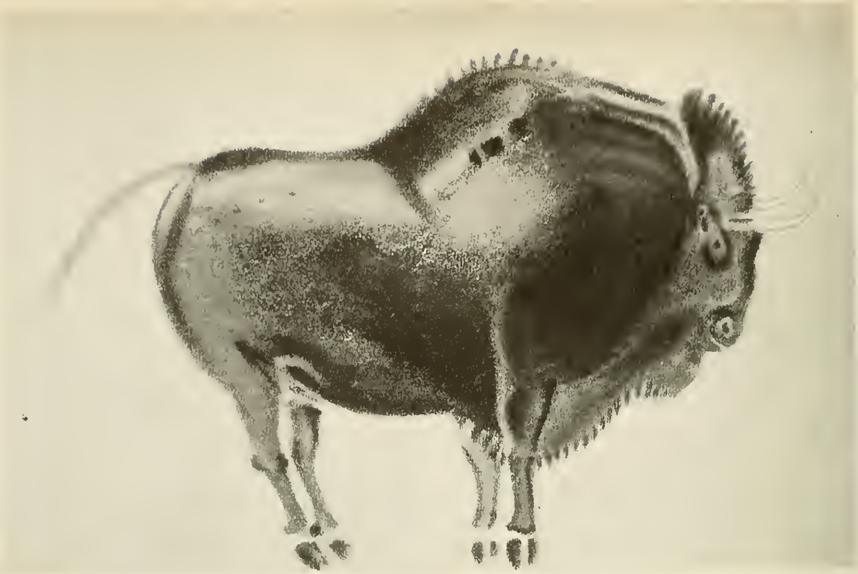
The desolate Bad Lands of South Dakota and the forest of Fontainbleau near Paris seem to us to have little or nothing in common, and yet, here, in the heart of the Paris basin, a little digging in the sand beds will reward one with sharp, well formed calcite crystals that, like those from Devil's Hill, are more than half sand. The Fontainbleau sand crystals are steeply rhombohedral in habit, with points considerably sharper than the corners of a cube, and with the points overlapping until the aggregates suggest highly modernistic conventionalizations of a rose. And are these stone blossoms from the famous forest true "desert roses"? It would seem so, for the sand that constitutes more than fifty per cent of their composition is certainly desert sand. There is no mistaking the rounded wind-blown character of the individual grains when seen under the microscope. Prof. A. Lacroix[1] has pointed out that "from the point of view of internal structure and origin, these crystals are comparable to those formed of gypsum from the Algerian Souf."

And as if further proof were needed, there have been found in Vaugirard, in the evirons of Paris, gypsum crystal aggregates, which are exactly like the desert roses of Algiers. To be sure, the Vaugirard aggregates have been replaced by quartz at some time subsequent to their formation, but, setting them side by side with the Sahara formations, it is not hard to believe that a desert of Oligocene age once covered the part of Northern France that is now the city of Paris.

[1]A. Lacroix, *Mineralogie de la France et de ses Colonies*. 1901, III, page 517.

AMERICAN DESERT ROSES

Rosettes of sand barite crystals from eight miles southeast of Norman, Oklahoma. In grouping, although not in composition, these desert roses closely resemble those from the Sahara and the Gobi. Presented by Charles N. Gould, Director of the Oklahoma Geological Survey



A bison drawing from a fresco on the ceiling of the cave of Altamira. After Breuil

ALTAMIRA
THE CAVERN OF THE STONE AGE ARTISTS

An Account of the Extraordinary Spanish Cave upon the Ceiling of which Artists of the Stone Age Painted Their Remarkable Pictures of the Animals of Prehistoric Times

By PROF. DR. HUGO OBERMAIER
University of Madrid

Translated from the German by Helen Gunz. Revised by N. C. Nelson
The American Museum of Natural History

THE Altamira cave, famed far beyond the borders of Spain, is situated thirty kilometers west of Santander (Bay of Biscay port) in the immediate neighborhood of the ancient little town of Santillana del Mar, whose glorious past is still manifested by a series of art monuments, themselves richly repaying a visit.

Primitive man roamed over this region already in early Palæolithic times, as is proved by a considerable number of implement finds made in the course of the last few years in the Quaternary clay deposit on the northeastern slope of the flat hillock near the summit of which the 270-meter long cave opens into the limestone formation. The implements are flaked from quartzite and consist in part of typical *coups-de-poing* (handwedges) and in part of large "choppers" which are retouched on one face only and have a rounded butt and a straight cutting edge. We must ascribe these tools to the Acheulean and Mousterian culture levels, i.e., to the period when the last interglacial age was drawing to a close, because the same industries appear in association with the straight-tusked or ancient elephant and Merck's rhinoceros in the not very distant Castillo cave at Puente Viesgo.[1]

The first occupation of the stately

[1]For more complete explanation, see the works of H. Obermaier, *Fossil Man In Spain*, Yale University Press, New Haven, Conn., 1924, and *El Hombre Fosil*, 2d Edition, Madrid, 1925.

entrance hall of the cave itself is to be assigned provisionally to Aurignacian times. My excavations, carried on during the years 1924 and 1925, furnished, scattered among gigantic bowlders, clear evidence of this culture stage (simple notched and stemmed points of the Font-Robert type); but thus far I have not succeeded in reaching the original cave floor, because the work of clearing away the débris has proved extremely difficult, the use of explosives being impossible. The fact that in the cave interior simple paintings and engravings are found which, according to information gained elsewhere, belong to Aurignacian times, corroborates this theory of early occupation.

Active life continued in the cave during subsequent Solutrian and Magdalenian times. The principal game animals were the wild horse, the bison, and the stag or red deer; besides which I came upon remains of the marmot, chamois, ibex, bear, deer, and wild hog; also, more rarely, with those of the reindeer, northern seal, wolf, lynx, and fox. The brooks yielded fish, as did the near-by sea, from which were fetched also astonishing quantities of shellfish, especially the periwinkle and limpet (*Litorina litorea* and *Patella vulgata*) for consumption in the cave. Both these univalve species are far more strongly developed than their descendants of the present day. In several archæological stations of the same age, in the adjoining province of Asturias, these univalves are usually accompanied by such northern bivalves as the clam and scallop (*Cyprina islandica* and *Pecten islandicus*). We are dealing obviously with arctic conditions, and in fact with the last glacial advance, during which the Cantabrian cordillera lay buried under snow and ice.

The Solutrian stratum belongs to the younger half of this stage and contains notched points expertly fashioned from flint or brittle quartzite—among them the Cantabrian variant with short side-barb; also laurel-leaf points with concave base, end scrapers, keel scrapers, discoidal scrapers, gravers, and the like.

Photograph by Prof. H. Obermaier, 1928

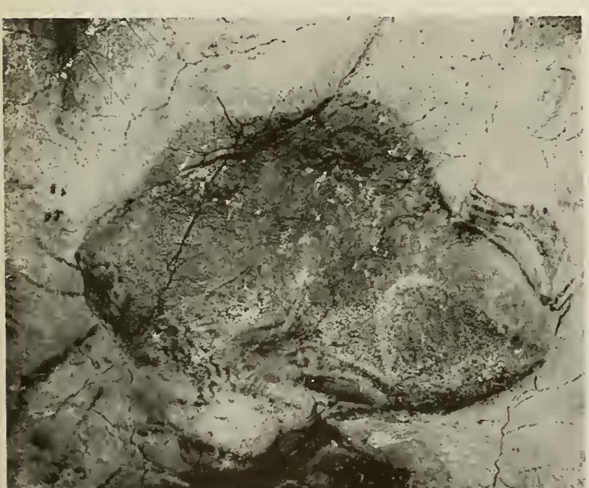
ENTRANCE TO ALTAMIRA CAVE

This shows the monument erected to Marcelino S. de Sautuola, the discoverer of the prehistoric paintings within

OUTLINE FIGURES ON THE CEILING OF THE ALTAMIRA CAVERN
These frescoes were discovered by Sautuola in 1879, and were the first examples of palæolithic mural art recognized as the work of primitive man

Awls and fine needles were made from antler, while pierced shells and teeth served for ornaments, as did thin rectangular ivory plates with incised and perforated edges. In addition, the inhabitants collected succinite (amber or amber-colored garnet), fossils, and rock crystals, as well as paintstuffs, including ochre, red iron oxide, and marl. The latter group consists partly of raw fragments, such as were ground and liquefied with animal fat or blood serum, and partly of real pointed "drawing pencils." These materials served chiefly for the execution of the numerous wall paintings, which reached their highest perfection during the Magdalenian period.

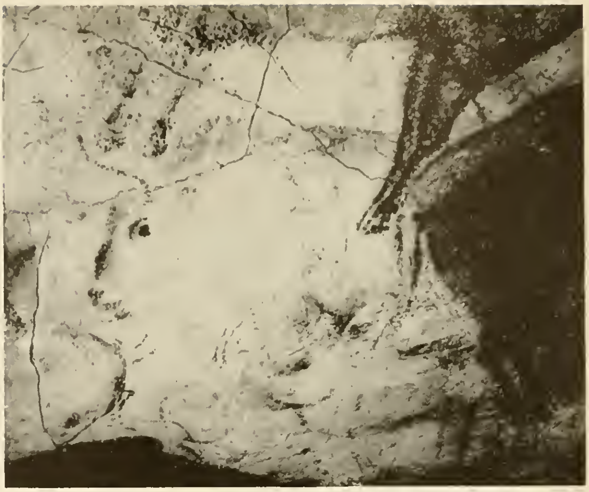
The uppermost and last stratum contains a rich early Magdalenian culture phase. From it have been taken several of the so-called *batons de commandement* or ceremonial wands; also shoulder blades of the stag with incised animal representations; while harpoons, so characteristic of the late half of the Magdalenian stage, are absent. At this time the cave suffered a fateful catastrophe. The rock roof of the entrance hall collapsed, its ruins so completely blocking access to



POLYCHROME PAINTING OF BISON
The crouched or trussed up attitude of the animal is due mainly to the fact that the body outline has been made to conform to the outline of an excrescence on the cave ceiling. Only the horns and tail are painted on the ceiling proper

Photograph by Prof. H. Obermaier, 1928 the interior gallery proper that no one could even suspect its existence. Thus the cave remained sealed up for many thousands of years, and during this time the Ice Age wall paintings slumbered in eternal night—a fortunate circumstance, for to it we owe their exceptionally excellent state of preservation.

The hour of rediscovery did not strike until the year 1868. A huntsman's dog lost his way among the crevices between some of the rocks. His rescue necessitated the removal of several large bowlders, and in this way the old entrance was again laid bare and made serviceable. Un-



Photograph by Prof. H. Obermaier, 1928

A FRESCO AT ALTAMIRA

Depicting the head of *Bos primigenius* in black, and other partially superimposed representations of animals

Photograph by Prof. H. Obermaier, 1928

THE PICTURE GALLERY IN ALTAMIRA CAVE

A view from the entrance, looking toward the left rear corner (Professor Obermaier at the right). The paintings occur on the ceiling of the cave and the visible rock projections have been utilized occasionally by the ancient artists to give the effect of high-relief sculpture to the animal forms represented

A HORSE SUPERIMPOSED OVER A HIND

Reproduction in a mural series in the American Museum of a mural fresco from the ceiling at Altamira cavern. The figure of the horse is painted in red ochre outlined with black manganese, and is more recent than that of the hind

ONE OF THE BISON FRESCOES

A polychrome bison in relief in the Altamira cavern. From a photograph by the author taken in 1928

THE RESTORATION BY BREUIL

The best preserved polychrome painting of a bison in Altamira cavern. This illustration is after the copy of the original painting by L'Abbé H. Breuil; the illustration on the right is from a photograph by the author taken in 1928

THE ORIGINAL FRESCOE

This is one of the figures in which two techniques have been employed—parts of the bison are engraved, and the entire figure is painted

Photograph by Prof. H. Obermaier, 1928

(*Above*) The deer is outlined in black and the body portions stained red. Length of deer 2.20 m. Note the small, black-painted bison beneath the head of the deer. (*Left*) From a restoration by L'AbbéH. Breuil

Painting of Female Deer

doubtedly, too, at about this time the most important part of the cave, namely, the picture gallery with its unique polychrome frescoes and engravings—situated about thirty yards from the entrance—barely escaped complete destruction. As I have ascertained from some of the oldest residents, and later proved by the discovery of numerous drilled blasting holes, a stone quarry was opened almost directly above the subterranean art chamber and exploitation carried on with a liberal use of explosives. In this way not only was the original stability of the painted ceiling impaired, but the roof as a whole, only a few meters thick, was everywhere shaken, occasioning dangerous cracks and fissures through which surface waters could trickle in abnormal quantities. As a preventive measure, in 1926 we waterproofed the outer surface of the roof portion concerned with a covering of cement, and in addition sprayed cement into the cracks of the limestone itself.

After the reopening of the cave, no one at first paid any particular attention to it, owing to the chaotic condition of the entrance. Not until 1875 were diluvial traces of occupation discovered there by the Santander archæologist, Marcelino S. Sautuola (1831–1888); and in 1879 his little daughter observed, deeper in the cave and to the left of the main vestibule, the rock paintings, the age and importance of which Sautuola instantly recognized and subsequently defended against the opinions of critics and skeptics. Unfortunately, this abode of art was not at first given the needed protection. Admission to the very low-ceilinged "picture gallery" was for many years free and unhindered, and even after the cave was closed and guidance entrusted to a plain countryman of Santillana, the supervision of visitors was by no means adequate.

In 1902, the noted savants Emile Cartailhac and Henri Breuil undertook the scientific study and ultimate reproduction of both the wall and ceiling paintings, giving us as a result the magnificent work, *La Caverne d'Altamira a Santillane, près Santander, Espagne* (Monaco, 1906), now long out of print. In the meantime, I have myself during 1928 completed a systematic photographic record of the pictures, examples of which accompany the present sketch.

When, in the course of my excavations of 1925, at a point near the entrance, a new collapse of the ceiling threatened, which also endangered the great picture gallery, there came to the rescue the high-minded Duke of Alba, who had already won well-deserved esteem by his endeavors on behalf of Spain's scientific treasures. Through the efforts of a Protective Committee, organized under his leadership, the endangered portions of the roof were consolidated without impairing the character of the grotto. At the same time, convenient electrically lighted walks were laid out in the cave proper; and the Picture Gallery—called by J. Dechelette the Sistine Chapel of Ice Age art—in particular was equipped with ingeniously placed reflectors, greatly facilitating the appreciation of the art works. A house, built in the local style next to the cave, shelters the

SUPERIMPOSED PAINTINGS

A complicated panel from the paintings in Altamira Cavern, showing in superimposition an ox, boar, and a horse, as well as undecipherable elements. After Breuil guardian as well as a small museum dedicated exclusively to Altamira discoveries.

In order conveniently to connect the cave with Santillana del Mar, there was built during the summer of 1928 an automobile road. The required rock material was procured from a quarry specially opened for the purpose about a hundred meters distant from the famous picture cave. This led to the discovery of a new grotto, which is remarkable for the extraordinary beauty and unmutilated condition of its numerous stalactitic formations. Whether archæological remains lie buried under the deep débris deposit at the former entrance I am not at present able to say. On one account do I wish, in view of my recently completed precise investigations, to bring up in this connection a human skeleton found within the cave, lying freely extended on a rock ledge without cultural accompaniments of any kind. The skeleton is, judging by its position and state of preservation, relatively recent, although certainly of prehistoric date. It is now preserved in the Altamira museum.

Photograph by Prof. H. Obermaier, 1928

POLYCHROME PAINTING OF A BISON

Done on the flat ceiling proper and therefore giving a lifelike representation of the animal. Length, 1.28 meters

Drawn by Arthur A. Jansson

Driving ducks into a trap with a returning boomerang

THE AUSTRALIAN BOOMERANG

The Two Types of Throwing Sticks Used by the Natives of the Island Continent. The Rarity of the Returning Boomerang, and a Report of How this Unusual Weapon is Sometimes Used

By EDGAR R. WAITE
Former Director, South Australian Museum, Adelaide

ACCOUNTS of the peculiarities of the boomerang and its faculty of returning can be found in innumerable works dealing with Australia or its aborigines, but the use to which it may be put is a subject that seems to have been consistently avoided. One must conjecture that any utilitarian employment of the weapon is a feature unknown to the writers. I have certainly not previously heard of the use of the returning boomerang in hunting ducks as herein described.

It is commonly believed, even in Australia, that all boomerangs, when properly thrown, will circle in the air and return to the feet of the thrower. This, however, is true of relatively few, and these are of a special type, known as come-back or returning boomerangs.

All boomerangs are broad in relation to their thickness, and are more or less flat on the under side and slightly arched on the upper. The long fighting or hunting type is only moderately curved, and, when sent on its course with a spinning or rotating motion, covers an effective horizontal area equal to its length, with each rotation, much as does the bolas of the South American Indians or as did the chain shot of a hundred years ago. A straight stick thrown at a man or kangaroo might, going lengthwise, just miss its objective, whereas a gyrating boomerang, taking a similar course, might easily cripple the man or break the legs of the animal. Such a weapon can be hurled 600 or 700 feet.

The returning boomerang is much shorter, seldom more than two feet in length. It is rather sharply bent, forming an elbow, and its plane is twisted so that it will not lie evenly on a table. As held by a right-handed man, the concave side is toward the body, and the inner forward edge and the outer hinder edge are raised so that when thrown, it ascends, in passing through the air, from right to left, and, forming one or more spirals, gradually falls as its impetus lessens, its speed again increasing as it approaches the earth. It strikes the ground with considerable force, often at or quite close to the feet of the thrower. Considerable agility is sometimes necessary to avoid its too accurate return.

This form of boomerang has two apparent motions in addition to those of rising and falling; it has its own extremely rapid rotation which, like the vanes of an aëroplane, sustains it in the air; it also has the slower traveling movement which carries it more or less horizontally through space.

Scissors, as ordinarily constructed, naturally cannot be used by left-handed people and, similarly, a left-handed thrower cannot use a normally right handed boomerang; weapons with reversed inclination are known, and indicate use by left-handed throwers. Since boomerang throwers, who exhibit their skill in cities or at fairs, invariably choose returning implements, it is not unreasonably supposed that, as above stated, this home-coming quality is a feature of all boomerangs. For this reason it has been presumed that the boomerang is a toy, or that the returning feature is a convenient quality designed to assist recovery of a valuable object in case the quarry has been missed. If a boomerang hits any object during the course of its flight it obviously cannot return to the thrower. I have never heard of an aborigine attempting to hit an individual object with a returning boomerang and I doubt if it could be done. It may possibly be thrown at a flock of feeding parrots or drinking cockatoos at short range, but I presume that a small hunting boomerang would be preferred for this purpose.

The following account of the employment of returning boomerangs was related to me by an old native living on the banks of the Murray River, but it refers to byegone times before white men had appeared and drained the swamps, built locks, ousted the original inhabitants, both man and beast, and otherwise changed the conditions of the country.

This special use of the returning boomerang refers to a method of netting ducks and may perhaps be best explained in conjunction with the drawing at the heading of this article.

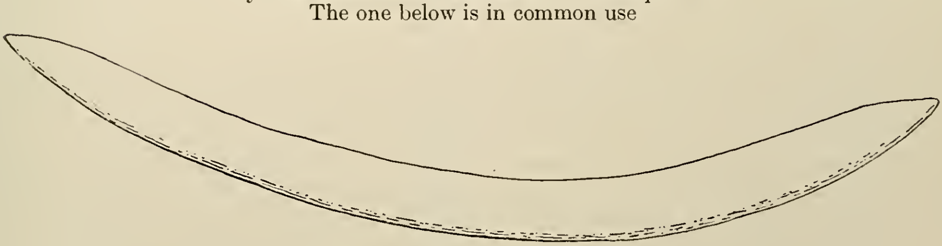
A stream entering or flowing from the *billabong*, or water hole, is previously netted over, the netting material being concealed with green boughs, rushes, etc.

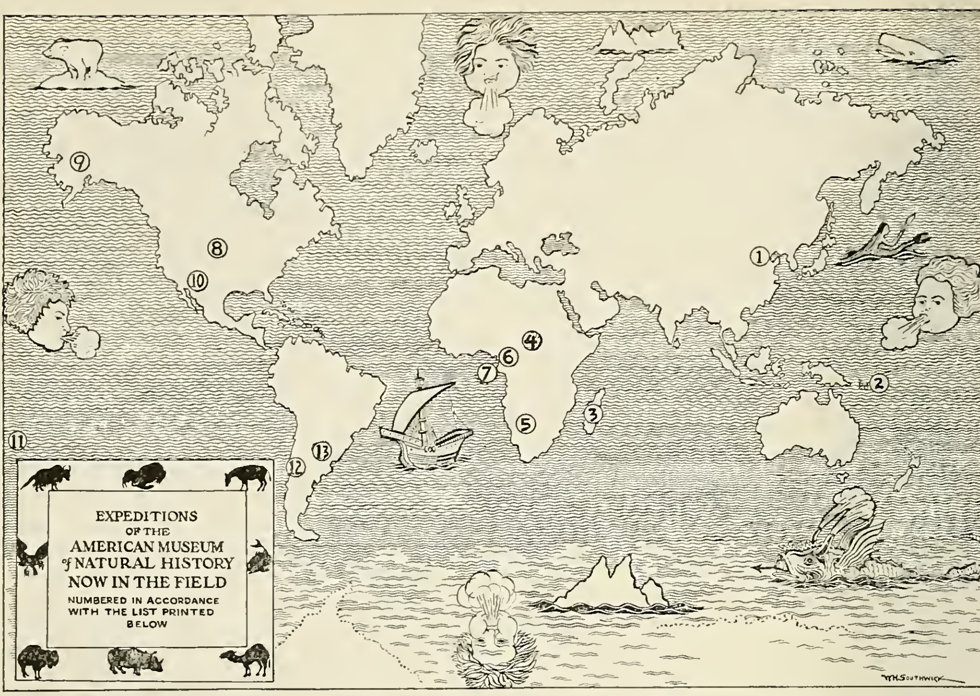
A flock of ducks has, let us say, settled on the *billabong* or water hole. By careful manœuvring on the part of hidden natives who take up strategic situations, the birds are induced to move to the position in which they are pictured. In order to effect this, the men may wade or swim under concealment of tufts of greenery held in the mouth, or the result may be attained by movements of bushes or reeds by natives distributed along the banks,—such movements being sufficient to disturb without actually alarming the birds. They are gently moved as far along the stream as possible, but as soon as they become unduly suspicious and rise to return to the middle of the water hole, as is their wont, natives concealed behind bushes fling their boomerangs into the air, and these, circling above and behind the ducks and threatening danger, as from a hawk for example, cause them to descend and rush helterskelter up stream and under the netting, where they are trapped.

The application to duck catching may conceivably be extended to the taking of small game, the boomerang being first thrown and, by arresting or changing the course of the quarry, bring it within reach of the spear or hunting boomerang with which it would be attacked. Such employment is, however, conjectural, only.

Weapons approximating the type of the fighting boomerang are known from ancient Egypt and India, but the returning boomerang appears to have originated in Australia and to be unknown elswwhere. It is not found, as far as I am aware, in waterless regions, such as parts of Central Australia. Whether first used as a toy and its utilitarian properties discovered later, or *vice versa*, will never be known.

TWO FORMS OF AUSTRALIAN BOOMERANGS
Contrary to popular belief, most boomerangs, when thrown, do not tend to return to the vicinity of the thrower. The boomerang pictured below is of the non-returning type, being only a very effective "throw stick." The more sharply curved type shown above does curve while in the air, and can be made to fly in a great curve, bringing it back more or less to the position of the thrower. This type, however, is rarely used by the Australian natives who developed it. The one below is in common use





1. Central Asiatic; 2. Whitney South Sea, Solomon Islands, for birds; 3. Madagascar, for birds, mammals, and fossils; 4. Chapin, Congo, for birds; 5. Vernay, to Africa, for mammals; 6. Columbia University-American Museum, to Africa, for anatomical study; 7. Thorne-Correia, Gulf of Guinea, for birds; 8. Frick-Falkenbach, Nebraska, for fossils; 9. Kaisen, Alaska, for fossils; 10. Frick-Rak, New Mexico, for fossils; 11. Shapiro, race mixture studies in Hawaii; 12. Olson, South America, archæological reconnaissance; 13. Naumburg-Kaempfer, Southeastern Brazil, for birds

AMERICAN MUSEUM EXPEDITIONS

EDITED BY A. KATHERINE BERGER

It is the purpose of this department to keep readers of NATURAL HISTORY *informed as to the latest news of the Museum expeditions in the field at the time the magazine goes to press. In many instances, however, the sources of information are so distant that it is not possible to include up-to-date data*

THE CENTRAL ASIATIC EXPEDITIONS.—A letter from Roy Chapman Andrews dated May 19 states that equipment is already *en route* to Mongolia and the expedition cars are in Kalgan. All permits both from Nanking and the Yen Hsi Shan government have been obtained, and the members of the expedition are ready to start the moment Doctor Teilhard and Doctor Young of the Geological Survey of China return from Manchuria on May 24.

RACIAL SURVEY OF HAWAII.—Dr. Harry L. Shapiro left New York early in July for Hawaii. He will spend the summer months there taking charge of a program of research in race mixture. This work will include particularly a study of Chinese-Hawaiian crosses, and a genetic study of the inhabitants from an anthropological point of view. He also intends to do some physiological work and make some physiological investigations. Doctor Shapiro is taking as an assistant William A. Lesser of the staff of the Presbyterian Hospital. Mr. Lesser will remain in Hawaii for two years after Doctor Shapiro's return, to carry on the project which Doctor Shapiro will direct from New York.

EXTINCT MAMMALS.—Four field parties for the search of remains of extinct Quaternary and late Tertiary mammals are being continued along the lines of previous years.

Mr. Peter Kaisen, with an assistant from the staff of President Bunnell of the College of Alaska, through the generous cooperation of the officers of the U. S. Smelting, Refining and Mining Co., is for the second season following up the vast stripping and dredging operations in the Fairbanks gold fields of Alaska. Mr. Kaisen, who has been with the American Museum more than thirty years, writes:

I have tried several kinds of transportation in fossil hunting but flying is the fastest and the easiest riding of all. . . . I never thought that I would go after fossils that way. I was at Livingood four days (50 miles northwest of Fairbanks). . . . We secured a sheep's skull . . . small goat skull . . . part of a musk-ox skull, complete bison skull and Carnivore skull . . . etc., which I brought back to the college by æroplane. . . The Alaska Airways very kindly gave us, in consideration of our particular work, a special rate of ten cents a pound which is very little more than the rate by the older means of transportation. . . . The mine interests, including Mrs. Hudson at the Hudson Mine and Mr. Douglas, are taking the greatest care to save all the bones uncovered. It was Mr. Douglas who sent the college the great male Mammoth skull. . . . It is slow picking in the Fairbanks district at the present time but they will soon open up again in the vicinity of the bone pocket at Cleary Creek. They have started also on certain deep muck where the miners tell of having dug out a lot of bones a few years ago, and where I believe we can expect a pocket sooner or later. . . .

A THIRD partial season in the Quaternary deposits in the vicinity of Hay Springs, Nebraska, is being carried on by Mr. Charles Falkenbach who obtained there a year ago a record sized skull and jaws of the great extinct bear-creature, *Arctodus nebrascensis*.

FOR the eighth summer season Mr. Joseph Rak has transferred his parties' hunt for extinct mammals of the Miocene and Pliocene from the Mohave Desert, California, to New Mexico. It is to Mr. Rak's painstaking investigations that we owe the great majority of our most important finds of the past many years. Mr. Rak himself has been incapacitated for some weeks by an abscessed foot.

AN unusually fine skull of a huge species of the extinct wolf, *Amphicyon*, has just been received from Mr. M. F. Skinner, who is operating for the fourth season in the vicinity of Ainsworth, Nebraska.

THE MORDEN-GRAVES EXPEDITION.—Two shipments have now arrived at the American Museum from this expedition. The first one comprises 150 birds and mammals from the Russian steppes Kazakstan, Central Asia, including the much-prized saiga antelopes. No less than ten species of the mammals are new to the American Museum collections, and among the birds a black lark and a grouse have not only never before been represented in the Museum's collections, but are reputed to be quite rare.

The second shipment included 200 birds and mammals from the Amur River region in Eastern Siberia, together with the three fine specimens of long-haired Siberian tiger. Two leopards collected in the vicinity of Vladivostock are of interest because of their unusually long, warm coats. Other animals represented are musk deer, wild boar, a fine series of yellow mink shrews, and rodents. Among the birds worthy of note is a series of Siberian woodpecker. These are all new and highly prized additions to the Museum collections.

The story of the Morden-Graves Expedition will appear in a later issue of NATURAL HISTORY.

CHAPIN CONGO EXPEDITION.—Dr. James P. Chapin, associate curator of birds of the eastern hemisphere at the American Museum, is now on a collecting trip in the Belgian Congo, which is made possible through a fund established by Mrs. Dwight Arven Jones. Doctor Chapin attended the Seventh International Ornithological Congress at Amsterdam with Dr. Frank M. Chapman, and from there went to Brussels to complete arrangements for his journey to the Belgian Congo. A letter from him dated June 24 stated that through the Belgian authorities he had been supplied with credentials that would greatly facilitate his work, and that he expected to sail from Antwerp the following day.

In Brussels, Doctor Chapin was joined by Franklin Edson 3d, a representative of the department of mammalogy at the American Museum, who had volunteered to assist him. The material collected by Doctor Chapin and Mr. Edson will make possible a group showing the bird life of an African tropical forest and will be a companion group to one depicting the bird life of the plains.

THE VERNAY-LANG KALAHARI EXPEDITION.—On April 29 Mr. Arthur S. Vernay cabled that his expedition had successfully traversed the center of the Kalahari Desert with important results, and that they were proceeding to Ngamiland. On June 15 another cablegram announced that the third stage of the expedition had also proved successful. The party is planning to return to Pretoria via northern Kalahari and Makarikari.

ARCHÆOLOGICAL RECONNAISSANCE IN COLORADO AND WYOMING.—Several years ago, in the course of palæontological work at the so-called bison quarry at Folsom, New Mexico, there were uncovered some peculiarly shaped stone points in association with bison bones, implements of a type not previously observed in the United States, except as sporadic finds. This association with bison bones suggested the existence of an early hunting culture, so in 1928 the department of anthropology of the American Museum, made a survey of the near-by Johnson's Mesa to discover, if possible, further traces of human occupation. This survey revealed plainly that Johnson's Mesa was not so occupied. It became necessary, therefore, to extend the search for these evidences of occupation farther afield, and in 1929, under the patronage of Mrs. Payne Whitney, Mr. R. M. Snodgrasse, a special field assistant, spent the summer in an archæological reconnaissance in the district around Yuma, Colorado. Mr. Snodgrasse will spend the field season of 1930 in a further extension of this reconnaissance to Colorado and Wyoming.

REPTILES AND AMPHIBIANS FROM CUBA.—Mr. Arthur Greenhall and Mr. J. A. Weber, who have been exploring in Cuba on expeditions financed by themselves, have recently sent the department of herpetology and experimental biology some important additions to its collections of reptiles and amphibians. Among these rarities are some large Anolis and the Cuban bullfrog.

INDIAN STUDIES.—The cultural position of Indian women will be the subject of study of Dr. Margaret Mead, assistant curator of ethnology at the American Museum, who is spending the summer months on the Indian Reservations at Omaha, Nebraska.

NOTES

ASTRONOMY

TWO ASTRONOMICAL PAINTINGS PRESENTED TO THE AMERICAN MUSEUM.—Two large oil paintings of the planet Mars, imaginary views, one from the inner moon, Phobos, and the other from the outer moon, Diemos, have been presented to the American Museum by Mr. Howard Russell Butler of Princeton. Mr. Butler was adviser to the architects in planning the Museum's hall of astronomy, and he has been for a number of years a member of the advisory committee of the department of the Museum. In recognition of his splendid gift and of Mr. Butler's services, the Trustees have elected him a Patron of the American Museum.

CONSERVATION

A WORLD MOVEMENT FOR THE PRESERVATION OF ANIMALS.—In view of the appallingly rapid extermination of wild mammalian life, it is encouraging to note the activities in connection with a world movement for the preservation of animals, chiefly mammals, as evidenced by the present work of the Society for the Preservation of the Fauna of the British Empire and the International Wild Life Committee. Just as acute and immediate is the problem of conserving whales and seals and other marine mammals. How long these rapidly diminishing herds will survive depends upon the speed with which protection is granted them through international regulations.

To be most valuable such regulations necessarily should be based upon careful investigations for the purpose of gathering all possible information on these marine mammals and on the factors which influence them. As these take time, the need for immediate action is all the more urgent.

The League of Nations has taken up the matter with great seriousness, and on April 3 held a session devoted to the question of the need for conserving the supply of whales. At this session there were present as advisors, representatives from a number of nations.

The Council for the Conservation of Whales and Other Marine Mammals, under the auspices of the American Society of Mammalogists, sent as the American representative Dr. Remington Kellogg, chairman of the Technical Committee of the Council. Doctor Kellogg reported that the experts agreed unanimously that it was possible to assist the whaling industry by international convention, and proceeded to consider what provisions could at present be recommended for inclusion in such a convention. It was recommended that there should be

Immediate and absolute protection of such species of whales as are in serious danger of extermination.
Protection of females nursing young.
Compulsory utilization of entire carcass.
Formation of an international commission to determine ways and means.

Doctor Kellogg considers that much good was accomplished at the session and that it should be productive of valuable results.

At the last annual meeting of the New York Zoological Society, Dr. Charles H. Townsend, director of the New York Aquarium, described the extent and operation of the whaling industry as it exists today, and contrasted the present-day methods with those of the Nineteenth Century. A resumé of Doctor Townsend's talk is given in another note in this issue of NATURAL HISTORY.

The rapid development of the British Dependencies of the Falkland Islands since 1904–05 has raised grave fears that Antarctic whaling by modern methods would soon come to an end because of the rapid depletion of the whales. Efforts were made by the British Government to control the industry by special regulations, but it was soon evident that more scientific knowledge was necessary. The problem was referred by the Secretary of State for the Colonies to an Interdepartmental Committee. As a result, in 1925 two vessels were sent to Antarctic waters to make an economic study of the whales and whaling grounds of the Dependencies.

The "Discovery Reports" issued by the Discovery Committee, Colonial Office, London, in 1929, on behalf of the Government of the Dependencies of the Falkland Islands, give a most interesting and informing account of the investigations, the ships, their equipment, the methods used in research, and the marine biological station at South Georgia. The work is still in progress, and as fresh data is accumulated, presentation of results will proceed simultaneously.

The following very latest statistics received from Oslo, Norway, for the last four years, show the tremendous growth of the whale oil industry.

PRODUCTION OF WHALE OIL

Barrels of Whale Oil	
793,790	1926–27
991,936	1927–28
1,540,200	1928–29
2,447,690	1929–30

The speed with which whale oil has been produced has glutted the market. American buyers, therefore, have two years' supply on hand, and will not purchase more except at greatly reduced prices.

It is estimated that the animals that remain will suffice for only two years more of whaling in the Antarctic—the last stronghold of the whales. This will be the end, unless something is done, and done quickly to preserve this last remnant from complete extermination.

THE VANISHING WHALE AND THE WHALING INDUSTRY.—The increasing drain on the stock of whales by the modern methods of whaling as contrasted with those of the Nineteenth Century was vividly set forth at the last annual meeting of the New York Zoological Society by Director C. H. Townsend, who is and for many years has been one of the foremost authorities in America on whales and other marine mammals. An excellent description by Director Townsend of what is now going on in the whaling industry, and of the efforts of conservationists to secure international regulations for its control, appears in the January–February, 1930, issue of the Bulletin of the Society.

The United States, once leader in the industry, no longer takes active part in it, says Doctor Townsend, save to a very limited extent in California and Alaska. Much of the information, therefore, comes from foreign sources.

The Whaling Committee of the International Council for the Exploration of the Sea, when discussing the subject of whale conservation early in 1930, felt strongly that "the enormous expansion of the whaling industry constitutes a real menace to the maintenance of the stock of whales, and if the expansion is continued at the present rate, there is real risk of these stocks being so reduced as to cause serious detriment to the industry."

Permanent measures of protection would be possible only after scientific researches have reached a definite conclusion, but temporary measures are strongly urged to include the prohibition of the killing of certain species of whales, principally right whales, the protection of cows with calves, immature whales, and the prohibition or restriction of the capture of whales in certain regions, notably in the tropics.

The Norwegian parliament has forbidden all Norwegian whalers to kill the right whale and all whale cows with calves. Whaling crews can no longer be paid according to the number of whales taken, and all parts of the animal containing oil must be used.

Today the methods by which the whaling industry is carried on are vastly more efficient than those in use in the Nineteenth Century. In those days only the slower moving whales, such as the sperm and the right whale, fell to the catch of the old-time whaler, but the present-day floating factories with their steam hunting boats and their enormously expensive equipment make possible the capture and disposition of the great blue whale, the finback, the humpback, the sei whale and others too speedy for open whale boats, and yield proportionately greater profits.

The larger vessels now being built are provided with slips through which all whales are pulled on board before being cut up. Some of the factory steamers already in use exceed more than 12,000 tons in size, and the "Kosmos" which recently began operations in the Ross Sea section exceeds 22,000 tons. It is accompanied by seven steam hunting boats and an airplane. There is a working deck for oil production and one for the preparation of fertilizer. Provision is also made for the canning of whale meat. Six or eight large blue whales a day, and more than twice as many of the smaller kinds, can usually be disposed of by the larger floating factories. The yield from the larger blue whales may be as much as seventy-five barrels of oil apiece, and from humpback and fin whales about half as much. The value of whale oil is greater than ever before, being worth about $26 a barrel. Soap-making industries purchase it in large quantities.

Whaling as now carried on is largely a Norwegian industry. The greater part of the catch is made in Antarctic waters, and amounts to about 70 per cent of the catch in all parts of the world. More than 20,000 whales have been killed annually in the Antarctic during recent years, and in addition to the shore stations at South Georgia and other Antarctic islands, during 1928–29, according to Director Townsend, there were eight floating factories. The catches made by the "Sir James Ross" and the "C. A. Larson" totaled 1306 whales and yielded 126,000 barrels of oil valued at more than $3,000,000.

Dispatches from Norway in August of 1929 announced that the most important preparations for the new season of Antarctic whaling ever recorded, namely a fleet of 190 steam hunting boats, 37 factory steamers, and 7 transport steamers are under way.

The Society for the Preservation of the Fauna of the British Empire.—At a meeting held April 28, the executive committee of the Society for the Preservation of the Fauna of the Empire passed a formal resolution expressing its gratitude to the members of the American Committee for their splendid effort made on behalf of wild life conservation, which has resulted in substantial assistance at a moment when an extension of influence is essential.

Del Norte Coast State Park.—Forever protected from defacement through its new status, Del Norte Coast State Park, a region nearly 2500 acres in extent, combining giant redwoods and seacoast scenery, henceforth is to be preserved for the people of California and the nation by the completion of the Del Norte Coast Project of the Save-the-Redwoods League and the California State Park Commission. Mr. J. C. Perry, councilor of the League and chairman of the committee having the project in hand, reported to the members and officers of the League that through private contributions, matched with funds from the State Park Board Issue, this area becomes a part of the California State Park System.

The Del Norte Coast Park is one of the four primary projects of the League. Those who have traveled California's Redwood Highway where it winds above the Pacific Ocean about ten miles south of Crescent City, Del Norte County, will remember this stand of giant redwoods. Its beauty is enhanced by the fact that in addition to the five miles of highway through the forest, the project includes more than seven miles of ocean frontage, the highway at times taking its course close to 1,000 feet above the shoreline. Many consider the stretch of highway in this new park area one of the most spectacular drives in the world.

Through the efforts of the Save-the-Redwoods League, redwood lands totaling 3,589 acres and representing a valuation of approximately $6,000,000 have been acquired since June, 1928.

EXPERIMENTAL BIOLOGY

Arboreal Salamanders of Kentucky.—Mrs. S. H. Pope recently made a trip to Pine Mountain, Kentucky, where with the help of the boys of Pine Mountain Settlement School, she brought together a large collection of the rare arboreal salamander, *Aneides æneus*. These specimens were shipped alive to the American Museum laboratories of experimental biology, where their courtship is being studied under controlled conditions of the dark room. The courtship of no plethodontid salamander was known before the department began its studies. Many plenthodontids have extraordinary secondary sexual characteristics, such as elongated front teeth and peculiar glands scattered over the body of the male. The courtship of these salamanders turns out to be very complex and closely correlated with the peculiar modifications found in the males.

The Most Primitive of Living Tetrapods.—The primitive family of frogs includes only *Ascaphus* of the New World and *Liopelma* of New Zealand. For some years the department of experimental biology has been making both anatomical and experimental studies of *Ascaphus*. This year Mr. Phillips Putnam again went into the field to study and collect *Ascaphus* in its native brooks. The species lives in the Olympic Mountains, in streams flowing from glaciers. While the common frogs become inactive in water temperatures approaching freezing, *Ascaphus* revels in water flowing directly from the ice fields. The tadpole is extraordinarily modified for holding on to rocks in the swift water of glacial streams. Very little is known about the early development of the species. The department is planning to breed *Ascaphus* in the Museum laboratories under controlled conditions and to study its early development.

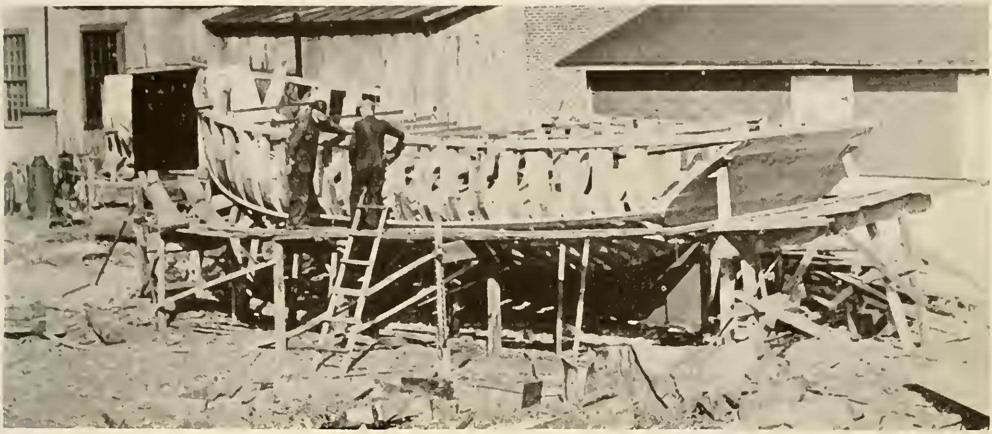
MAMMALS

On The Extinction of Mammals in the Lorian Swamp During the Drought of 1928.—Captain Alexander T. Curle, writing from his present residence in British Somaliland, has contributed some very interesting notes on the terrible conditions in the Lorian Swamp during the drought of May, 1928. The Lorian Swamp is situated in the Northern Frontier Province of Kenya Colony, (Lat. 0° 58′ 03″; Long. 39° 49′ 16″) at an altitude of 691 feet and covers an area of about five by three miles. The River Uaso Nyiro runs into the Swamp, which is covered by dense papyrus grass over six feet in height, flooding it in normal season with about six inches of surface water and disappearing into the mud. In May, 1928, owing to the failure of the rains, the river discontinued its flow into the Swamp; only a series of isolated pools about eight or ten feet in width remained in the middle along the channel of the river. One pool about four feet below the level of the bank and consisting of mud to a depth of three feet was practically a solid mass of hundreds of fish (Siluroids) many of which had died so that the odor was terrific. Another pool contained crocodiles, all small and living; still another was jammed with fish, and hippopotami packed closely together with their heads under the mud. One hippopotamus was driven out of the pool, tormented by the nibbling of the fish at a gash in its side. Farther down the Swamp natives had dug wells to a depth of twelve feet in the dry river bed and into one of these a small elephant had fallen and could not be removed. During the fortnight Captain Curle and his companions were in the region six elephants had died of thirst. They were small, as elephants go, somewhat over three-quarters grown. Other elephants, maddened by thirst, had killed a camel and some goats, while hundreds of elephants were seen daily in the Swamp searching for water. Most of these were small tuskers, the older animals having made the waterless trek across to the Tana River. A similar drought is reported to have occurred in 1912, but to have been not nearly so severe as the drought of 1928. H. F. O.

HERPETOLOGY

A NEW ALLIGATOR ON EXHIBITION.—Large alligators are today very rare because of the depredations of the skin hunters. The American Museum is, therefore, fortunate in being able to place on exhibition a full grown specimen of the American alligator recently presented by the New York Zoological Society. The specimen has been mounted by Mr. Walter Escherich in a very life-like position. It will replace the old alligator which has been on exhibition for some years in the Reptile Hall.

REPTILE AND AMPHIBIAN STUDY.—Small tropical islands are frequently rich in reptile life, and colonies of lizards are known to occur on various uninhabited islands. There are many problems connected with the organization of lizard colonies which have an important bearing on the social organization of higher groups of vertebrates. Mr. Gilbert C. Klingel, of Baltimore, Maryland, who has recently published an article in NATURAL HISTORY on his work in Haiti, is planning to continue his studies of the reptiles and amphibians in the West Indies and Central America, and for this purpose is building a vessel which will be an exact replica of the famous "Spray." The expedition will be under the auspices of the American Museum, and will leave New York late in the fall. A year and a half will be spent in the West Indies and along both coasts of Central America.



THE "BASILISK" UNDER CONSTRUCTION
The boat in which Mr. Gilbert C. Klingel will travel for a year and a half, and which is an exact replica of the famous "Spray"

FISHES

A BASKING SHARK FOR THE AMERICAN MUSEUM.—The department of ichthyology has recently acquired a fine specimen of the basking shark *Cetorhinus maximus*. This fish became entangled in the gill net of Messrs. Carl Holgerson and Edwin Gustafson off Long Branch, New Jersey, on June 5. These men managed to get it ashore where it was preserved in the freezer of the Monmouth Beach Fish Company. News of this shark reached the Museum through the kindness of Mr. Morris Ranger of this city. Dr. E. W. Gudger went down on June 9 and

"THE HEAD OF A MARTINIQUE WOMAN"
By Malvina Hoffman
Presented to the American Museum by Lincoln Ellsworth

purchased it. On June 11 it was brought up by truck frozen solid as a log. While in this condition it was measured and photographed and a color sketch was made. On June 12 when it had thawed out, more photographs were taken, a plaster cast was made, the skin was removed and the head and mouth and gill structures preserved as a whole.

From the data and materials at hand it will be possible to make a fine mount for the Hall of Fishes. (The only mounted specimen at present on exhibition in the United States is in the Boston Society of Natural History). The head and attached gill parts will furnish material for study of the structures with which it feeds. It is called "bone shark" because it has whalebone—like horny gill rakers with which it sieves out the small crustacea and other food materials from the great volume of water passing into its cavernous mouth and out of its enormous gill slits. The specimen, a half grown female, measured 14 feet, 3 inches between perpendiculars.

HISTORY OF THE EARTH

MEDITERRANEAN LAND BRIDGES.—For a long time students of Pleistocene faunal distribution in southern Europe and northern Africa have assumed or claimed evidences of former land connections between the two continents both by way of Sicily and over what is now the Strait of Gibraltar. In the Journal of the Royal Anthropological Institute for Jan.-June, 1928, Miss Dorothea M. A. Bate published among other items, a list of more than twenty-five mammal species found in a small Gibraltar cave associated with cultural and osseous remains of the Neanderthal man. Her conclusions are that "the evidence provided by both the mammalian and avian faunas indicates that there was *no* land connection at this point with the opposite African Coast in Mousterian times" (p. 92).

Recently a reprint was received from Prof. R. Vaufrey, of the Institut de Paleontologie Humaine, Paris, dealing at some length with the question of the supposed Tunis-Sicily-Italy isthmus. The article appears in the *Revue de Geographie Physique et de Geologie Dynamique* for December, 1929, and is entitled "La Question des Isthmes Mediterranéens Pleistocenes." The author's negative conclusions, given under three separate heads, may be rendered in translations as follows:

1. *Evidence of submarine geography.* Contrary to the conclusions accepted before the war from examination of the marine charts, the submersion of the continental shelf was not in itself sufficient—"at a depth of some ten or twelve meters"—to join Cap Bon of Tunis to Sicily. Figuring from the most recent soundings it is apparent that it would need a retreat of water of nearly 400 meters to enable one to pass dry shod from Tunis to Sicily.

2. *Evidence of archæology.* We have seen that man probably did not reach Sicily for the first time until the end of the Upper Paleolithic. The maps showing the distribution of industries, such as often figure in recent treatises, are therefore erroneous. Instead of a shaded area it is a blank which must be understood to exist throughout all Calabria to the south of the 40th degree of latitude and in Sicily, during all the Chellean and Mousterian. Opposite, on the African shore, there are no ancient industries in the north, from a line drawn from Bougie to Gafsa. Rare indeed are the traces of Upper Paleolithic industries, as I was able to prove in 1926 during my survey of this region. These facts are not favorable to the hypothesis of a Sicilian-Tunisian land bridge, which, if it had existed in the last interglacial epoch, must have been the ground for active faunal interchanges, especially marked by the passage of man.

3. *Evidence of paleontology.* There is therefore no evidence found either in Sicily or in Malta

of the Chellean, the Acheulean, or the Mousterian cultures. Accompanied by only a few other mammals, the hippopotami and fossil elephants are the sole masters of the isle; these animals came from Europe, not from Africa. These latter, caught in a cul-de-sac, barely continued existence up to a period probably contemporary with the beginning of the Upper Paleolithic and developed their dwarfed mutations, such as the pigmy elephant and hippopotamus. Had a Sicilian-Tunisian land connection existed, would they not have inevitably ebbed again to Africa? But no dwarf elephant has been found in Africa, for the *E. Melitensis* of Palikao is imaginary. On the contrary, the African fauna is easily distinguishable from that of the Pleistocene of Europe, and especially from that of Sicily, by the abundance of antelopes, gazelles, a few deer, camels, giraffes, and buffaloes. No single point of contact is possible between the two faunas, so different both in the number of species and in their affinities. It is through Syria, as evidenced by recent paleontological discoveries in Galilee, that the cryptogenic elements, namely the fossil mammals preserved in the caverns of Sicily and Malta have infiltrated with the north African Pleistocene fauna: deer, cervids, bears, cats, hyenas.—H. F. O.

ICELAND MILLENNIUM

AMERICAN EVERGREEN TREES PRESENTED TO ICELAND.—Dr. Clyde Fisher, of the American Museum of Natural History, sailed from New York on June 17 bound for Iceland on a mission for the New York Bird and Tree Club of which he is president. He will also visit Norway, Denmark, and Sweden, where he expects to take photographs for the educational work of the American Museum. Doctor Fisher took with him as a gift from the New York Bird and Tree Club to the people of Iceland several crates of small American evergreen trees, as well as the promise of seedlings to be sent in the coming fall and spring. These were presented at the millennial celebration of the founding of the government of Iceland, the oldest parliament in existence. This gift combines a gesture of international friendliness with the interesting horticultural experiment of trying to re-establish trees on this island that once grew forests.

INSECTS

OUTDOOR MUSEUM INSPECTION.—Dr. Frank E. Lutz, curator of insect life and outdoor education at the American Museum left the latter part of June for Yellowstone National Park. As a representative of the American Association of Museum's committee on outdoor museums, he will visit the nature trails and trailside museums connected with the National Park to give helpful advice regarding these projects. Doctor Lutz will also investigate the ecology of the hot springs.

HOFFMAN SCULPTURES

MUSEUM ACQUISITIONS.—Three striking sculptures by Malvina Hoffman have recently been acquired by the American Museum. Two of these, "The Head of a Martinique Woman" and "The Head of a Senegalese Soldier," were presented by Lincoln Ellsworth as a memorial to his sister, Mrs. Clare Ellsworth Prentice. They have been placed temporarily in the Hall of Minerals, but will be on permanent exhibit in the African Hall when it is completed.

The third sculpture entitled "The Coal Man," is especially remarkable for the fact that Belgium coal was the medium used. The coal was treated by a process which prevents the carbon from rubbing off and hardens the coal sufficiently to be handled by the sculptor. "The Coal Man" is now on view in the Hall of Geology.

Another example of Miss Hoffman's art which has been on exhibition in the Hall of Forestry at

"THE HEAD OF A SENEGALESE SOLDIER"
By Malvina Hoffman
Presented to the American Museum by Lincoln Ellsworth

the American Museum for ten years is a bust of John Muir. Miss Hoffman's sculptures have achieved for her a world-wide reputation, and the Museum is most fortunate to be recipient of these valuable gifts.

Miss Hoffman is now engaged on a series of racial groups for the Field Museum.

MEETINGS OF SOCIETIES

THE AMERICAN SOCIETY OF MAMMALOGISTS MEETS.—The convention of the American Society of Mammalogists, which met at the American Museum of Natural History from May 20 to 24, had the greatest attendance of any meeting in the Society's history. This was due in large measure to the widespread interest taken in the three symposia which occupied most of the program. These were on the conservation of predatory mammals, particularly the coyote; the gorilla and its place among the primates; and the zoological parks as centers for research.

The general program covered a wide field. The life histories of the chipmunk and the raccoon were detailed. The overcrowding of deer in Pennsylvania was discussed. Fine motion pictures of muskoxen, giant Alaskan brown bear, lions, gorillas, and other African animals were shown. One paper demonstrated the occurrence of two races of a single species of deer-mouse in one area. This was shown to be possible by reason of the different habitat preferences of the two races. An account was given of the testing of the strengths of various internal drives of the white rat, and it was shown that the maternal drive was stronger than all others. Another test, on the learning ability of kittens, demonstrated that there was a remarkable, though individually variable, degree of ability among them.

The gorilla was discussed by many of the country's authorities. Its behavior both in the forest and in the laboratory, as well as many parts of its anatomy were thoroughly described, and considered in the light of the gorillas' probable relation to man.

In Defense of Coyotes

The chief interest in the meeting centered around conservation. The United States Biological Survey has for fifteen years been at work attempting to control the coyote, which occasionally makes serious inroads upon young stock on the western ranges. While it is universally agreed that control measures are necessary, there is well-founded criticism of the results obtained by the present method of distributing poisoned baits with the result that all flesh-eating fur bearers are killed without discrimination. It also has yet to be demonstrated that, in general, the coyote does more harm than good, for the animal feeds very generally on rabbits and other rodents which the government must in turn poison when their populations are unchecked by natural enemies. In expression of its conviction that the bill now before Congress to increase appropriations for predatory animal control without adequate research to establish the desirability of such control, the Society passed the following Resolution:

Whereas: The American Society of Mammalogists, a group of over 1000 naturalists, is vitally concerned with the welfare and preservation, of all kinds of wild mammals; and

Whereas: We heartily approve the stated policy of the Bureau of Biological Survey of the United States Department of Agriculture not to carry control measures to the point of extermination, and hope that field practice will conform strictly to this policy; and

Whereas; Nevertheless, many valuable mammals have been destroyed by the methods of control now being used by the Biological Survey and coöperating agencies; therefore,

BE IT RESOLVED: That campaigns for the destruction of predatory mammals should be conducted only in those localities where scientific study has shown that such control measures are necessary for the general public welfare and are not solely for the benefit of some special interest; and

BE IT RESOLVED: That the use of poison for the control of predatory mammals should be abandoned, except in case of absolute necessity, such as might arise during the outbreak of rabies in coyotes.

Alaskan Brown Bears Threatened

The largest of living land carnivores are the brown bears of Alaska. Protection previously accorded them has recently been removed, with the result that their extermination must soon follow if protection over at least part of their range is not immediately restored. To furnish a sanctuary where the bears might continue without danger to man, the Society urges that certain little-inhabited islands be set aside for the purpose. The following two Resolutions urging the protection of the brown bear were passed:

Whereas: The natural habitats of the grizzly and brown bears of Alaska are now being claimed by Civilization, which threatens their complete extermination; and,

Whereas; The islands of Admiralty and Chichagof, located in Southeastern Alaska, are now populated by grizzly and brown bears of several species, and are ideally situated both by reason of location, size, and physical topography to be permanent sanctuaries for these animals; therefore,

BE IT RESOLVED: That the proper governmental authorities be urged to set aside the said islands, Admiralty and Chichagof, as inviolate sanctuaries for the Alaskan brown bear and grizzly bear in order that these two characteristic American animals may be protected and preserved.

Whereas: The Alaska Game Commission by amendments to the Alaska Game Law, which will become effective July 1, 1930, have removed all restrictions on the killing of grizzly and brown bears by residents, except in several comparatively small areas; and,

Whereas: The removal of these restrictions will endanger the existence of these species; and,

Whereas; The grizzly bear is fast becoming extinct in the United States and has been lessened greatly in numbers in Alaska in recent years by intensive hunting; therefore,

BE IT RESOLVED: That the American Society of Mammalogists deplores the action of the Alaska Game Commission in removing restrictions on the killing of grizzly and brown bears by residents of Alaska; and,

BE IT FURTHER RESOLVED: That copies of this resolution be sent to the Members of Congress and the Senate; to the Chief of the United States Biological Survey; and to the Alaska Game Commission, urging that steps be promptly taken to the end that the protection now accorded these animals be continued.

Those interested in these conservation measures should communicate with Mr. John Holzworth, White Plains, N. Y. —Robert T. Hatt.

At the American Association of Museums meeting held at Buffalo, June 4–8, a new scientific section was established under the chairmanship of Dr. Roy Waldo Miner, curator of lower invertebrates, American Museum, and with Director Charles J. Fish of the Buffalo Museum of Science as section secretary. The purpose of the section is to organize programs of particular interest to scientific curators and those associated with them in various museums.

This newly formed section was well attended and received an enthusiastic backing. The following program was presented:

I. Introduction by Doctor Miner.
II. Making Scientific Collections.
"Field Work for a Scientific Museum" by Doctor Fish.
III. Analyzing Scientific Collections.
"Problems of the Study of Scientific Material in the Museum," by Dr. Waldo L. Schmitt of the U. S. National Museum.
IV. Utilizing the Scientific Collections.
"The Use of Living Material in the Museum," by Dr. Frank E. Lutz of the American Museum of Natural History.

These papers were discussed at length.

The Thirteenth Annual Meeting of the American Society of Ichthyologists and Herpetologists was held in the American Museum, May 20–21. Twenty papers were read by members of the Society, and eighteen demonstrations were presented. Among the special features was a symposium on The Flight of Fishes, and a discussion of the Origin of the West Indian Fauna. Some very unusual motion pictures were shown by Mr. Gilbert C. Klingel and Mrs. Grace Olive Wiley. A large part of the program was given by the staff of the departments of fishes and reptiles of the American Museum.

MINERALS

Iceland Millennium 930–1930.—June 26, 1930, commemorates the one-thousandth anniversary of the establishment of the Althing, the national assembly of Iceland. The department of mineralogy of the American Museum gave recognition in its exhibition hall of this millennium by attaching small paper reproductions of the flag of Iceland to the mounts of the 40 mineral specimens from that island, which included zeolitic minerals and the Iceland spar variety of calcite. A placard calling attention to the marked Iceland minerals was placed in a prominent position in the Morgan Gem Hall.

SCIENCE OF MAN

Mexican Archæology.—The excavations at Ticoman, Federal District, Mexico, carried on by Dr. George C. Vaillant of the division of anthropology of the American Museum, from November, 1929, to March, 1930, yielded additional data for the early cultures in the Valley of Mexico. At Zacatenco the previous year, three chronological phases were established, of which the latest, Late Zacatenco, seemed to represent a strong intrusive influence. At Ticoman this late period of Zacatenco becomes the earlier of two phases closely related ethnically but showing increased artistic and technical development chronologically. As yet, however, no link with the great Toltec pyramids of San Juan, Teotihuacan, has been found. A small series of skulls examined hastily by Dr. H. L. Shapiro of the American Museum showed traits indicative of an actual shift in population between the inhabitants of Ticoman and those of the early two phases of Zacatenco, substantiating the evidence of the artifacts. Information was collected that the level of the lake on which Zacatenco and Ticoman are situated was much lower in the Early Zacatenco Period, but owing to some blocking of the outlets in the Middle Period, the rise in the lake drove the population up the hills along the shores.

S. BRINKERHOFF THORNE

On June 3 last, Mr. S. Brinckerhoff Thorne, member of the Board of Trustees of the American Museum since January, 1928, and Secretary of the Museum since January, 1930, died at New York in his 57th year.

His wise counsel, his sincere enthusiasm for the Museum and its work, will be greatly missed by his colleagues.

At a memorial meeting of the Board of Trustees, President Henry Fairfield Osborn paid the following tribute to Mr. Thorne:

> The sudden death on June 3, 1930, of Mr. S. Brinckerhoff Thorne, recently elected Secretary of The American Museum of Natural History to succeed the late Mr. Percy R. Pyne, is an inexpressibly sad blow to the institution. For his deep interest in the welfare and progress of the Museum united with his many endearing personal qualities he was admired and esteemed by all his fellow Trustees as well as by an ever-widening circle of friends in this community. Since he came on the Board some years ago his especial interests have been in the Department of Birds in support of his college mate and friend, Doctor Leonard C. Sanford of New Haven. He contributed most generously to several of the bird collecting expeditions in the far east and was rapidly becoming one of the most influential and useful members of our Board.
>
> Personally I was greatly attached to him and to his family with which I have been associated for three generations in the American Museum, in the Zoölogical Park and in other philanthropic enterprises. I also vividly recall him when as a brilliant end rusher of the Yale University eleven, he was a widely-known and honored figure in the college athletic world. It seems very hard that we should lose from our none too large circle of public-spirited citizens such a man as this in the very prime of life and in the high tide of usefulness and unselfish devotion to the public welfare.

It was resolved that this tribute be adopted and incorporated in the minutes of the Trustees as an expression of their high esteem and affection for their late colleague.

ERRATUM

IN the March–April issue of Natural History, the caption for the illustration on page 148 which read "The towering peaks of the Three Brothers and the Yosemite Falls are outlined on the right" was incorrect. It should have been "The towering peaks of the Cathedral Rocks and Bridal-veil Falls are outlined on the right."

CONTRIBUTORS TO THIS ISSUE

Capt. C. W. R. Knight, the author of "Photographing the Ospreys of Gardiner's Island," is a widely known lecturer and photographer of birds. He began his photographic studies before the World War and even managed to carry them on during part of the time he spent in the front line trenches, making pictures of the small birds which frequented No Man's Land. Captain Knight's film of the golden eagle is an especially fine piece of photography and shows the life history of this impressive bird. His article in this number of NATURAL HISTORY relates his experiences in filming ospreys during the summer of 1929, which he spent on Gardiner's Island, situated off the eastern end of Long Island. Captain Knight is the author also of several books on birds, as well as of many magazine articles on eagles, hawks, and falconry.

"With Brush and Palette in the South Seas" by **Miss Caroline Mytinger** tells of some of the obstacles of portrait painting among aborigines. Accompanied only by a woman friend, Miss Mytinger spent four years in the South Seas, a trip which she engineered and financed herself. She is the first person to bring back from these tropic islands any considerable number of paintings which accurately portray fast-disappearing types of man. These paintings, which for some time were on exhibit at the American Museum, are a valuable record of the charm and diversity of these Melanesian peoples.

Dr. Hugo Obermaier, whose article "Altamira—The Cavern of the Stone Age Artists" appears in this issue of NATURAL HISTORY, is one of the world's foremost archæologists. For many years he was associated with Henri Breuil in the Institut de Paleontologie Humaine in Paris. With l'Abbé Breuil, and under the tutelage of Emile Cartailhac, Doctor Obermaier's life has been especially devoted to work in northern Spain. For nearly ten years he has been professor of the prehistory of man in the University of Madrid. His greatest works are *Der Mensch der Vorzeit*, which was published in 1912; and *El Hombre Fosil*, which appeared in 1916, and which is regarded by archæologists of Europe as the most authoritative and up-to-date work on the prehistory of Europe.

Edgar R. Waite, the author of "The Australian Boomerang," was director of the South Australian Museum from 1914 until his death in 1928. From 1888, when he was given his first scientific appointment as sub-curator of the Leeds Museum, Mr. Waite led an active life in his chosen field of museum management. He also undertook considerable editorial work in connection with scientific and natural history publications, and was the author of numerous papers dealing with mammals, birds, fishes, reptiles, amphibians, and some ethnological subjects.

The cover design for this issue of NATURAL HISTORY is from a painting by **Francis L. Jaques** of the American Museum's department of preparation, and is based on the still and motion picture photographs by Captain Knight, the author of "Photographing the Ospreys of Gardiner's Island." The osprey, illustrated in the painting, is one of the most interesting of fish hawks, and Mr. Jaques has caught the bird in a characteristic pose as it is about to seize a fish that is near the surface of the water. Captain Knight's exceptional motion pictures show clearly that upon striking, the osprey often disappears for a moment beneath the water in its attack upon its prey.

Facts concerning other authors have appeared in previous issues of NATURAL HISTORY.

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FOUNDED IN 1869

MEMBERSHIP MORE THAN TWELVE THOUSAND

For the enrichment of its collections, for the support of its explorations and scientific research, and for the maintenance of its publications, the American Museum of Natural History is dependent wholly upon membership fees and the generosity of friends. More than 12,000 members are now enrolled who are thus supporting the work of the Museum. The various classes of membership are:

Associate Member (nonresident)*	annually	$3
Annual Member	annually	$10
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FREE TO MEMBERS

NATURAL HISTORY: JOURNAL OF THE AMERICAN MUSEUM

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

AUTUMN AND SPRING COURSES OF POPULAR LECTURES

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

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

MEMBERS' CLUB ROOM AND GUIDE SERVICE

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

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EDUCATION

RESEARCH
EXPLORATION

SIXTY years of public and scientific service have won for the American Museum of Natural History a position of recognized importance in the educational and scientific life of the nation and in the progress of civilization throughout the world. With every passing year the influence of the Museum widens, as is witnessed by the increasing number of visitors who daily enter its halls without the payment of any admission fee whatever.

THE NEW SCHOOL SERVICE BUILDING, with the increased facilities it offers, makes it possible to augment greatly the Museum's work not only in New York City schools but also throughout the country. About thirteen million contacts were made during 1929 with boys and girls in the public schools of New York and the vicinity alone. Inquiries from all over the United States, and even from many foreign countries, are constantly coming to the School Service Department. Information is supplied to, and thousands of lantern slides are prepared at cost for distant educational institutions, and the American Museum, because of this and other phases of its work, can properly be considered not a local, but a national—even an international—institution. Through its loan collections, or "traveling museums," which are circulated locally, 557 schools were reached last year, and 1,857,729 direct contacts were made with the pupils. More than a million lantern slides were lent to the New York City schools, and 4,297 reels of the Museum's motion pictures were shown in 271 public schools and other educational institutions in Greater New York, reaching 1,725,865 children.

COLLEGE AND UNIVERSITY SERVICE. The President and the Curator of Public Education have extended and intensified the courses of college and university instruction. Among the institutions with which the Museum is coöperating are Columbia University, New York University, College of the City of New York, Hunter College, Rutgers College, University of Vermont, Lafayette College, and Yale University.

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

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

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

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

EXPEDITIONS from the American Museum are constantly in the field, gathering information in many odd corners of the world. During 1929 thirty expeditions visited scores of different spots in North, South, and Central America, Europe, Asia, Africa, and Polynesia, and nearly as many are now in the field continuing last year's work or beginning new studies.

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

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

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Sept.-Oct.
1930

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VOLUME XXX
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SEPT.-OCT.
1930

The Journal of The American Museum of Natural History

HAWTHORNE DANIEL
Editor

A. KATHERINE BERGER
Associate Editor

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A MODERN CITADEL OF SCIENCE

Like the stronghold of knowledge that it is, the American Museum of Natural History looms up in this picture from an appropriate natural setting. This view, showing the southeast tower, was taken from Central Park

VOLUME XXX

NATURAL HISTORY

NUMBER FIVE

SEPTEMBER-OCTOBER, 1930

THE INSPIRATION OF NATURE

ON a scale hitherto unknown the American Museum of Natural History is advancing the knowledge and inspiration of Nature. Its activities encompass the globe and all prehistoric time, through vast ages to the feeblest beginnings of life. While chiefly recording the present life of the world, the study of the living races of man leads us back through the long human ancestral period and finally step by step through the increasingly long chapters which fill up the whole record of a billion years.

The field of Nature is limitless. Discoveries lead to discoveries in geometric progression. The more we learn, the more we learn to look for. The world today is the sum total of what we know about it; tomorrow's discoveries will show a different and richer world, which can best be defined and interpreted by such an institution as this Museum,—and then only as the Museum continues to search, to collect, and to evaluate.

Looking backward some six decades to the Museum's first foundation, which has been built upon so mightily, there is a temptation to congratulate ourselves upon gathering one of the vastest and most valuable natural history collections—upon bringing "the world under one roof." Yet we cannot be satisfied, for from this very achievement rises a new and ever-widening obligation to disseminate and diffuse this slowly gathered knowledge as broadly as possible, for from a knowledge of Nature come all health and all wealth.

This future usefulness, for which a spacious vista opens, depends upon the same factor that has made the Museum so fruitful in the past—an appreciation of its work and aims, which is ever the stimulus of the generous financial support hitherto accorded by the people of this community and country. Now that the American Museum faces the need for completion of its Sixtieth Anniversary Fund of $10,000,000 in order that our broad and significant searchings after world-wide truth may not falter, a summary of the Museum's activities seems timely in these pages of NATURAL HISTORY, which for thirty years have conveyed more of the Museum's achievements and results than of the essential means used in its attainment.

Complete description of the Museum and its work would require several volumes. Hence, though forming the first account, appearing in a single issue, of the principal Museum activities—Exploration, Research, Preparation and Exhibition, Education, and Publication—the following articles by Museum people are, perforce, summaries only. They are submitted, nevertheless, with the earnest hope that they may convey to the readers of NATURAL HISTORY new and stimulating glimpses into the methods, enterprises, and problems of the American Museum.

Henry Fairfield Osborn.

THE AMERICAN MUSEUM OF NATURAL HISTORY

A Brief Statement of Its Inception and Growth

As life on this earth had small beginnings, so had the American Museum of Natural History. Influenced by his teacher, Louis Agassiz, Albert S. Bickmore, while yet a student, conceived the idea that a great natural history museum should be established in New York City. This view he broached first to William Earle Dodge, 2d, and later to the elder Theodore Roosevelt, both of whom were destined to become founders. Presenting a well-matured plan, the young man eventually obtained through them the interest and activity of a remarkable group, in which were New York's great business and civic leaders of the day.

After making a tentative agreement with the Commissioners of Central Park as to housing and an approach to citizens for funds with which to purchase important collections, this group organized the first Board of Trustees of the American Museum. In its statement of the aims of the Founders, the first annual report was prophetic. In part it said:

"That, recognizing the necessity of such a Museum as a means of education and recreation, and desiring its establishment upon a scale commensurate with the wealth and importance of our great city . . . we have, if properly supported and aided with funds by our fellow citizens, a guarantee of a prosperous future in the formation of a Museum of Natural History that will be second to none, and which, while affording amusement and instruction to the public, will be the means of teaching our youth to appreciate the wonderful works of the Creator."

The same vision was in the minds of the park commissioners, who, on December 30, 1868, accepted the responsibility of "the establishment of a Museum in the Park that shall become an aid in the great educational system of the city, concentrate and develop scientific efforts in all branches of natural history, and at the same time be an instructive and acceptable resort for the people of the city, and for the throng of strangers that visit it."

The outcome was the establishment of a principle of operation and support, since widely adopted elsewhere, which was embodied in a wise and workable agreement drawn with the City by Joseph H. Choate, another of the Museum's distinguished founders. On the basis of its provisions the new museum thrived from the start, and has continued to grow amazingly toward its eventual physical goal—the complete occupation of the seventeen and one-half acres of Manhattan Square, part of the Central Park lands—and toward its scientific and educational goal of a country-wide and world-wide influence "second to none." The terms of this contract, in brief, established for all time two responsibilities: Erection and maintenance of the building by the municipality, and donation of all the collections by the trustees and other citizens.

The Museum, with its arrangements for administration already well under way, received its formal charter of incorporation April 6, 1869. By November $44,500 had been subscribed by citizens, and the Museum was soon enabled to purchase four important collections, comprising 9300 mounted birds, 200 fish and reptiles, 820 mounted animals, 4000 mounted skeletons of mammals, birds, reptiles and fishes, and 250 specimens of Siberian fauna.

Though but the tiniest fraction of the collections eventually accumulated, these first accessions made a splendid nucleus. The problem of housing them for public display led first to the Cooper Union and then to the old Arsenal Building in Central Park, where the commissioners, validating their early interest in the project, turned over two floors and furnished new cases.

With the adapted Arsenal Building soon outgrown and the youthful Museum daily attracting more friends, there were made the first moves leading to erection of the great granite pile at Seventy-seventh Street and Central Park West. A petition enclosing 40,000 names of "the best and most valuable" citizens went to the Legislature on behalf of both the American Museum and the Metropolitan Museum of Art, then occupying private dwellings but soon to have its own home in the Park. Immediately the Legislature responded by authorizing the Department of Parks to erect and maintain a building suitable for display of natural history material. In the conviction that growth and greatness would come, it was decided to start a structure which eventually would form a hollow square 700 feet long on each side. This arrangement has since been adhered to, though certain interior wings not at first contemplated have been added. The first section was begun in 1874 with the laying of the corner stone by President Ulysses S. Grant. With completion in a few more months of the beautiful Roosevelt Memorial by the State of New York and another unit by the City, both facing Central Park, the original plan will have been half carried through.

© by the Fairchild Aërial Survey

AN AËRIAL VIEW OF THE AMERICAN MUSEUM OF NATURAL HISTORY IN 1930

The excavations shown in the picture are those for the State Roosevelt Memorial Hall, the African Hall, and the Power and Service Building. These buildings are now well under way

HENRY FAIRFIELD OSBORN
The fourth president of the American Museum, who has served in this capacity since 1908

The subsequent history of the American Museum has been one of almost continuous progress in its chief fields of exploration, research, preparation, exhibition, education and publication—an expansion of activity of which its lengthening edifice has been only an outward sign. In this progress thousands of men and women have had a share; yet to a few it was given to be reckoned among the great builders.

From Professor Bickmore, with his ability to organize and to obtain financial support, the Museum which was the dream of his youth received not only its real beginning but also a conception of what a museum should be. As the Museum's first superintendent and first curator of education Professor Bickmore was a powerful influence during all its formative years.

Though a business man untrained in science, Morris K. Jesup, inaugurated as third president in 1881, when the Museum's full acceptance of its opportunities was in jeopardy, lifted the institution to a position of eminence which attracted the attention of the whole scientific world. The great achievements of his administration, the climax of a service to the Museum which had been continuous from its founding, were attributable to a rare ability to envision the possibilities of scientific effort. These he developed by bringing to the Museum's staff notable scientists and to its treasury the funds with which to work.

To another founder, who for fifty-six years remained an active trustee, the Museum and all who have profited through what it offers owe a special debt of appreciation. The late J. Pierpont Morgan's business acumen, eagerness to recruit supporters for the Museum and large gifts to its projects were powerfully conducive to its achievement.

Coming to the Museum in 1891 to found a department of palæontology which was to attain preëminence, Prof. Henry Fairfield Osborn first became President Jesup's assistant, then in 1908 succeeded him,—to add new chapters to the book of achievement. World-known as exponent of science for layman as well as scientist, the present president of the Museum brought in a fruitful era especially marked by elucidation to the public of what are generally held to be cryptic technicalities of science. "Dinosaur" has become a household word; to great hosts without the tools or language of science have been made plain the mysteries of the ages and obscurities of the present. With President Osborn at the helm the Museum has not only become a leader in this interpretive field, through the use of many media, but it has made a notable general progress and gained new levels of prestige.

Under such chieftanship the American Museum has often led and always gone forward, in step with scientific advance. And this has been steady, for searching and learning, science and education, never come to an end; Nature itself, and knowledge of Nature, never stand still; neither can a great Museum, which for the benefit of mankind holds up a many-faceted mirror.

The irreplaceable institution, glimpsed in the articles to follow, that has resulted from more than sixty years of devotion to a vision, is the work of many hands. What more the Museum may become in a world that will never cease to yield new mysteries for human examination and profit depends also upon the work of many hands.

A SECTION OF THE HALL OF THE AGE OF MAN
In this remarkable exhibition hall, the collections and murals tell the story of prehistoric man as he was in the great days of the glaciers and mammoths. This hall attracts its full quota of the 1,000,000 annual visitors to the Museum

Photograph by J. B. Shackelford

Roy Chapman Andrews, leader of the Central Asiatic Expeditions, in the sand dunes at Tsagan Nor

INCREASING KNOWLEDGE THROUGH EXPLORATION

How Exploration Has Changed from the Hit or Miss Method of an Earlier Day—The Value of the Work of the Museum in the Field

By ROBERT CUSHMAN MURPHY
Curator of Oceanic Birds, American Museum

The following article touches upon many phases of exploration, primarily as conducted over a long period of time by the American Museum. Natural History *is fortunate in being able to round out the subject by presenting, in two other articles in this issue, descriptions of specific expeditions—the most recent important Antarctic survey, conducted by an explorer not connected with the Museum, and a Siberian expedition conducted under the auspices of the Museum itself. These expeditions, of diverse type, are the Byrd Antarctic Expedition, as seen in some of its scientific aspects by its leader, Rear Admiral Richard E. Byrd, first man to conquer both poles by air; and the Morden-Graves Expedition, which brought back to the Museum specimens of rare fauna, described by William J. Morden, field associate of the department of mammals.*—The Editors.

MANY visitors to the American Museum pause in a corner on the ground floor, near the entrance to the elevators, to inspect an outline map of the world dotted with black thumb-tacks. The markers tell the whereabouts of American Museum expeditions, concerning each of which there are a few marginal words. The position and number of the tacks is frequently changed as field parties start forth, shift their base, or return to New York. At the moment of writing there are seven such black spots on three continents and in Oceania, far flung around the globe from the Gobi Desert in the east to the Solomon Islands in the west—a point at which west becomes east again. At times, however, scores of tacks, scattered over every great land mass, certain remote islands, and one or both of the polar regions, have revealed unusual contemporary activity of field workers representing the American Museum of Natural History. The map is one indicator of how our institution keeps its elongate fingers upon the pulse of nature.

Natural history museums were not always sponsors of exploration. Originally their function was passive, for they served mainly as repositories for objects from many different sources. The emphasis, unlike that of today, was placed upon the strange and the abnormal rather than upon orderly processes of nature such as are now recognized as having the greatest meaning and application. Information concerning specimens was regarded as of less importance than their mere possession, and most collections were reminiscent of Shakespeare's apothecary shop in which

> a tortoise hung
> An alligator stuff'd and other skins
> Of ill-shap'd fishes.

Even after natural history museums had begun to evolve beyond the primitive stage, they retained their original character to the extent that their property continued to be built up chiefly by gifts from acquisitive travelers, through the accumulation of private collections bequeathed by patrons and specialists, or through the purchase of natural history objects from professional collectors. The early treasures of our own institution were of this sort. In the second annual report of the Museum, devoted to the events of the year 1871, mention is made of large and valuable zoological collections purchased in Europe and at last safely deposited in the Arsenal in Central Park, the original home of the Museum. These comprised the entire museum of Prince Maximilian, of Neuwied, Germany. They were later to prove especially valuable to investigators because they included a large number of type specimens in several groups of ani-

Photograph by Walter Granger

EXCAVATING THE HIND LEG OF A DINOSAUR

The Central Asiatic Expeditions are responsible for the greatest discoveries of recent years in the field of fossil vertebrates, including the far-famed dinosaur eggs

Photograph by R. C. Murphy

THE AMERICAN MUSEUM AT AN OUTPOST OF THE ANTARCTIC

The expedition's brig "Daisy" at Cumberland Bay, South Georgia. The mossy slope beyond the vessel has since become the last resting place of Sir Ernest Shackleton

Photograph by G. Kingsley Noble

THE RARE SPIKE-TAILED IGUANA

(*Cyclura ricordii*)

A field study from one of the Angelo Heilprin Expeditions to Santo Domingo

mals. During the same period the Museum also acquired by purchase further important nuclei of its early representation of birds in the form of 2800 mounted examples from the great series amassed by Edward Verreaux in Paris.

Throughout the record of all the early years, until 1888 or later, there are frequent other references to purchases, culminating in the acquisition of the great Lawrence Collection of American birds, numbering 12,000 specimens. Even allusions to gifts from friends of the Museum represent, with a few notable exceptions, indirect purchases. D. G. Elliot, however, generously turned over his own invaluable collections, and there are occasional other items concerning specimens in large part personally collected. One such tells of the receipt of the first dodo bones from Col. Nicholas Pike, United States Consul at the island of Mauritius.

In the eleventh report of the Museum, for the year 1879, we find a second stage of museum development indicated by the record of exchanges with sister institutions. One transaction included a transfer of specimens to the mutual benefit of the American Museum and the Smithsonian Institution, of Washington.

These ancient affairs are cited with the object of suggesting the steps by which natural history museums emerged from the level of morgues toward which ready-made collections gravitated and, *pari passu*, by which their scientific staffs became transformed from mere "curators" (care-takers), in the original sense, into exploring naturalists who with planned purpose go out in search of their own scientific evidence. In recent years, to be sure, the Museum has absorbed large collections brought together by specialists, but in many instances it has taken the collector along with the collection. Thus in finding space for the

Photograph by Rollo H. Beck

BIRDING IN THE SOUTH SEAS

A field worker of the Whitney South Sea Expedition, and his Polynesian guide, survey the densely wooded heights of Tahiti. In the background is a spur of the Diadem, highest mountain of this tropical isle

Photograph by H. E. Anthony

THE DECK OF THE SCHOONER "MORRISSEY"

The Stoll-McCracken Expedition northward bound for the Arctic Ocean and a walrus group for the Hall of Ocean Life at the American Museum

EXCAVATION OF A PUEBLO RUIN AT AZTEC, NEW MEXICO

Since 1909 the department of anthropology of the American Museum has carried on an intensive survey in the Southwestern United States to recover the history of this interesting area. The work is divided into two sections, one to study the living primitive peoples of the area, the other to study the prehistoric remains

Photograph by Earl H. Morris

Dwight Collection of North American birds, and in having the privilege of adding its owner to the staff, our institution acquired not only matchless ornithological material which has since become its permanent property, but also the interest and knowledge and devoted labor of the man who through sheer zeal had brought it together.

President Osborn once expressed in the following words the changes brought by the years:

Since 1881 the American Museum has developed a policy of exploration rather than of purchase for the acquisition of collections. Although large purchases are still made from time to time, exploration is now the chief means of enriching the exhibition halls of the Museum. While specimens for exhibition are the chief aim

SEASONAL RECORDS OF THE ICE AGE

Members of the geology department of the American Museum in the clay pit at Dutchess Junction, New York. They are investigating the clay layers which were deposited seasonally in glacial lakes. These clay layers give a clew to the length of time it took the ice front to retreat northward

Photograph by Chester A. Reeds

ON MOUNTAIN HEIGHTS

Aconcagua, the highest peak in the Western Hemisphere. A photograph taken while the Ottley-Anthony South American Expedition was in the field collecting small mammals and making a survey for future intensive collecting in Southern South America. Aconcagua is in Argentina, and is 23,080 feet high

Photograph by H. E. Anthony

of the explorer. he brings back a large amount of information regarding the country visited, as well as photographs, drawings or paintings, which are absolutely essential both for publication and as accessories to exhibition. The field photographs thus acquired now number over 8000, and are in constant use in lectures and publications all over the country. In all, thirty-five parties were operating in the field during the year 1912; every continent on the globe, except Australia, has been visited, and remarkable success has crowned the efforts of the leaders, who have not only made important contributions to science but have brought rare collections from remote seas and parts of the earth.

Since these remarks were published, work in Australia has been well begun, the field photographs in our archives have increased from 8000 to 126,454, and a corresponding growth has marked

BENEATH THE SEA

One of the photographic studies for the Coral Reef Group, made through the window of the Williamson submarine tube on the outer side of the Andros barrier reef, the Bahamas. The Williamson submarine tube is the best method so far devised for obtaining under-sea photographs to a depth of 100 feet

Photograph by Roy Waldo Miner

every branch of the Museum's expansion into what might be called a laboratory of exploration. Because increase of knowledge through exploration has always transcended effort on the part of the Museum to add merely to its intrinsic treasure, the institution has shown a broad spirit of coöperation with related work not under its own control or for its direct benefit. It has, in fact, given its moral or material support, or both, and has served as a source of specialized scientific information, in the campaigns of many independent discoverers from du Chaillu to Beebe, from Peary to Byrd.

Of the ten marble likenesses of pioneers of American science thus far installed in the main entrance hall of the Museum, at least seven, namely, Humboldt, Audubon, Torrey, Agassiz, Dana, Baird, and Peary, represent men who were in a literal sense explorers. In the special assemblage of books by members of the staff, associates, and trustees of the Museum, an exhibit which has attracted much interest during the past year, it is worth noting how large a proportion are works of pure exploration. Such titles as *In Brightest Africa*, *Dragon Lizards of Komodo*, *Ends of the Earth*, and many in similar vein, tell their own story. It becomes clear from a perusal of these books that practically every modern phase of the Museum's activity is correlated with exploration. As expressed by Frank M. Chapman in Natural History, study collections of scientific worth may be acquired in various ways, but

> the aims of original research may best be served by sending out expeditions with definite problems in view, led by, or under the direction of, men who will attempt to solve them. A specimen is of far greater value to the man who is familiar with the country whence it comes and the conditions under which it lives, than to one who has no first-hand knowledge of these most important factors. It is, therefore, the policy of the Museum to give its curators wide field experience, knowing well that this will result not only in better collections, but in more discriminating reports upon them.

Probably the first expedition actually sent out by the Museum was that of D. G. Elliot and

Photograph by Arthur S. Vernay

GETTING INTO A "MACHAN" TO WAIT FOR A TIGER

The Vernay-Faunthorpe Indian Expedition obtained for the American Museum the greater part of the material for the Hall of Asiatic Mammals which will be opened to the public this autumn

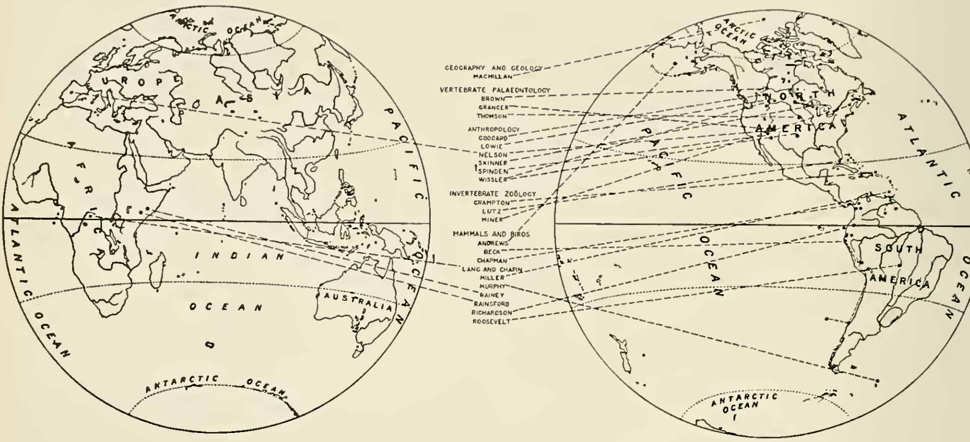
Photograph by H. E. Bradley

A MUSEUM CAMP IN THE GORILLA MOUNTAINS OF AFRICA

When Carl Akeley studied and photographed gorillas in their native haunts, he exploded many myths regarding one of man's closest existing relatives

Jenness Richardson to Montana, in 1887. This was at any rate the first field undertaking of the newly created department of vertebrate zoölogy, and I have been unable to find a record of earlier projects under the auspices of the Museum. The main object was to obtain for permanent display specimens of the American bison, then believed to be approaching extinction. In 1889, Chapman began in Florida the field work that ultimately resulted in the famous series of North American habitat groups of birds. The goal of these undertakings, and of those during many succeeding years, was frankly acquisitive, namely, specimens with which to build exhibits. It was the pioneer age of museum exploration. A long period was necessarily to elapse before field work could be thought of except in terms of carcasses; before a Martin Johnson could go to Africa equipped with batteries of motion picture cameras instead of firearms; before members of the Museum staff could spend months at a tropical island laboratory without the obligation of bringing back a skin or skeleton; before experimental work with living animals, under controlled conditions, had been dreamed of as part of the Museum's program.

Early steps in the plan of growth took us beyond the borders of the United States, for the annual report for 1890 refers to a subscription of $1,000 made by the trustees in aid of the Carl Lumholtz Expedition to northern Mexico and Sierra Madre, the objects of which were chiefly ethnographic. The next year was marked by an important mile-post in the history of the Museum when the department of palæontology began its epoch-making explorations in the Cretaceous and Tertiary horizons of the western United States. In 1892 A. F. Bandelier began archæological studies in Peru, under the patronage of Henry Villard, and for eleven years this notable research into the culture of the Incas and their predecessors was continued in the Andean highlands.



FIELD WORK OF THE AMERICAN MUSEUM IN 1913

The location of twenty-three American Museum field parties during 1913 shown on the above map is an indication of the institution's expansion in exploration during recent years

The report for 1893 mentions accessions added to the collections of several departments through Museum expeditions. By 1894 exploratory work may be said to have extended "from Greenland's icy mountains to India's coral strand," for the trustees largely financed the Peary Relief Expedition of that year, and during the same period dispatched Rudolph Weber to prosecute field work in the island of Sumatra. By 1896 the influence of our institution in the field of exploration had become so potent that the Mexican legislature enacted a special law authorizing the President of the Republic to grant the American Museum a concession for conducting its archæological excavations in Mexico and Yucatan. Previously, such privileges had long been denied to foreign organizations.

1897 was another memorable date, signalized by the launching of the Jesup North Pacific Expedition, one of the outstanding events in the history of American exploration. Its program included an intensive study of native peoples on both the American and Asiatic sides of the North Pacific Ocean and Bering Sea. The work was subsequently carried out by distinguished scholars, and reports relating to the ethnology of many tribes, and to their anthropological and geographic relationships, have been published during a long series of years. The investigation, in fact, is still in progress, for the final publications have not yet appeared. Only a few other expeditions of the Museum, such as those of the great period of fossil discovery in North America, and the recent work on the Central Asiatic plateau, can compare in size and influence with the project visualized so long ago by President Morris K. Jesup.

Space would by no means permit a catalogue of the Museum's explorations through the decades, but the brief list on page 465, of important representative names, the respective fields of operations and primary aims, may prove stimulating.

Some American Museum Expeditions During the Last Forty Years

Amphibians and Reptiles	Asia, North America, West Indies, South America, Central America.	Burden, Dickerson, Hassler, Marshall, Noble, Pope, Weber
Anthropology	North America, Africa, Asia, Polynesia, Arctic.	Bernheimer, Boas, Broom, Lowie, Matthew, McGregor, Morton, Pepper, Shapiro, Stefansson, Sullivan, Weber, Wissler.
Archæology	South America, Central America, Europe, North America, Asia, Middle America.	Bandelier, Hay, MacCurdy, Morris, Nelson, Olson, Schmidt, Spinden, Vaillant.
Birds	North America, South America, Oceania, Asia, Subantarctic Islands, Africa, Central America, Madagascar, Pacific Islands, Arctic, Middle America, Oceanic Islands, Polynesia.	Beck, Beebe, Bennett, Carnochan, Carriker, Chapin, Chapman, Cherrie, Crosby, Delacour, Drowne, Dwight, Ekblaw, Griscom, Hamlin, Holt, Jaques, Kaempfer, Miller, Murphy, Quayle, Robinette, Streator, Watkins.
Birds and Mammals	South America, North America, Arctic America, Madagascar, Tropical America, Africa, Siberia, Middle America, Subantarctic Islands, Oceanic Islands in Atlantic and Pacific, Europe, Arctic, Abyssinia, Asia, Mediterranean region, Australia.	Allen, Anderson, Archbold, Batty, Boulton, Buxton, Carter, Colburn, Collins, Comer, Correia, Day, Elliot, Figgins, Frick, Heller, Legendre, Mathews, McCracken, Mearns, Metcalf, Miller, Murphy, Raven, Richardson, Rockefeller, Roosevelt, Rowley, Sage, Sanford, Stoll, Stone, Tate, Tyler.
Entomology	Central America, South America, North America.	Curran, Lutz, Schwarz, Watson, Wheeler.
Ethnology	Asia, North America, South America, Middle America, Oceanic Islands, Melanesia, Arctic.	Bogoras, Goddard, Granger, Jochelson, Kahn, Laufer, Lumholtz, Mead, Saville, Skinner, Smith, Wissler.
Fishes	North America, Europe, Asia, South America, Mediterranean region, Subantarctic, Oceanic Islands.	Breder, Dean, Gudger, Heilner, Hussakof, Metcalf, Murphy, Nichols.
Geology	Asia, Arctic, North America, West Indies.	Berkey, Ekblaw, Grabau, Hovey, Morris, Reeds.
Invertebrate Zoölogy	Polynesia, Melanesia, Australia, South America, North America, West Indies, Central America.	Crampton, Miner, Van Name.
Mammals	Africa, North America, Oceanic cruises, South America, Asia, Australia, Central America, Arctic America, Oceanic Islands, West Indies.	Akeley, Andrews, Anthony, Carlisle, Clark, Faunthorpe, Goodwin, Graves, Gregory, Hatt, Heilner, Lang, Lucas, McGregor, Morden, Morton, Ottley, Putnam, Rainey, Raven, Taylor, Tjäder, Townsend, Vernay.
Meteorite Collection	North America, Arctic.	Hovey, Peary, Reeds.
Mineralogy	North America.	Gratacap, Whitlock.
Oceanography	Atlantic, Pacific, and Indian Oceans	Beebe, Murphy, Townsend.
Photography, Painting and Accessory Collecting	North America, Asia, Middle America, Africa.	Bickmore, Butler, Fisher, Fuertes, Johnson, Rainsford.
Polar Exploration	Arctic.	Hovey, MacMillan, Peary, Stefansson
Vertebrate Palæontology	Asia, Africa, North America, South America, Europe, Egypt.	Andrews, Broom, Brown, Frick, Granger, Matthew, Osborn, Sorensen, Thomson, Wortman.

In the annual report for 1907, the first from the pen of President Henry Fairfield Osborn, the principal accomplishments of Museum field work up to that date are summarized. Accompanying the text, moreover, is a world map with areas in red indicating regions reached by Museum expeditions or from which important collections had been received during that year. Such areas appear upon every continent except Australia, and also at isolated localities from the northern tip of Greenland to the southern island of New Zealand. In subsequent reports some such comprehensive plan has been generally continued. Thus the volume for 1909 reveals that we had carried on work in thirteen states and territories of the United States, and in twenty-two distinct foreign regions. The same year marked the beginning of the great Belgian Congo Expedition, in charge of Lang and Chapin. In 1911 forty-four parties were sent out directly for the Museum, while at seven localities work was carried on for our account by local agents. In the report for this same year, Frederic A. Lucas, then director of the Museum, explained the special reason for such activity in the following words:

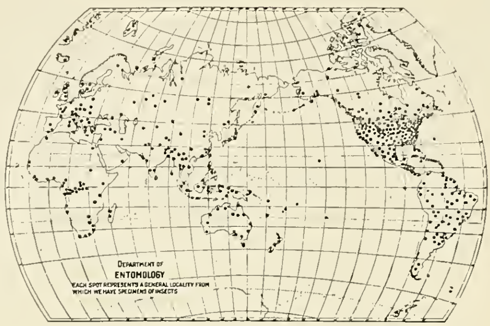


Diagram Prepared in 1923 to Show General Localities from Which the American Museum had Received Specimens of Insects

> Realizing the rapidity with which not only animals, but races of mankind with their beliefs and customs, are being swept out of existence by what we are pleased to call the march of civilization, special effort has been made . . . to gather objects and information while they are yet to be had.

It goes without saying that effective exploration involves the expenditure of considerable sums of money, far more today than during the fortunate Seventies when, we read, an entire wing of the Museum building could be erected for "an aggregate cost of five hundred thousand dollars"! The regular resources of the Museum long ago proved inadequate to support field work, and it is to the gifts and bequests of our friends, that we have looked for financing this fundamental phase of the Museum's purpose.

In the past, fortune has sometimes smiled during periods that had promised little. In 1914, for example, the general budget of the Museum was low, and yet the recent opening of the Panama Canal pointed naturally toward a great extension of our South American exploration. At this juncture the munificent bequest of President Jesup came to the rescue, as it did again in 1916 with the beginning of intensive Asiatic exploration under Roy Chapman Andrews.

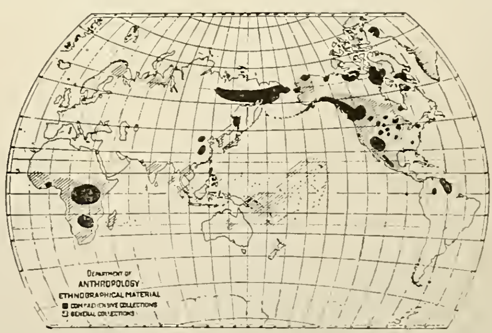
The year 1917, in which all our activities were interrupted or curtailed by the entrance of the United States into the war, was marked, nevertheless, by the placing of the capstone on the first great unit of zoölogical exploration in South America. This was the appearance of Chapman's monumental book on the distribution of bird life in Colombia which interpreted the studies of Andean life zones that had occupied six years of practically continuous field work.

By the date of the European war, American Museum representatives had made at least reconnaissance explorations in all the earth's great regions except Australia. When Gregory and Raven finally began their mammalian investigations in the island continent, President Osborn explained the need for this work, as follows:

> We are approaching the close of the Age of Mammals all over the world, but in no continent has the devastation been more rapid than in that of Australia, owing to three causes: deforestation, an enormous fur trade, and an increasing leather trade. In 1921, it became apparent that the American Museum must secure its representative collections now or never.

Today, more than ever, is the earth full of such pressing challenges. It was a realization of the fact that led to the beginning of our ornithological survey of the Pacific islands in 1920. This comprehensive project, known as the Whitney South Sea Expedition in honor of its generous supporter, Harry Payne Whitney, is still in progress. So rapid and devastating have been the changes in parts of Polynesia during the last ten years that it is doubtful whether the early work of the expedition could ever again be accomplished, in which case our knowledge of a fascinating and highly significant island fauna would forever have been slighter than may now be possible. The discoveries resulting from this expedition will eventually be elucidated in a new section of the Museum on Central Park West.

During preparation of the annual report for 1923, the curators were once again called upon for more than ordinarily detailed data on the collections of all departments. The results of this new inventory were in part shown graphically upon a series of eleven maps, two of which are here reproduced.



IN 1923 THE AMERICAN MUSEUM POSSESSED COMPREHENSIVE ETHNOGRAPHIC COLLECTIONS FROM THE AREAS INDICATED ON THE MAP IN SOLID BLACK, AND GENERAL COLLECTIONS FROM THE SHADED AREAS

In more elaborate form than is possible even in the annual reports, NATURAL HISTORY has during thirty years chronicled the explorations of the Museum for its members; for a host of other readers, too, because while the circulation of this journal is relatively small, it holds nevertheless, a peculiarly authoritative position, and it is the most widely quoted periodical of its kind. It is especially interesting to browse through successive numbers in the files in order to trace the fitting sequence of Museum activities, as shown in articles, reportorial notes, and reviews, from the first penetration of some geographic field by a Museum expedition to the ultimate expression of the discoveries in

(a) Authentic press information from the Museum's own bureau of publicity,
(b) Narrative accounts,
(c) Papers read before scientific societies,
(d) Popular illustrated lectures,
(e) Technical publications based upon original research,
(f) Articles intended for laymen,
(g) Exhibits.

Some such arrangement makes the ideal cycle, from an educational point of view. Upon its consummation the way is cleared for new departures, and the specimens and photographs are added to our tangible sources of information for use in further studies.

NATURAL HISTORY likewise records various summaries of the Museum's explorations, such as the tabulation of field activities of the department of birds between 1887 and 1921, published on pages 311–313 of the volume for 1922. It would be a temptation, if space permitted, to build the present brief epitome largely by quotation from the notable list of explorers who have helped make NATURAL HISTORY. *Inter folia fructus*—including descriptions of haunting charm from many pens. Even among the contributions that are frankly suited to robust-minded readers, we frequently feel the hot, first-hand impressions of discoverers who in one sense or another have 'seen new planets swim into their ken.'

So firmly is the Museum associated in the popular mind with exploration that the director and curators are more or less continuously besieged by applicants who long to go, on any terms, to the far places of the earth. After one newspaper announcement of plans for Central Asiatic research, fully a thousand letters, including several score from women, swamped the office of the leader. All of these aspirants were eager; most, no doubt, were physically fit; the great majority would probably have given faithful service. But how few of them even guessed at the specialized knowledge, the intensive training, the inborn "divine effluvium" that are necessary for participating in modern field work. Exploring is not the equivalent of "camping."

It is essential that recruits should come more and more from laboratories like our own, that those who go out into the lands and waters should have their specific problems clearly before their eyes and should be equipped with the latest resources of science for attacking them. For the haphazard age of discovery is over, and exploration is no longer an end, but a means. The modern conception has been beautifully expressed by the great Scotch geologist, Sir Archibald Geikie, who has written that true geographical science is not a

> chronicle of marvellous and often questionable adventures by flood and fell . . .
>
> It now 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.

Photograph by Martin Johnson

LIONS AT HOME IN AFRICA

Only the modern view of museum exploration could conceive an expedition in which studies of absolutely undisturbed wild creatures replaced the old idea of collecting specimens. Hundreds of such photographs are now in the files of the American Museum

PROBING LIFE'S MYSTERIES

Some Aspects of the Research Work of the American Museum

By G. KINGSLEY NOBLE

Curator of Experimental Biology, American Museum

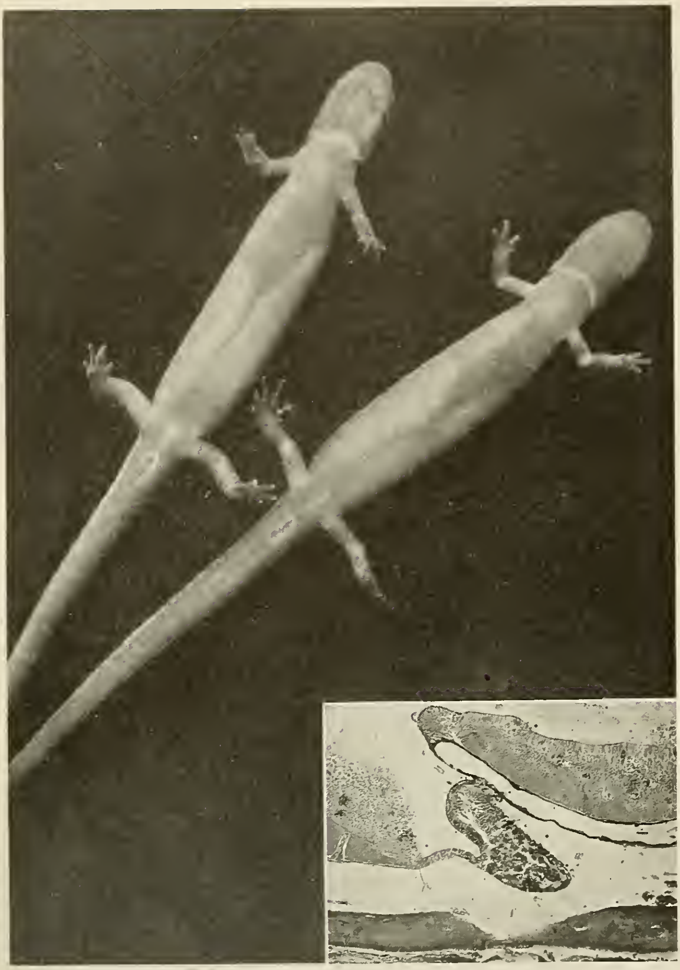
Few visitors to the American Museum realize that one of the major functions of the Museum is research, not only the identification of the many kinds of specimens which come to the Museum, but the investigation of their origins, distribution, and vital processes which win for them success in the world. The Museum employs a staff of competent investigators who are making each year many original discoveries of great importance to science. In recent years the attention of these investigators has been turning more and more to living specimens in order to solve fundamental problems which confront the naturalist and biologist. Doctor Noble, who has recently been appointed curator of experimental biology, tells in the following article of some of the work which he and other scientists of the Museum have now in hand. Experimental biology is one of the newer but more important fields of Museum research.—The Editors.

An exhibit of automobile bodies including types from 1900 to the present would be attractive and interesting, but it would in no way inform the spectator as to the evolution of the propelling machinery which has taken place in thirty years, or of the forces which have made possible this evolution. We can enjoy Nature just as we can enjoy our 1930 model without bothering to look "under the hood." Still there is a certain allurement and value in studying the machinery of life and in trying to fathom what makes the universal wheels go round. In the progressive museum, just as in the progressive automobile show, exhibits will not be confined to exteriors. Hence it happens that museum research is being directed more and more toward throwing light upon mechanisms.

Museums were invented by the Greeks and dedicated as the name implies, to the Muses of Art and Learning. Aristotle's Museum of Alexandria was a great library and home for scholars. With the enormous expansion of man's geographical horizon in the Fifteenth and following centuries, natural history museums became established as repositories for the collections of explorers and later as reference series for those who sought accurate information as to the many kinds of peoples, animals, plants, or minerals existing in the world. Describing, classifying, and caring for the collections became the principal work of the curators and has remained so until today. There is, however, a growing tendency to look beneath the surface of the material collected and to seek out basic causations with the aid of advanced biological research methods.

One might imagine that with the opening up of all parts of the world to commerce a time is approaching when all the species of the world will be known. That time, however, will probably never come. There are some 470,000 distinct species of insects recorded today and there probably live as many more which have not been captured and properly defined. Still, it is not the abundance of unknown forms which will provide occupation for the systematist for many years, but the complex nature of the species itself. America, for example, was well known geographically seventy-five years ago, but at that time only 220 kinds of mammals were known. Today more than 2500 forms have been described from the same area. One of the principal reasons for this increase is the recognition that a species is composite, consisting of many strains, some of which may be isolated geographically and hence are worthy of a subspecific designation.

Further analysis, especially by con-



THE CONTROLLER OF THE BREEDING CYCLE

The pituitary gland (lower figure) at the base of the brain produces a hormone which controls the breeding cycle of many animals. Although the eggs show through the body wall, they cannot be released until the hormone is free in the system

rôle in determining their survival. Species are built out of these units, and as many of the units are covered up, so to speak, in the process of constructing one form but appear again in derived species, the work of the systematist to be complete or final resolves itself into genetics, an experimental study of hereditary units.

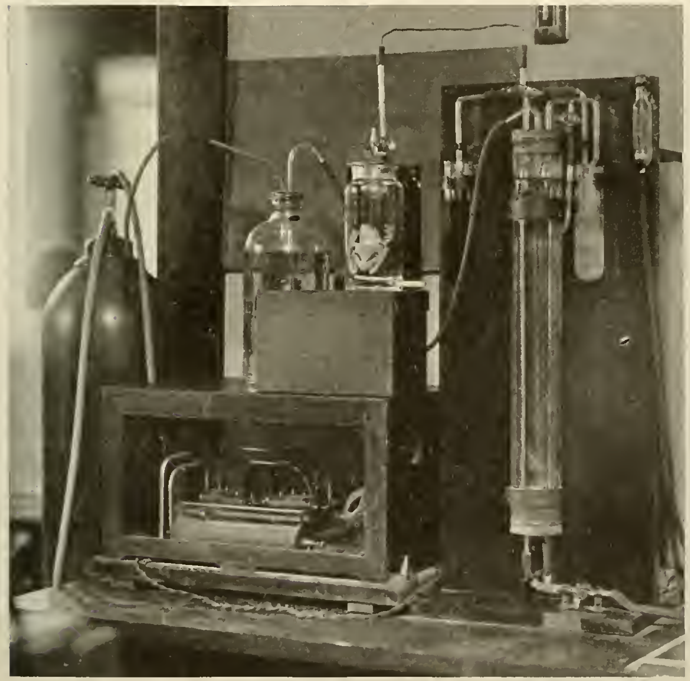
There is, however, much more in museum research today than finding a name for every kind of animal or determining the units out of which the species has been produced. People want to know why animals behave as they do, why they differ one from the other. They want to know the reasons for bright colors, the reasons for protective colors—and the mechanisms whereby these are produced. In walking through an exhibition hall a museum visitor raises a host of questions which only research can answer, and research for the most part with living specimens.

Fortunately the museum is in a unique position to answer these questions. Through its expeditions and field work the museum investigator learns to know the animals in relation to their environment. Further, he is able to secure the most significant species for working out particular problems. The museum investigator, in other words, can handle his problems without restricting himself to rats, guinea pigs, or other domestic types. A few of

trolled breeding experiments, is revealing that even these subspecies are composite groups and may be resolved into separate genetic strains. It is these strains which are the basal units of animal and plant life. Some strains are immune to epidemic diseases, others can survive higher temperatures than the bulk of the species, others are restricted to particular habitat requirements. Many strains show slight structural differences, but the physiological peculiarities play the more important the problems being attacked in the American Museum laboratories may be briefly outlined as an indication of their nature and scope.

The world we know is limited by the capacity of our sense organs or deductions we may draw by bringing their messages in juxtaposition. It is obvious that the robin listening to an earthworm in its burrow must live in a world having a far different range of sounds than our own. Similarly the male moth that flies through the darkness of the forest at night guided by the odors of the female, or the bat which avoids obstructing branches by analyzing the echoes of its flight, must sense environments of which we can know only indirectly. The mystery of bird migration has often been explained by the theory that certain species require the maximum number of daylight hours and hence move into those regions which will fulfill these requirements. The hypothesis has been put to test by experimental methods. It was previously known that birds migrate when their gonads are either growing or dwindling; they remain in one locality when their sex organs are in a state of equilibrium. Rowan found that he could arrest the normal spring recrudescense of the gonads of the junco, or cause a premature midwinter growth, by controlling the number of light hours of captive birds. Further, juncos with increasing or dwindling gonads, migrated when released. Neither rising nor falling temperature had a similar effect. However, increasing the periods of com-

ON TO THE SEA
Loggerhead turtles migrate to the sea on hatching, not because of any ancestral memory but because of certain instinctive responses to gravity and to open horizons



TESTING THE OXYGEN CONSUMPTION OF A TREE FROG
The distribution of animals is controlled by their physiological requirements. These can be determined only by measurement under controlled conditions

pulsory exercise produced the same result as increasing the light. It would thus seem that the length of the daily period of activity in some way influenced the gonads and hence migration.

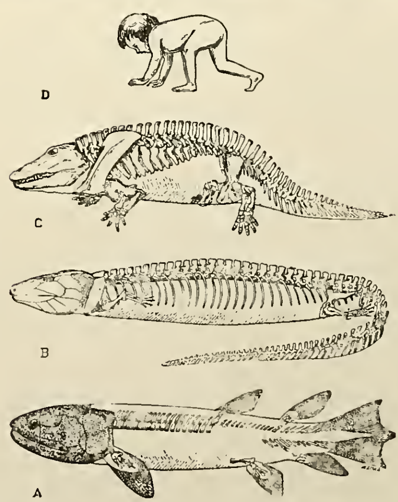
In other groups of vertebrates the migratory impulse may be controlled by secretions from the gonads, but the latter in turn are under the control of a hormone from the anterior pituitary gland at the base of the brain. We have induced spring breeding salamanders to lay their eggs in the Museum laboratory in mid-winter by treating them with pituitary substance. Frogs, which are migratory creatures, have been made to breed out of season by the same technique. Whether or not the hormone is released by the pituitary of the artificially exercised birds is at present unknown, but surely the anterior pituitary hormone plays an important rôle in inducing the migration of many kinds of vertebrate animals.

There is, however, another aspect to the problem of migration, namely the specific cravings of a hormone-activated frog or bird. Newly hatched turtles migrate to the sea because they inherit a certain combination of sense organs, nerves, and muscles, which forces them to move down hill and away from an obstructed horizon. If the horizon near the sea is experimentally blocked, the turtles move inland, as Parker showed. The migrating turtle has no "ancestral memory" of the sea and it is doubtful if young birds migrating to the south for the first time are directed by any knowledge of the delightful winter resort which awaits them. The sensory data which orient a migrating frog are probably not those which orient the bird. However, the desire to move during periods of gonad growth is a very old one among animals.

Animals do not foresee the use of their

THE EVOLUTION OF THE BROODING INSTINCT

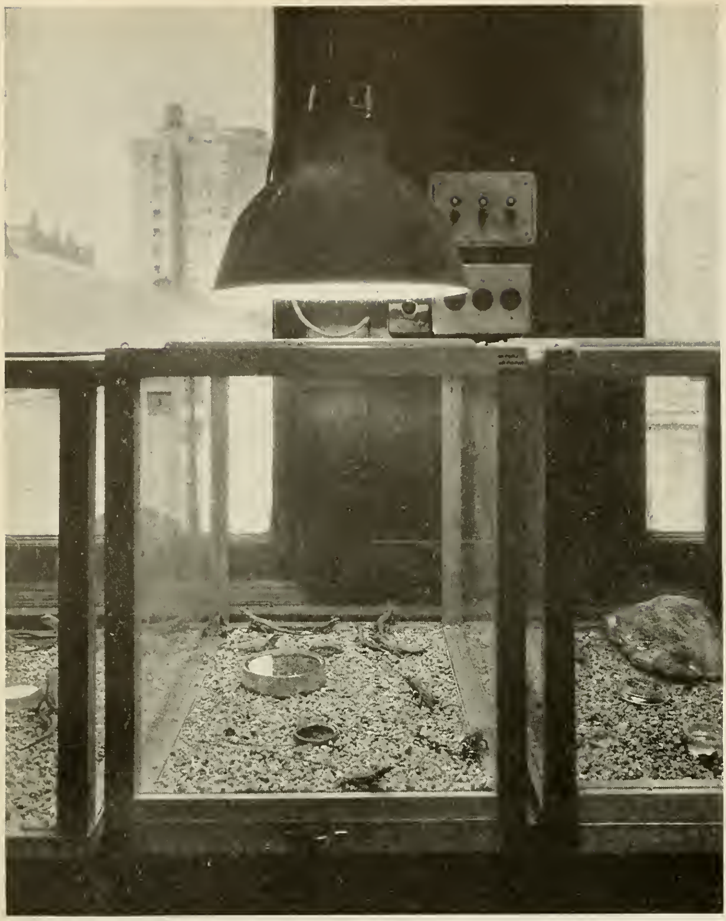
The female marbled salamander (left) remains with its eggs merely through exhaustion, but this habit has the advantage of keeping the eggs, which are laid on land, from drying. In some other Amphibia, such as the mid-wife toad (right), an instinct to take care of these eggs has become established habits. The mother marbled salamander remains with her eggs merely through exhaustion. The habit, however, has the advantage of keeping the eggs moist, and in other Amphibia which lay their eggs on land, this habit has become established as an instinct. The male midwife toad carries the eggs wrapped around his legs until they are ready to hatch. In some higher vertebrates the instinct to care for the young may dominate all the others. In the vertebrate series various instincts appear at certain stages and gain ascendency now in one group, now in another. The desire for territory appears during the breeding season in fish and becomes an important part of the social organization of birds. Very little is known about the organization of lizard colonies, but plans are under way through the coöperation of Mr. Gilbert C. Klingel to take up this field of investigation in the West Indies. Universities have organized expeditions solely for the study of behavior in various groups of animals. The important results obtained warrant further work in this direction.



RECONSTRUCTING THE TREE OF LIFE

The fossil record discloses the to Dr. W. K. Gregory the principal steps by which certain primitive fish were modified to form the first land vertebrates, with their great potentialities for future evolution

Only a very few kinds of animals live in colonies or have developed a social organization, but all species form more or less important links in food chains. While plants can stand in one place and manufacture their carbohydrates out of the air and water, most animals, being devoid of chlorophyl, must obtain their carbohydrates from plants or secure them once or more removed from the source by preying on other animals. Plants are built to expose broad surfaces to the sun,—their source of energy for carbohydrate manufacture. Most animals having to move or starve, are bilateral with food detectors,—the sense organs,—clustered about the food trap at the forward end. The form of the food trap, sense organs, and locomotor apparatus is closely correlated with the speed of movement and kind of prey. It is not mere chance that submarines have the form of some pelagic fish, and that speed aëroplanes resemble certain fast flying birds and insects. There are certain mechanical conditions which make for efficiency in rapid progress through water and air. Nature has met these conditions and the engineer has much to learn



BASKING IN THE WARMTH OF AN ULTRA-VIOLET LAMP

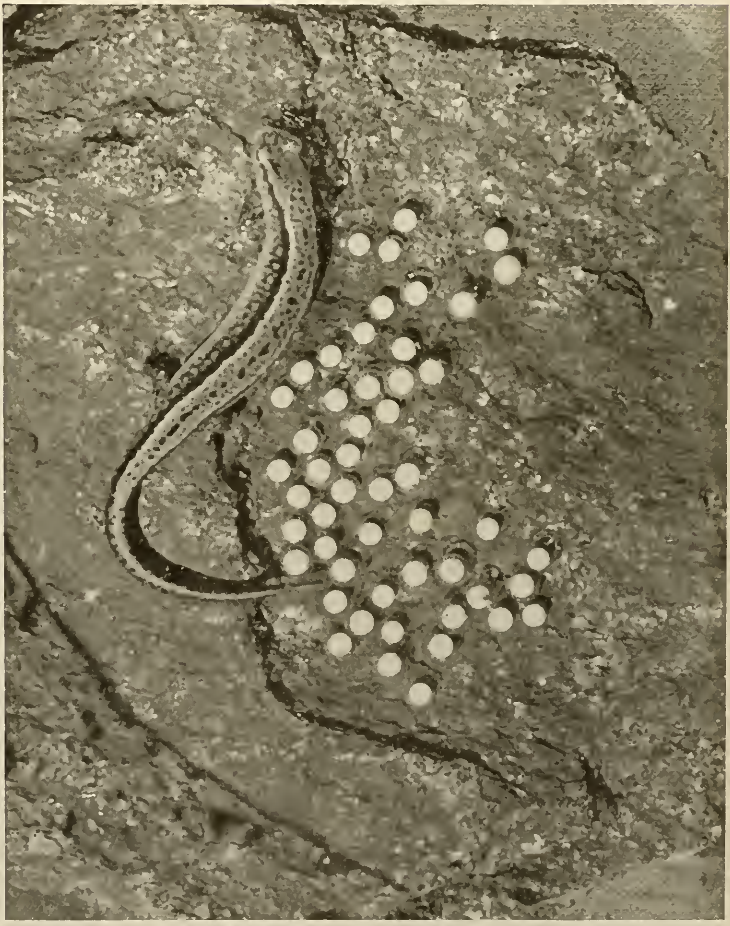
Lizards to behave normally must be kept in the pink of health. The Haitian lizards shown here receive fifteen minutes of exposure to ultra-violet a day

A RED-HEADED SKINK INVESTIGATES

During the courting season the male redheads are very pugnacious and fight with every lizard they chance to meet. The bright colors of most male lizards serve as warning rather than attracting devices during courtship

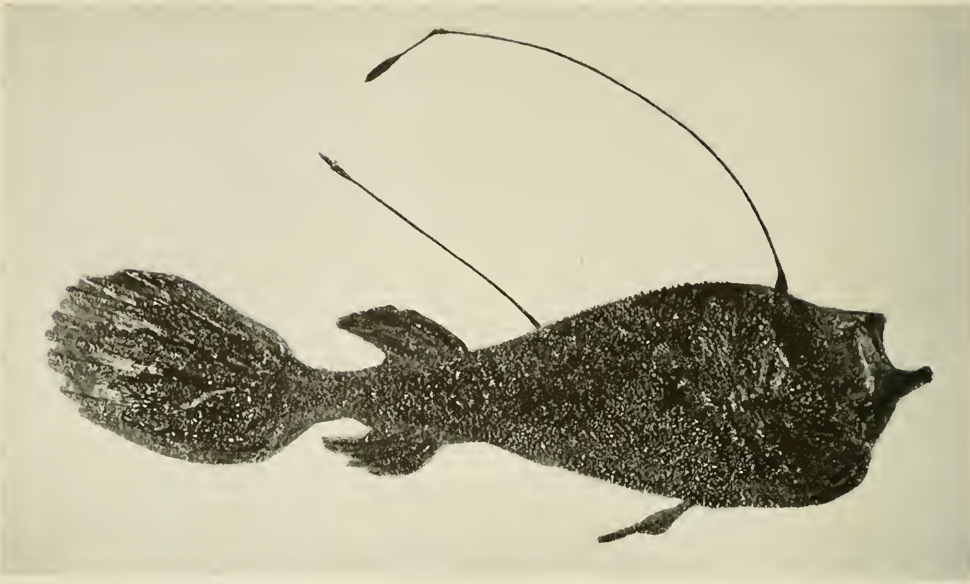
ANALYZING THE COURTSHIP OF SALAMANDERS

Under the controlled lighting of the dark room the elaborate courtship of many rare salamanders has been studied. The male slimy salamanders shown above have a skin rich in hedonic glands, the secretion of which attracts the female during the courtship antics

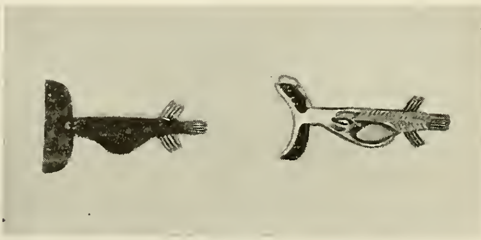


THE RESULT OF AN EXPERIMENT

The southern two-lined salamander lays its eggs in clusters or singly attached to water weed in North Carolina swamps. When females were given the choice of water weed or stones, they selected the latter and reverted to the primitive manner of attaching their eggs to the under surface



In the deep-sea angler fish the males are parasitic on the females and become permanently attached to them as inconspicuous appendages. Their digestive organs dwindle as shown in the model on the left. The male in the upper figure is the small appendage attached to the ventral surface of the female angler



A PARASITIC MALE

from her. The study of animal mechanics has long held the attention of Museum investigators, while the analysis of food chains, the principal work of the ecologist, relies to a large extent on the field reports of Museum naturalists.

All animal life to survive must live in harmony with some particular environment. This indirect relation of an animal and its environment may leave its impress on later generations. During Devonian times, for example, a premium was placed on the development of lungs in certain primitive fresh-water fishes which inhabited pools subject to rapid dessication. The increase in the lungs necessitated a remodeling of the circulatory system and a profound change in the heart to pump blood in need of oxygen directly to the lungs. The heart of land vertebrates, including man, owes its ground plan of structure to the idiosyncrasies of a fickle Devonian climate.

To appreciate other distinctive features of animals it is often unnecessary to look beyond conditions existing in nature today. One frequently wonders why there are so many beautifully colored creatures in the world. Do the bright colors of male birds have any significance? Have they come into existence as the result of generations of choice, each female tending to mate with only the more splendidly garbed males? In spite of many years of field work there are only one or two convincing series of observations which would confirm this conclusion.

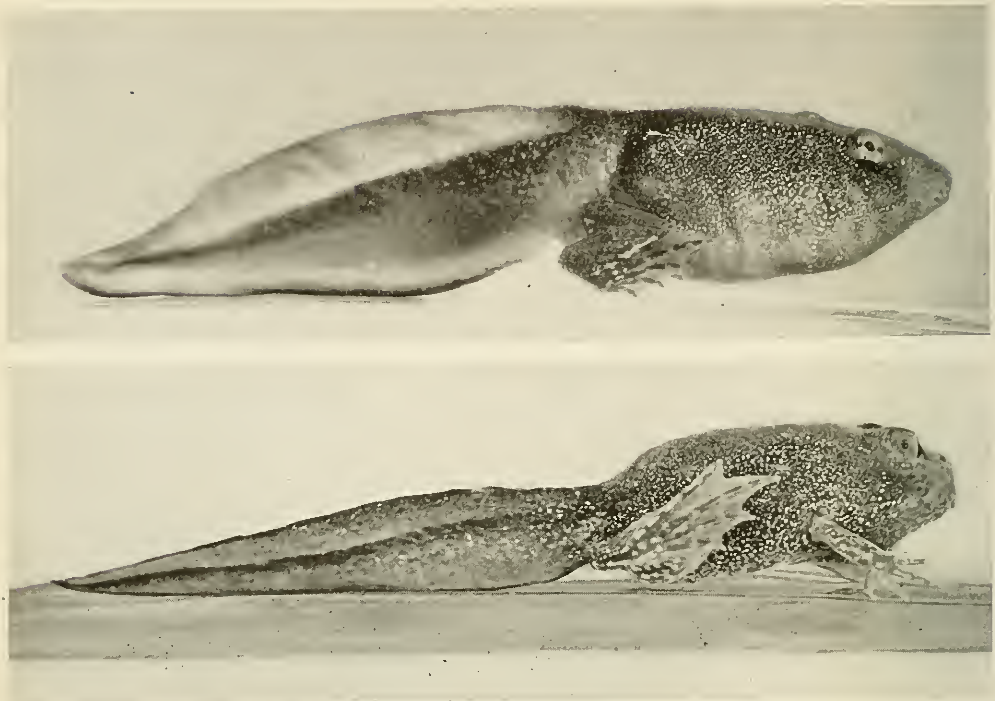
On the other hand tropical lizards, which often vie with the birds in their absorbing beauty, have been imported to our Museum laboratories and studied under ideal conditions for observation. Here it has been found that bright colors are employed merely to bluff possible rivals into avoiding encounters with their owners. Bright colors in birds may in some instances be alluring devices, but in lizards the female usually has no choice in the matter of selecting a mate.

Similarly, the grotesque, subjected to laboratory observation, has yielded information which could not have been determined in the field. Many common salamanders have the front teeth in the upper jaw of the male protruding well beyond the mouth. Under the controlled lighting of the dark room it was found that the males use these teeth in stimulating the female during the first phase of their elaborate courtship.

There are many other peculiarities among well known animals which still await explanation. Until recently the "four nostrils" of rattlesnakes and other crotaline snakes seemed incomprehensible. The posterior pair of facial orifices have a membrane stretched across their lumen but this serves neither as a smelling nor hearing organ. Evidence has been worked out in the Museum laboratories indicating that this structure is a tactile organ adapted to record air disturbances produced by passing enemy or prey. Air waves impinging on the membrane direct the strike of these deadly serpents. Snakes are notoriously deaf creatures, and as some are active at night, refined tactile organs would be a decided advantage in capturing their food. The work on the

THE FACE OF THE COPPERHEAD

The lower facial orifices of the copperhead are not extra nostrils, but delicate tactile organs for detecting air vibrations. They apparently serve to direct the strike of most of the poisonous snakes of the New World



PART OF THE MECHANISM OF METAMORPHOSIS

The front legs of the tadpole develop under the skin of the neck until a time when a secretion released by the degenerating gills digests a pair of holes through which the limbs make their appearance. The tadpole shown is that of the rare southern bullfrog, *Rana heckscheri*

senses of serpents is still in progress in the Museum.

Not all species of animals can be subjected to experimental observation, and many questions concerning them are bound to remain unanswered. Recently it has been shown that the male deep sea angler fish shortly after hatching, seeks the female and bites into her body or head. The lips and tongue unite with the skin of the female and the husband becomes an insignificant appendage on his wife. Now, fish are highly organized creatures and it is remarkable that such fusions could occur.

Still more remarkable is the claim that the blood stream of the female is continuous with that of the male. The sex of an animal although determined at the time of fertilization by the factors in the chromosomes may be altered or reversed by the hormones of the opposite sex. Salamanders have had their sex changed in both directions by hormones of more mature gonads of the opposite sex transplanted into their bodies. Many Amphibia may pass through a prolonged neutral stage before the gonad develops into an ovary or a testis, and during this stage hormonal or even temperature effects may bring sex reversal. Hence it is something of a mystery why the male appendage can retain its masculinity if its tissues are really bathed with female blood.

The parasitic dependence of the male on the female is obviously of advantage in keeping the pair together in the inky blackness of the deep sea. A description of any adaptation gives no clue as to the causes which have produced it, and the same may be said for even the small differences between species. It was recently found that wallabies introduced sixty years ago from Australia to an island near New Zealand have today longer and silkier fur than the same species in Australia. Whether this change was the direct result of the environment producing its effect during the growth of the first generation, or whether some germinal change has appeared in this isolated stock can only be determined by experiment. It would seem that the latter was the more probable. If we inbreed a few specimens of a species, strains will tend to become purified and show themselves merely because there is a better chance of like variant combining with like under such conditions. For the same reason, when birds, reptiles, or other creatures become isolated on islands, they rapidly diverge from the mainland stocks.

Not only the real nature of species differences but also many other problems of the naturalist can be solved only by experiment. Let us take an example from but one department of the Museum. It has recently been established that the mode of life history of a frog or salamander frequently gives good evidence of its relationship. In the coastal plain of southeastern United States the two-lined salamander lays its eggs singly or in small clumps attached to water weed or débris in the small streams. The northern race of the same species holds to the more primitive method of attaching its eggs singly to the underside of a flat stone. In the region where the former race occurs there are no flat stones, and the question arose: Might not the egg cluster method be a makeshift arrange-

THE CONGO "EEL"

Amphiuma is not an eel but an aquatic salamander which has begun, but not completed its metamorphosis into a land form. A partial metamorphosis has been shown experimentally to occur in several other giant salamanders

GALAPAGOS FINCHES

Four species of Galapagos ground finch (*Geospiza*) of the same sex and taken from the same island. Since all these finches eat approximately the same food, the marked difference in bill shape is in no way correlated with their habits

ment which would be abandoned if the salamander lived in a more favorable environment. When several southern salamanders were given their choice of laying their eggs among water weed or attached to rocks they reverted to the primitive method as shown in the photograph on page 475.

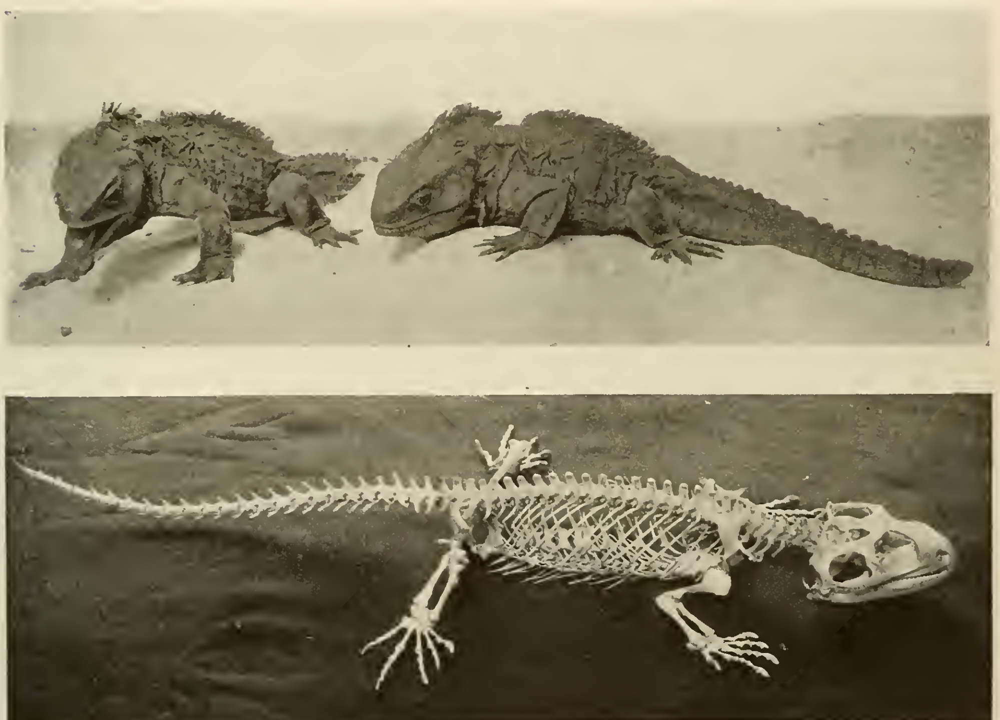
Many kinds of data may be utilized in studying relationship. In recent years the existence of "blood groups" has been demonstrated in all races of mankind. The only other animals which possess corresponding group reactions are the anthropoid apes. This in itself may be taken as important evidence of man's relationship to lower forms. There are, however, other methods of blood study which may be profitably employed on anthropoids. A study of blood relationship by serological methods has recently yielded important results, and the Museum with the help of Dr. Alan Boyden has recently taken up a program of investigating the relationship of Amphibia by this method.

With the increasing use of living material in the Museum, various investigators have been attracted from other institutions to study special problems. For example one of the more spectacular phenomena in nature is the sudden color change which many fish, lizards, squid, and a few other types are able to undergo. This is brought about by the contraction or expansion of the pigment cells. If a piece of skin of a chameleon is isolated from the body, the pigment cells may still respond to changes in illumination. Dr. C. E. Hadley, a Museum guest, has recently made use of Museum material in working out the various influences, nervous and hormonal, which control the movement of these cells in the living animal.

The scientific staff of a museum is usually organized into departments which are held responsible for knowing the classification of certain groups of animals. This is essential for the handling and identifying of the large collections which come to a museum. The curator is frequently called upon to account for the distribution of the species he studies. With the increasing use of instruments of precision, the oxygen, temperature, humidity, and other requirements of any species may be worked out, provided the specimens are brought back alive.

The presence of living material in the laboratory invites the investigation of fundamental processes which are common to many groups of animals. To take but one further illustration, in lizards and birds molting may occur at regular intervals, while in Amphibia environmental influences may have a profound effect. It would seem that the mechanism controlling the molt must be the same throughout vertebrates, and investigations are under way in the Museum to determine what this mechanism might be. Evidence that it may be hormonal in nature has been obtained for certain groups.

Comparative studies strongly suggest that the glands of internal secretion, the endocrine organs, have played an important part in the evolution of many groups of animals. We have tested one small corner of the field experimentally. The giant salamander and congo "eel" are purely aquatic salamanders which retain some of the gill apparatus of larvæ. The question arises: Are these strange creatures degenerate young of some formerly terrestrial salamanders? Cretinous children if treated with thyroid grow into normal human beings and why should not the salamanders grow up?



NOT WHAT IT SEEMS

The *Sphenodon* or Tuatera is not a lizard but the only surviving representative of the reptilian order Rhynchocephalia, a group of reptiles more closely related to the crocodiles than to lizards. Various features of the skeleton, such as the bones of the temporal region, reveal the reptile's true identity

Although the treatment brought a rapid metamorphosis in the skin and a few other structures, the animals failed to change into land forms. Nevertheless, the result was interesting in showing how an animal may become adult in one part of its body and yet remain juvenile in another part.

During development the secretions of tissues which are not endocrine organs may enormously affect an adjacent part. At the time of metamorphosis, for example, the pollywog does not thrust out its forelimbs which have been growing under its throat skin, but a neat hole is digested through the cover for each forelimb by the degenerating gills of that side. This was first demonstrated by Dr. O. M. Helff, an associate of the Museum who has been coöperating in its research program. The processes of development are very complex, but such progress in their analysis has been made in recent years that an increasing number of investigators in universities and medical schools are being attracted to the field. Since the differences between animals first come into existence during development, the immediate cause for the difference must be in the developmental processes. Why, we may ask, should the Galapagos finches exhibit such a diversity of bill form when they live in the same place and eat essentially the same food. Obviously internal processes are molding these bills, but their nature has not yet been determined.

The advance of biology resembles the growth of a tree in that while branches may be thrust out in all directions there are certain zones of growth near the apex which carry the tree upward. These zones of growth lie today in the experimental approach to problems of species, structures, and functions. The grandeur of the theme of life, its multitudinous variety, makes the task of isolating any essential components difficult. The Museum with its many opportunities for securing the significant material is in a unique position for advancing biological progress. The work depends for its support on the generosity of public-spirited Museum friends who are glad to see unravelled at close hand some of the mysteries of life.

BIOLOGICAL DIAGRAMS

The principles controlling the origins and functions of animals have an important place in exhibition halls. Biological diagrams, such as those mounted along the walls in the Reptile Hall of the American Museum, represent the results of research in many institutions and are eagerly consulted by students

Group of Indian tiger for the new South Asiatic Hall

SCIENCE, ART, AND ADVENTURE BEHIND MUSEUM EXHIBITS

The Many Phases of the Work of Preparation and Installation of Materials Collected for Exhibition Purposes — The History of Life as Portrayed in the American Museum Exhibition Halls

By JAMES L. CLARK

Assistant Director, American Museum, in charge of Preparation

THAT the natural history museum of today is increasingly attractive and increasingly recognized as a community asset is due in large measure to a revolution in the display of museum material, which has taken exhibits out of the depressing sawdust doll class into the realm of art, and added alike to their appeal, their scientific exactness, and to their educative value. The revolution, in which the American Museum of Natural History has been a world leader, has been apparent to museum visitors, but the meticulous and incessant creative labor that has made it possible is unknown except to the initiate who has gone "behind scenes." This is the labor of love performed by the department of preparation, which makes ready for the critical eye of scientist and lay public alike the American Museum's acquisitions of material from the field.

It is a popular misconception that a museum is unchanging and unchangeable; that specimens are collected, "stuffed," mounted, and given an assigned post in perpetuity. The impression is common that with extensive collections once placed on exhibition, the museum is finished and needs only upkeep.

How different is the reality,—continual change! Improved methods of preparation and presentation are ever being devised, while the more exacting standards of exhibition alluded to make the mediocre unthinkable and set higher and higher goals. Meanwhile in the limitless field of nature are found almost daily new specimens to bring collections just so much nearer the completeness that is aimed at but never quite reached. Identification of new species and new phenomena, whether of today or of 50,000,000 years ago, brings to recognition new sets of facts. Research, study, and the grouping of these, bring new scientific conceptions or reassigns scientific values. With these gains the museum must keep step in what it displays, or break faith with the public that looks to it for authoritative guidance.

It follows then that the work of museum preparation is extensive, exacting, and never at an end. Nor is variety the least of its attributes. Its tasks range from the modelling of a microscopic organism to the reconstruction, in life size, of a whale, through all the ages the largest animal. Between amœba and leviathan lie vast worlds of creatures, the preservation and proper exhibition of which in the American Museum engages the full-time services and utmost cunning and ingenuity of more than fifty men and women—artists or superior artisans every one. And to supplement their services with structures and casings the Museum's department of construction must be called upon for resourceful workers in metal, wood, concrete, and stone.

But there is no more convincing evidence of the extreme thoroughness and artistic zeal wrought into the Museum's preparatory work today than the fact that making habitat groups ready for display usually costs as much as the expedition which collected the material in some remote quarter of the globe, and often takes much more time. Indeed, with funds for this work restricted, the Museum has had to decline offers for the financing of specific expeditions, unless an

MAKING A GROUP MODEL IN THE FIELD
James L. Clark, the author, designs and executes his sketch model of the lion group for the African Hall, while encamped in the very land of the lion

Photograph by James L. Clark

A FIELD STUDY FOR THE SCULPTOR-TAXIDERMIST

The actual material is but a small part of a successful group. First-hand information is inspiring and imparts an equal contribution to its success

equal sum were made available to care for the exploring scientists' specimens. For the same reason the Museum has had to decline offers of desirable material.

Time was when museum preparation—to speak specifically for the moment of mammal groups—went little beyond common taxidermy. Animals were frankly "stuffed." (Indeed, who does not remember the old exhibit whose seams finally parted to reveal the "stuffings?") Skins brought to the museum were packed with excelsior and other material, and the resultant "animal" was generally mounted stiffly erect, often with no hint of his natural attitudes, and certainly with no appropriate background or surroundings. The subtleties of form, the rippling of muscles under the skin, all the evidences of power and grace without which the animal cannot be truly visualized, were missing. But taxidermy has given way to veritable sculpture supported by innumerable arts and crafts and controlled by infinite sketches and measurements, protracted observations in the field and the evidence of the camera as well as of the eye. Preparators and artists of the department of preparation accompany the scientist explorer, half around the globe if need be, to gain the data and accessory material with which alone a habitat group can artistically display the animals as they actually are, in a section of their natural home as it actually is.

The advantage of participation in the collection of material and data by the men who are to prepare groups is obvious, but there is an even greater intangible gain. No one could possibly recreate these beasts, as they are found in their native ranges, unless he had seen and studied their rounded, subtle forms under all normal conditions of their daily life. Nor could an artist paint the superb backgrounds which enhance all recent groups,

STUDIES OF EUPHORBIA TREES AND ROCKS
Such bits of nature offer fine background studies for groups, and are typical settings for animals that live in the same locality

A LIMB OF THE EUPHORBIA TREE
Detail photographs, casts, and color notes are taken even of trees so that the accessory men may have data for their reconstruction

AN AFRICAN LANDSCAPE
Numberless beautiful vistas almost bewilder the collector in his selection of the best background for his group

PREPARING A LION SKIN
Special tools and preservatives must be taken into the field to insure proper care of all material until its arrival at the American Museum

Photograph by James L. Clark

W. R. LEIGH WITH SPECIMENS OF PLANTS
Mr. Leigh has accompanied two American Museum expeditions to Africa for the sole purpose of getting color studies of plant life and for backgrounds

unless he, too, had seen and absorbed the spirit of the veldt, of the jungle, or of the desert in which the animals roam. The modern group fails unless it imparts the living sense of beauty which inspired the museum men in the field itself.

So it is that our work starts, not in the studio, but in the field, and generally with more than one single representative of the department—for several must work on the group and much that is seen can never be imparted. If the expedition is objective—planned to obtain a certain group rather than to explore—the general design often is well in mind even before the field is reached. Accordingly there is no random taking of specimens. Every animal that comes within range is carefully scrutinized as to sex, age, condition of skin, and various phases of coloration or character.

Immediately the selected specimens are shot, each item of information that will assist in reconstruction in the American Museum studios thousands of miles away is permanently recorded. In the most recent instance, some seventy tape measurements were made of a tiger. Almost endless details are recorded in sketches, and casts are often resorted to. Meanwhile the camera has been making its own record, not only of the animal taken, but of his brothers and sisters in life. Even the movements of the beast, it is almost needless to say, can be and generally are recorded by photography—to remain as a permanent check on the naturalness of posture which the preparator today insists upon.

Actual preparation work—in the care of the pelt, bones, horns, etc.—of course has to start on the spot, and often entails the most intensive day and night applica-

Photograph by James L. Clark

THE FLOWER OF THE "SANSEVIERIA"
A detailed photograph of the plant shown in the upper picture. Such pictures with sketches and preserved specimens show the accessory man the formation of the flower cluster

tion to guard against damage and to insure preservation till the shipment, perhaps months later, reaches the tannery and other workrooms of the Museum. Meanwhile the preparators will have been busy in other directions. There will have been selected a representative section of the animal's habitat that will lend itself to framing into the foreground of a habitat group. By pencil, brush, and camera this is recorded with utmost accuracy as to composition and form. The artist makes sketches of the foliage and flowers; selecting a suitable and typical background, he spends days in transferring it to canvas. Thus are recorded completely the form and color of animals and their immediate and remote surroundings which will guide the preparators during the months of work to be done "back home."

But the expedition will also bring back

Photograph by James L. Clark

THE SPOTTED ALOE

From among the groups of plant life usually one is selected with its flowers from which to make plaster casts, while another is preserved intact

Photograph by James L. Clark

GROUPS OF PLANT LIFE AND ROCKS

No one could possibly conceive such a beautiful arrangement of color and form. Only nature produces them, and seeing them in their natural setting insures preserving all their original charm

preserved in many ingenious ways, the "accessories". (See "The Accessory Man and the Museum group," by A. E. Butler, NATURAL HISTORY, Vol. XXX, No. 3.) Bushes, grasses, flowers, tree trunks, and samples of soil and rocks are carefully selected and transported back to New York, so that the finished group may be made up entirely of material obtained in the field and of cunningly fabricated material based with exactitude upon it—even to individual leaves and buds.

Some of these "accessories" are dried and used as they are—but green leaves, flowers, and fleshy plants must be reproduced in wax, glass, celluloid, or other suitable materials, while rocks generally are made of plaster matching the sample in color and texture.

While the skins are being tanned to a soft and durable flexibility, the modelling

MR. LEIGH PAINTING A DETAILED BACKGROUND STUDY
In the wilds, the artist sitting quietly intent on his work may not be aware of rhino or leopards coming up from the rear. He must, therefore, always be guarded by a boy armed with a gun

R. C. RADDATZ MAKING PLASTER CASTS OF SELECTED LEAVES
Often a small "shop" must be set up in the field that the varied material may be properly handled while it is still fresh

IMPALLA IN AN ACACIA FOREST

An inspiration for a group. What artist could paint these exquisite tree forms unless he had actually seen them. The reproduction of such gems makes the American Museum groups unique

A BED OF "SANSEVIERIA"

From this photograph the accessory man reconstructs the bed in the group, using the specimens shown on page 488

AN ANIMAL IN THE MAKING

This and the following eight pictures show the stages in the mounting of a lion. A rough frame supported on an upright carries the leg bones and skull on which the clay is built up

of the animals begins. Here the medium usually is clay, which can be and is handled with the artist's touch despite the necessity for incessant check with measurements, photographs, and sketches. The objective is the reverse of tailoring—the modelling of a body to fit the "garment," in this case an animal skin. The model satisfactorily completed, a plaster cast is made, inside which are built up layer by layer sections of maché and wire mesh which are later joined. This thin but enduring shell or manikin, when removed, exactly duplicates the clay model. Upon this manikin is applied the tanned skin.

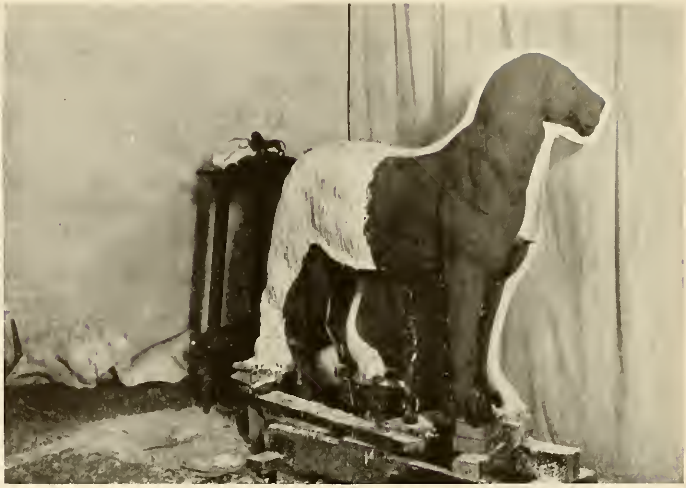
Meanwhile, in a broad recess in the wall of a proposed exhibition hall, the foundation will have been laid, the rock work set, and the larger trees and other objects put in their determined places. The artist, with his field sketches, and a vivid memory of field observations, is well along with the broad panoramic painting which will be the background for the whole scene and provide its general atmosphere. And in half a dozen workrooms the artisans in glass and wax and fabrics have been producing in infinite detail leaves, flowers, and all the hundreds of nature's smaller bits that lend conviction to the whole. Among these birds of the region are sometimes depicted. It is an interesting fact that birds remain the one large classification of Museum specimens for which the time-honored "stuffing" technique has not been excelled.

When all is brought together in accordance with an original sketch model, the lighting worked out, and the great

THE LION TAKES FORM

The author sculpturing the anatomy of the lion as it would be without the skin. Note the care with which the muscles have been worked out. A plaster cast of a lion's head and shoulder taken in the field rests on the floor at the lower left plate glass window sealed into place, we have a habitat group which is literally a section of pulsing wild life transported almost bodily from the field.

The habitat group, however, is not built and put on exhibition with the promptitude that the news announcement, "the expedition brought back valuable specimens," etc., brings to mind. The public inevitably has to wait from three months to three years for the completion of the intricate work involved. Further, the drying and curing of various materials enforces frequent waits, which are utilized to advance other groups. So many groups and so many tasks on other specimens are always in progress that the department generally wonders how, without more hands, it can accomplish the work asked of it.



MAKING THE PLASTER MOLD

The model completed and the skin tried on to insure the fit. One half of the model is shown already molded, while the other half has been partly applied

The sculpture method in use in the preparation of mammals has been found applicable to large animals; yet for elephants, rhinoceroses, and similar hairless, heavy-skinned beasts, other techniques must be used. Probably the most successful has been the method devised by the late Carl Akeley upon whose artistic skill, zeal, and ingenuity depends so much of the modern improvement in preparation, and who, like Dr. Frank M. Chapman, curator-in-chief of ornithology, was one of the pioneers in establishing the habitat group idea in this Museum. By this method, to state it briefly, the body of the animal is shaped on a frame which is covered with soft clay. The thick hide is laid on to the moist clay and the convolutions pressed into it. With the

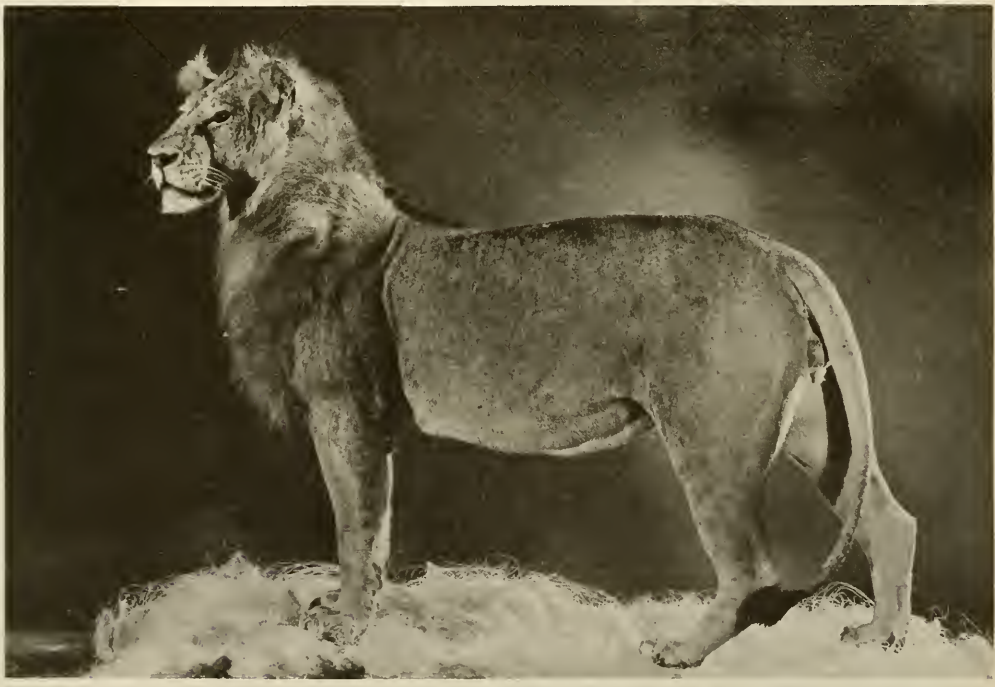
THE MOLD COMPLETED AND PARTLY REMOVED

One half of the mold has been removed and is resting on the floor. As the second half is the larger, it is necessary to break up the clay model before this part can be removed. It is inside this mold that the manikin is constructed

MAKING THE "MANIKIN"
The mold carries the form, and into this is constructed layer by layer sections of papier-maché and wire mesh to form the manikin

REMOVING ONE HALF OF THE COMPLETED MANIKIN
The manikin, a thin shell not more than one-eighth of an inch in thickness, is reinforced with half-inch wooden ribs, and then removed from the mold

APPLYING THE SKIN
The skin, which has been tanned into a soft, permanent leather, is dampened and applied with an adhesive to the manikin and arranged in all its details before it is allowed to dry



THE COMPLETED SPECIMEN
Strong, permanent, and lifelike—a product that has involved more work than if it had been sculptured in bronze

aid of field notes, sketches, and photographs, the body takes its final and correct shape from the hide, which is the reverse of the method employed with the hair-skinned animals.

There are, however, limits to the application of either of the above methods. Modelling a whale in clay or even preserving the "skin" would be impracticable. Accordingly the whale is represented in a built-up model exact in measurements (made from an individual specimen) and in coloration. Sharks and smaller finned creatures may be modelled from casts or measurements and the skins used over the model.

Interesting phases of preparation which have reached high development at the American Museum are those supporting the exhibition and research work of the departments of palæontology and lower invertebrates. Palæontological preparation, dealing with fossil remains of prehistoric creatures whose probable weight might range from a few ounces to many tons, has little in common with the preparation of extant animals. It may involve the gradual exposure of a skeleton or a clutch of dinosaur eggs by picking surely and patiently with a needle-like instrument at a block of sandstone shipped home from the Gobi desert. Or it may entail six months' trial of patience, eyesight, and skill in gradually piecing together under a magnifying glass from thousands of random fossil fragments the skeleton or a few bones of an animal previously unknown. This pursuit probably has no counterpart except in the cut-up picture puzzle, but is a vastly more trying game because it is played in three dimensions instead of one, there is no picture or model to go by, and pieces are inevitably missing. The preparator in this case must have extensive knowledge of present and past bone structure and anatomy. Eventually the skeleton appears in the exhibition hall or the study collection so perfectly restored as to give the impression that it was found that way.

THE PREPARATOR'S VARIED WORK
Otto Falkenbach turns his hand to restoring a minute fossil

As much a trial of patient skill is the modelling of invertebrate life,

H. O. MUELLER WITH HIS GLASS-BLOWING APPARATUS
Patience, skill, and infinite knowledge through research, alone make it possible to reconstruct in glass enlarged models of the most delicate organisms of life

especially the organisms which are so tiny as to be ordinarily invisible but are seen to take grotesque or beautiful but involved forms when magnified. In all their translucent intricacies these strange bits of living matter are exactly reproduced, even to color tints, by artists specializing in glass, wax, and other media, so that the visitor has under the naked eye hundreds of specimens which otherwise only the microscope in expert hands and in many exotic places could show him. Here, too, are prepared for exhibition corals, sponges, and many other marine growths—often with much of their substance intact but with their colors and life textures restored by the artist, who perhaps has descended fathoms under water in a windowed steel tube to make his color notes.

In all the varied and demanding activities of museum preparation a special technique combined with the ability to improvise or invent is required. (Many of the processes now widely used were devised in the American Museum.) Eloquent of the resourcefulness which a preparator can bring, and often is obliged to bring, to his task, is the fact that Mr. Akeley, in the course of museum work, invented a cement gun which was adopted and widely used by industry, just as he invented a motion-picture camera for field use which is now employed by news reel photographers. It can be seen readily why the Museum preparatory personnel is all "hand picked" and largely "hand grown." There is no school for preparators except Museum experience, and consequently no supply from which full-statured preparators can be obtained.

Men and women of the department of preparation have come to the Museum from many walks of life and many places on both sides of the Atlantic, usually as the result of demonstrating some unusual aptitude which could be turned to the purpose of delighting and instructing the public through the medium of the exhibition hall. It is a matter of record

A PUZZLE IN PALEONTOLOGY
Otto Falkenbach reconstructing a large tortoise from fragments of fossil bone. Infinite patience and knowledge are required for this laborious work

that one man, who afterward became a skilled preparator, first proved his aptitude by the accuracy and judgment with which he wielded a pick in the excavation of fossils. Another, whose occupation was far removed from the scientific, was self-taught in art; the merit of bird studies which he made in spare hours brought him to the Museum, eventually to do outstanding work with the brush. Still others have had unusual skill in glass-working or other of the less common arts.

In the coming to life of museums which long slumbered in a dusty obscurity the twin activities of preparation and exhibition have stimulated and been stimulated by an increasing public interest. And this interest, as well as the recognition of the Museum as a great educational factor which has resulted in city appropriations for buildings to house exhibits, is well justified by the variety, beauty, and content of the great exhibition halls, which soon will number fifty.

The long steps forward which have led to the adoption and development of the habitat group have had so appreciative a response from the public that the further step now being taken in the development of the exhibition hall as a definitely planned and balanced unit should lift the Museum to a still greater place in the community. For the modern hall but carries the habitat group idea to a logical conclusion—as a whole hall of habitat groups, or of related specimens, predesigned in every detail for the purpose, which gives the visitor a balanced view of the fauna, flora, and topography of a whole region, or of the phenomena of a scientific classification.

Such halls, each one an open textbook, may require, from preliminary scale model to dedication, years in the preparation and they may cost hundreds of thousands of dollars. Yet they are well worth the expenditures of time and money in the sheer pleasure alone which their beauty and interest grant, aside from their obvious purposes of disseminating knowledge of nature with scientific exactness and of preserving for generations to come significant species which are fast disappearing.

A case in point is the South Asiatic Hall, soon to be opened after eleven years of arduous collecting in the field by the late Col. J. C. Faunthorpe and Mr. Arthur S. Vernay, and several years of preparing and mounting groups. The hall, which will hold the finest collection of Indian game groups in existence, and will in every architectural detail create the veritable atmosphere of India, is to be dedicated to public use in the presence of dignitaries from India, England, and this country, as befits one of the finest, if not the finest, museum exhibition hall in the world.

The new Hall of Ocean Life, housed in a separate building within a court, will be, it is believed, the largest of all museum halls given over to a single division of natural history. It will, even though but a single hall, surpass the average small city museum. Another major project, now awaiting increased personnel and money, is the redesigning of the North American Hall of Mammals in order that our own fauna shall be exhibited in a manner fully comparable to those from distant continents.

Other new and prospective halls, awaiting only the funds to carry them forward, might be mentioned if space allowed, but they must be left to tell their own stories to the millions of visitors who will pass through them.

This article cannot close, however, without mention of the Akeley African Hall, conceived and projected by Mr. Akeley as probably the first of these modern exhibition halls. It was his dream and into it to day is going much of his work and planning. Unfortunately the project did not get well under way until after his death. This, it will be recalled, came in his beloved field—"brightest Africa"—to which he had returned, despite precarious health, to gather more of the specimens that make plain to all comers to the Museum Africa's secrets and her beauties.

Such is the zealous spirit of the seeker after truth—the spirit which the preparator must bring to his task.

Pupils arriving at the American Museum for a Public School Children's Lecture

THE MUSEUM IN EDUCATION

Its Unparalleled Present-day Opportunity to Serve the Community and to Participate in the Rapidly Advancing Movement for Visual Instruction

By GEORGE H. SHERWOOD

Director of the American Museum and Curator-in-Chief of the Department of Public Education

DURING the past quarter of a century pedagogical thought has stressed more and more the importance of visual instruction and tactile education, and marked changes in teaching children have been developed. The book learning of fifty years ago has given way to methods which require greater observation on the part of pupil and student, and encourage acquisition of perceptions through hand as well as eye.

Many factors have contributed to this development, important among which are the perfection of the camera, permitting ready recording of experiences and observations, the remarkable development of the motion picture, and the other recent discoveries of science which have made the marvels of yesterday the commonplaces of today.

In this forward movement of visual education, museums of all kinds—museums of art, of history, of industry, and of science—have played and continue to play an increasing part. In the clamor for visual aids and physical objects which can be examined at close range, or actually handled, teachers naturally should turn for assistance to museums, the great reservoirs of treasures from the world over. The museums have responded splendidly, willingly, and themselves have undergone an evolution which has made them a more vital influence in the community. They have passed from a static condition to one of progressive activity; they are now recognized educational agencies whose importance in our school and college curriculums is more widely appreciated every day.

For centuries art museums have catered to the love of the beautiful, inherent in everyone, and have been sources of delight and inspiration. Only comparatively recently, however, have they taken an active part in the educational field, visualizing for child and adult significant facts of history and the achievements of man. Similarly, historical museums, through their memorabilia and models, make fascinatingly real to the child his otherwise somewhat dry and lifeless history lesson. The infant of the museum family, the industrial museum, has arisen in this industrial age to perform an important mission in illustrating principles of applied science on which our civilization is based.

The growing interest in the out-of-doors, a result of modern ease of travel by bicycle, trolley, automobile, motor bus, and airplane, has given the natural history museum an undreamed of opportunity to serve the community, and participate in this movement for better visual instruction.

The up-to-date museum, therefore, if performing its proper function, must be thoroughly alive. It is not enough for it to be the depository for valuable records, for strange and beautiful specimens, and to accumulate a vast store of information. It must touch the lives of the people through its exhibits and displays. It must be able to make available and intelligible to the people the results of its researches and their application to human welfare.

Through improvements in the technique of preparation, through attractive and readable labels, through the development of the habitat group—which shows the interrelation and interdependence of life—the exhibition halls of the natural history museum have become veritable magnets drawing young and old. The attractiveness of the exhibition hall presentations reflects the arduous efforts of the explorers and field workers who have penetrated to remote corners of the earth to assemble facts, and the careful and painstaking study of the curators who have coördinated these facts and interpreted their significance. It is, however, through direct contact with the school system that museums have become important factors in education.

The American Museum of Natural

THE LANTERN SLIDE ROOM IN THE SCHOOL SERVICE BUILDING

Practically the biggest activity of the American Museum's service to the schools of Greater New York is the lending of lantern slides. A corps of workers is constantly collating the slides into sets to fit the New York City Board of Education syllabus in every school subject. Teachers in the Public Schools of Greater New York may borrow the particular set which best meets their class-room needs

A NATIVE HABITAT BIRD GROUP

The oldest feature of the American Museum School Service is the circulation of nature study collections comprising specimens of mammals, birds, insects, lower invertebrates, minerals, woods, and public health exhibits. These collections are planned to enable the school children to handle and to visualize in natural surroundings the actual animals about which they are studying

History belongs to the modern museum group, and the purpose of this article is to set forth the various phases of the service which it is rendering to schools, colleges, and universities. The Founders of the Museum, led by Morris K. Jesup, J. Pierpont Morgan, Joseph H. Choate, and Theodore Roosevelt, the father of President Roosevelt, foresaw the educational possibilities of the Museum, even in its inception in 1869, and their ideals have been fostered and ably and wisely developed by President Henry Fairfield Osborn throughout his administration.

Early in the Museum's history the desirability of close contact with the school system was realized, and in 1880 Prof. Albert S. Bickmore, that great pioneer in education by the visual method, inaugurated his illustrated lectures for teachers, known as the "Bickmore Lectures." The standard of quality which he established has not been surpassed even today with all the improvements in photography.

The present School Service policy dates from 1904, when nature study was introduced into the curriculum of the city schools and many teachers sought the Museum for visual aids. The Museum school activities have the hearty endorsement of the Board of Education, superintendents, and other school officials of New York City, but the conduct of the work is left entirely to the department of public education of the Museum. The members of the Board of Estimate and Apportionment of the City, too, have expressed their belief in the value of the Museum's service to the schools by constructing our School Service Building with its unequalled facilities for carrying on this work.

The present educational program of the Museum may be grouped under two main headings:

(a) Extra-mural activities—Museum service in the schools and colleges

(b) Extra mural activities—school service at the Museum.

Under the first group are:

1. Circulation of nature study collections.
2. Lending of lantern slides.
3. Distribution of motion picture films.
4. Lectures in schools and special lecture centers.
5. Lending of circulating collections to branch libraries.
6. Coöperation with nature rooms in schools and with organizations working with children.
7. The Trailside Museum and Nature Trails at Bear Mountain.

The intra-mural activities include:

1. Lecture courses at the Museum.
2. Instruction for the blind and sight conservation classes.
3. Exhibition hall instruction and guidance for visiting groups.
4. The Junior Astronomy Club.
5. Special courses for teachers.
6. Adult education.
7. Coöperation with the training schools for teachers, high schools, and colleges.

The rapid development of this service in education and the extent of its influence is indicated by the table on this page, which shows an increase of con-

	1914	1919	1924	1929
Visitors, Trailside Museum and Nature Trails, Bear Mountain[1]				186,000
Attendance at Library Loan Exhibits		104,339	33,472	40,283
Attendance at Lectures	65,785	35,221	117,910	226,608
Pupils Viewing Motion Picture Films			115,849	1,725,865
Pupils Using Nature Study Collections	1,273,853	860,992	1,247,914	1,866,399
Pupils Viewing Lantern Slides		records not available	3,147,156	8,550,181
		Grand Total of Contacts	4,662,301	12,595,336

[1]Nature Trails established 1927.

THE PHILIPPINE ISLAND LOAN EXHIBIT

The Museum has prepared for the use of schools and libraries special exhibits illustrating the typical culture of a country or people. The intention of these exhibits is to stimulate the interest of the school child, and through him, his parents, to extend their knowledge of the world and its peoples by wider reading and by visits to the Museum to study the more complete exhibits in its halls

HIGH SCHOOL STUDENTS ATTENDING A BIOLOGICAL LECTURE

Among the cultural courses at the American Museum is a special series of biologic lectures, given by specialists, and arranged specifically for students in high schools and teachers' training schools. The subjects are chosen for their general interest and correlation with the courses of study in the schools

tacts in five-year intervals nearly tenfold in fifteen years, and nearly trebled in the last five alone.

The recent rapid growth of our educational service is one that Museum resources could not have accomplished unaided. Timely recognition and support by the Carnegie Corporation and the Cleveland H. Dodge Foundation made it possible. Further development has been helped materially by generous contributions of funds and advice by Mr. Felix M. Warburg and Mr. George D. Pratt of the Museum's Board of Trustees.

The remarkable success of our present School Service is in great measure due to the fact that the collections, slides, and films are lent to the schools for specified periods and not presented to them. This policy, adopted from the beginning, has resulted in a closer contact between the Museum's educational staff and the schools, has stimulated the interest of the children, and indirectly has led to a more practical use of the material supplied. This intensive School Service is city wide. Museum messengers by motor trucks deliver specimens, slides, films, and other material to schools in Greater New York, without expense to school or teacher.

The oldest feature of the Museum's School Service is the circulation of nature study collections, begun in 1904 in response to many requests from teachers. The collections are contained and displayed in transportation cases about the size of a large suit case. They comprise specimens of mammals, birds, insects, lower invertebrates, minerals, woods, and public health exhibits, selected primarily to place in the hands of the teachers material actually required in their work. These collections may be obtained by teachers merely for the asking, the Museum representative attending to all other matters, including delivery to the school and the transfer of the collections at the end of the loan period.

To the question "Is this method of visual instruction worth while?" the following statistics are in themselves a sufficient answer: In 1929, 557 public schools regularly received these collections. The total number of loans was 5,327. The specimens were studied by 1,857,729 pupils. It would be impossible to overestimate the indirect value to the thousands of city children who have little opportunity to see the great out-of-doors. The country dweller can hardly realize the restricted environment of many city children. Their knowledge of nature is limited to the dog, the cat, and perhaps the horse. The vegetable market window and the pushcart represent their knowledge of flowers. In a class recently at the Museum a child for the first time saw grass. No wonder, then, that the little nature study exhibits from the Museum stimulate their imagination and broaden their outlook!

Perhaps the most useful feature of the Museum's School Service is the lending of the lantern slides, because of the great variety of the subjects covered, the simplicity of use in the classroom, and their practical application to the work of the individual teacher. The Museum now possesses a library of more than 70,000 slides. The statistics show a phenomenal growth, but, impressive as these figures are, the service can be greatly enhanced if financial provision is made for duplicat-

BLIND CHILDREN STUDYING NATURAL HISTORY

Only through their sense of touch are the blind able to "see" the objects in the world around them. At the American Museum, children of the New York City Schools who are so handicapped have the opportunity, under sympathetic instruction, to handle and learn all about animals, birds, flowers, and minerals

A MEETING OF THE JUNIOR ASTRONOMY CLUB
Mr. Albert Ingalls, of the *Scientific American*, is demonstrating to the youthful members of the Club how to construct a telescope

ing sets of slides, the educational value of which has been established by the use of the original set. At present we are obliged, because of lack of duplicate material, to deny fully 40 per cent. of the requests from teachers for this visual instruction material. So considerable is the demand that some of the lecture sets are reserved eighteen months in advance. A fund of $100,000 can be wisely spent in relieving this situation.

The motion picture film has now an established place as a supplementary aid in classroom instruction. The production of the narrow width film (16 mm.) and the perfection of projection apparatus make it possible to use films more extensively in the schools than has been the case with standard film, where a licensed operator was required under the fire laws.

Through purchase, gift, and deposit, the American Museum has built up an extensive loan library of films, both of standard and narrow width, which are available for the schools and, in part, for other organizations or individuals. Requests from teachers for this type of visual aid make it highly important to enlarge our film library.

For several years the lending of nature study material to the schools has been supplemented by special exhibits lent to public libraries of the city. These are more extensive than the regular circulating collections, their primary purpose being to stimulate the child to read good books and induce him to come with his parents to see the more complete exhibits in the Museum halls.

As one of its contributions to out-door education, the Museum is operating a Trailside Museum and Nature Trail at Bear Mountain, in coöperation with the Palisade Interstate Park Commission. In this primitive forest area, visited each year by many thousands of children and adults, the living specimens in their natural habitats are interestingly labeled, so that the visitor can readily learn about the habits of plants and animals and their relation to their environment. There is a botanical trail, a zoölogical trail, a geological trail, and a historical trail, this region being of special importance in Revolutionary history. Coöperation with the educational and camping department of the Interstate Park has been carried on, and assistance given to nature councilors and directors throughout the Park with their individual museums and general educational problems. Nature educators from many parts of the country and abroad have studied the trails with a view to establishing similar projects.

Important as are the extra-mural aids, of equal or even greater value is the service which the Museum can give when teachers and pupils come to the Museum. First among these activities are the lecture courses, if numbers are taken as the criterion. Last year more than 226,000 from elementary and high schools and from colleges attended these lectures. Included are the regular courses of lectures given annually in the auditorium of the Museum and designed especially to supplement, *not to replace*, the classroom work of the teacher in geography, history, and natural science. There is also a course for high school students, and a series of lectures or films for the general public on Saturday afternoons, in addition to a number of special lectures arranged upon request. The enthusiasm of principals and teachers is evidence of the value of this branch of the Museum service.

The instruction given through the lectures in the auditorium, which seats some 1,500, is mass instruction, in which many schools are represented at each lecture. In order to give more intensive instruction than is possible in an auditorium lecture, we have recently developed a series of exhibition hall talks. Under this plan a single class of pupils is taken into

A SCHOOL GROUP GATHERING INFORMATION ABOUT MINERALS

By making arrangements in advance, teachers who desire to bring groups to the American Museum for study may have the services of an instructor who will accompany them through an exhibition hall, thus enhancing the value of the visit

THE TRAILSIDE MUSEUM AT BEAR MOUNTAIN
Visiting groups from near-by camps always find a warm welcome awaiting them at the Trailside Museum. Here they get first-hand knowledge of the wild animals and plants of the vicinity, a knowledge that is of practical value to them during their camping sojourn

one of the classrooms of the School Service Building personally to examine and handle material under the guidance of a Museum instructor. After half an hour in the classroom, the group is taken into the exhibition halls to examine the larger collections pertaining to the particular subject of the talk. This development is meeting hearty commendation.

A specialized branch of the Museum's educational work is the instruction for the blind which has been developed through a special endowment, the Jonathan Thorne Memorial Fund. The blind children in New York City are taught in the same public schools as normal children. They are grouped in sight conservation classes in charge of trained teachers under the guidance of a special supervisor. The Museum makes special provision for these children. In consultation with the Supervisor for the Blind, informal talks which can be illustrated with actual specimens or with apparatus are given by the Museum staff.

Another important feature of the Museum's service is the general guidance through exhibition halls. The well-labeled exhibition hall, with its habitat groups, its carefully selected specimens, and its well thought-out arrangement, stands as the great silent teacher, a true exponent of visual education. What a vast store of information is contained in these halls, and what an aid they are to teachers in giving to their pupils accurate knowledge of nature! By making arrangements in advance, teachers who desire to bring groups for study and examination of the principal exhibits may have the services of an instructor who will accompany the group through the exhibition halls, thus enhancing the value of the visit.

A new development of our educational program of special interest to children is the Junior Astronomy Club for boys and girls in organized coöperation with our department of astronomy. Meetings are held weekly and programs are given alternately by club members and by guest lecturers. The club is conducted by its own members, which stimulates the children's initiative and will do much to develop leadership. The children have shown a keen interest in this subject.

Last year the Museum arranged two courses of lectures and laboratory work for teachers,—a course in geography primarily for teachers in the elementary schools, and a course on natural history topics for teachers in high schools, colleges, and universities. These lectures were given by members of the scientific staff of the Museum, and their purpose was twofold: first, to give to teachers in background lectures some of the intimate information resulting from the explorations and researches carried on by the Museum, and their relation to similar researches elsewhere; and, second, to give to the teachers something of the inspiration of personal contact with explorers and other scientific workers who have achieved success. The experience of the past year indicates clearly that this service is heartily welcomed and plans for its further development have been made.

Mere mention of the names of the organizations, institutions, and individuals who have sought Museum assistance would be altogether too long to include in this article. For years, however, the department of education has coöperated with the Training Schools for Teachers of the city, supplying material to the pupil teachers; coöperation has been extended to the colleges and universities of the vicinity, and many groups from such institutions have utilized for study and

A TRAILSIDE EXHIBIT

The children who live near the Trailside Museum at Bear Mountain lose no opportunity to visit the nature trail exhibits of live creatures, and often bring to the Museum helpful additions to its collections

IN THE "NATURE ROOM"

The American Museum has set apart this room in the School Service Building especially for the activities of the School Nature League. So popular has the Nature Room become that there is scarcely ever an hour in the day when there are not present several groups of interested students of Nature

research the valuable collections to be found in our exhibition halls and study rooms.

While the foregoing review of the Museum's educational activities makes an impressive record, in reality only the surface of the possibilities for service has been scratched. Up to the present time attention has been given principally to service for the elementary schools, and only recently have plans been developed for a more intensive service for high schools, colleges, and universities, and for teachers themselves. The Museum with its incomparable collections in many branches of zoölogy, geology, and palæontology, with its highly trained men of science, with its special researches, with its publications, is a fertile source of information for advanced students in colleges and universities. The next phase in the development of the Museum's educational service is provision for closer coöperation with such institutions of learning.

Where can the student of palæontology find such illuminating material as exists in our hall of palæontology? Where can the student of ornithology find a more comprehensive presentation of birds in relation to their environment than in our habitat bird groups? Where can the student of anthropology obtain better material for his studies than in our anthropological halls? The hall of reptiles, Darwin hall, and the hall of insects have proved of inestimable value to teachers and students of fundamental biological principles. In short, all of our exhibition halls, supplemented by the vast collections in the study rooms, are great indoor laboratories for science students. With the idea of bringing about closer coöperation between the Museum and the colleges and universities of the city and vicinity, special provision is now being made for the reception of such groups and a more intensive use of the exceptional facilities which the Museum possesses.

Another almost untouched opportunity is in the field of adult education. Here the Museum can render a valuable service to adults by giving instruction, illustrated with Museum specimens, to industrial groups, to those of foreign parentage who are eager to learn of American institutions, and to those who are desirous of having a more intimate knowledge of the latest developments in biological research and who want to know more of the Museum's methods of exploration and discovery.

Further growth of the existing branches of the Museum's School Service and these new activities briefly outlined are held in abeyance until additional financial support can be secured. Here is an opportunity for generous-minded friends to make a direct contribution to human welfare because of the far-reaching influence of the Museum's work.

A TAXIDERMY CLASS AT THE AMERICAN MUSEUM

Here Boy Scouts are being taught how to prepare specimens for use in their own museums, in camps, and at Troop meeting places. The profession of taxidermy has drawn into its ranks more than one Boy Scout who had his initial instruction in that art at these classes

A view in the composing room of the American Museum Press

THE AMERICAN MUSEUM PRESS

An Open Door to a Quickened Knowledge and Appreciation of Natural Science for a World-wide Audience

By HAWTHORNE DANIEL
Curator of Printing and Publishing, American Museum

IN a very real sense the whole world comes to the American Museum of Natural History, whose roster of visitors, if so huge a book could be conveniently kept, would be seen to include men and women from all parts of this continent and all nations on the globe. Yet the million of visitors who each year traverse its halls mark but the beginning of the Museum's world-wide contribution to the knowledge of Nature and to advanced scientific thought. Had the Museum relied only upon its exhibition halls and lectures for the spread of its gleaned information, it would still be great and influential, but it would not be the household word it has become in virtually every land.

Time was when the scientist worked and lived as a recluse. He was a man apart, who neither sought nor expected to have his labors understood and who felt under little obligation to distribute his knowledge. But science has become indispensable to everyday life and habitual to everyday thought. What the scientist has to say goes broadcast by printed word to all seekers, and in this age they are many. Meanwhile, the scientist has come to see the opportunity which the printing press gives him to inform and to educate. This he does through scientific articles, through scientific and "popular" books, through handbooks, textbooks, and guidebooks, and through articles in magazines and newspapers. Thus a scientific group, such as distinguishes the American Museum, has an audience, and wields an influence upon thought, for which there is no territorial limitation.

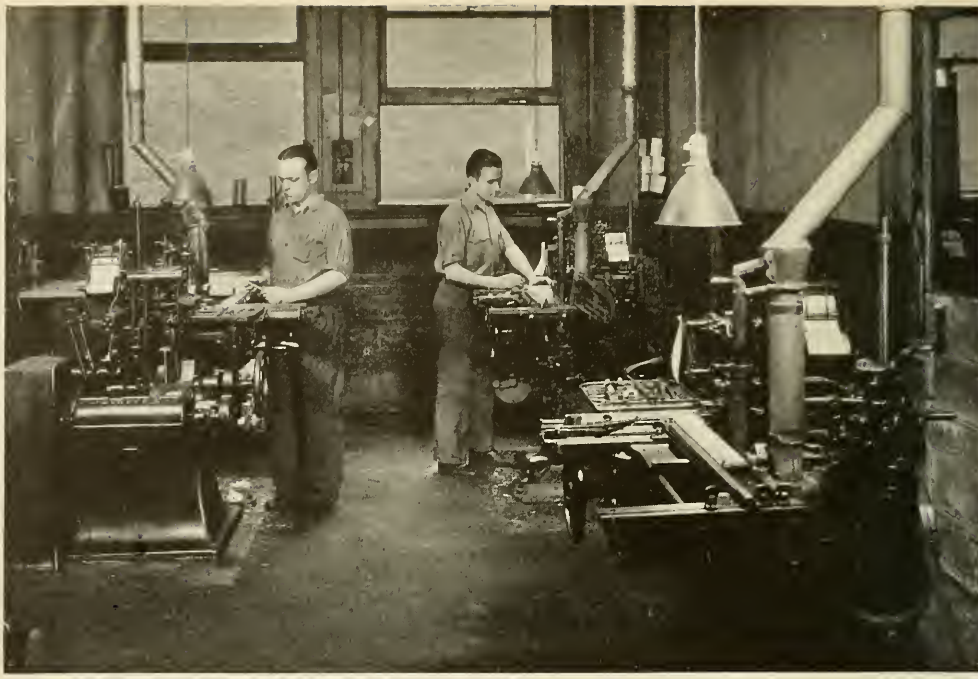
The detailed list of publications by the Museum scientific staff and affiliated scientists which the American Museum Press issues is formidable, and to it can be added an even longer list of books and articles distributed through outside publishers. The one is addressed primarily to a scientific audience and reaches the general public only by proxy; the other goes to the larger and growing audience that seeks vicarious travel, knowledge of what Nature so lavishly provides at home and in odd corners of the world, and the stimulation of threading—with the scientist turned popular guide—the miracled paths of the ages and the newly surveyed byways of today.

For Museum authors the pace in output and in impress upon the public mind has been set by the president, Henry Fairfield Osborn, who, entirely aside from technical works, generally issued by the Museum itself, has opened to many thousands of laymen readers in many languages the door to understanding of the larger problems and broader dramas of Nature from the beginning. "It is not enough for scientists to know," says Doctor Osborn, "it is important that *people* should know." Accordingly, palæontology, archæology, biology, and evolution become to the world at large more than words. In *Men of the Old Stone Age* Doctor Osborn is credited with having produced the standard work on archæology, with a virtual sequel in *Man Rises to Parnassus.* In *The Origin and Evolution of Life*—translated into French, Spanish, German, and Japanese—is seen the whole scope of evolutionary rise; in *The Evolution of Mammalian Molar Teeth* the rounding out of one phase of research into the broad picture of the past. Other works in a varied list too long to appear in detail include *The Age of Mammals, From the Greeks to Darwin*—translated widely, *Impressions of Great Naturalists, Evolution and Religion in Education,* and *Creative Education in School, College, University and Museum.*

In length of list Dr. Frank M. Chapman, dean of the Museum's scientific staff, follows Doctor Osborn, with the delightful and authoritative bird

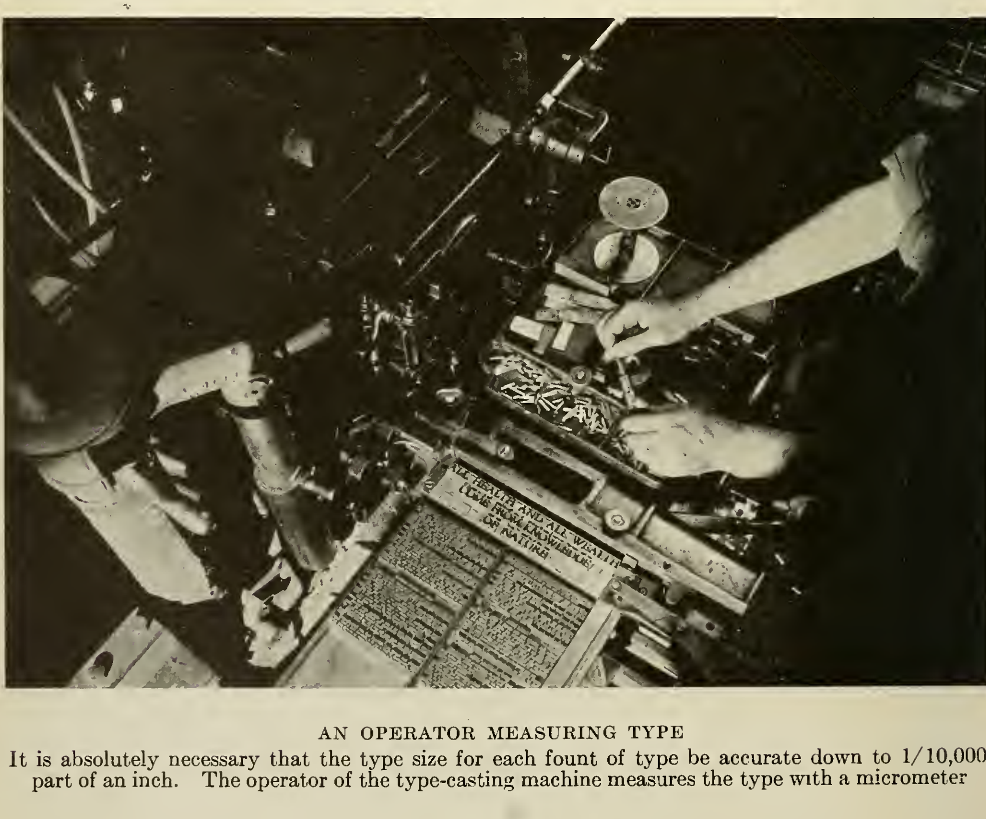
THE MONOTYPE KEYBOARD

By pressing the keys, the operator cuts stencils into a paper ribbon, which later is run through and controls the type casting machines



MONOTYPE TYPE CASTERS

The stenciled ribbon can be seen in place in the type casting machines. These machines cast individual types, which set automatically, line for line, in a galley (printer's tray)

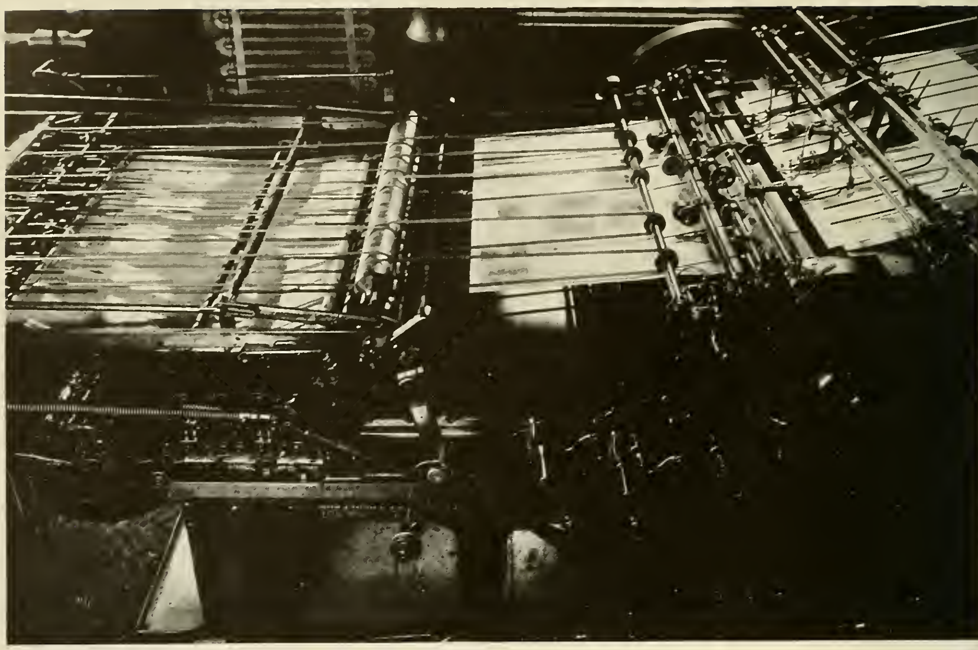


AN OPERATOR MEASURING TYPE

It is absolutely necessary that the type size for each fount of type be accurate down to 1/10,000 part of an inch. The operator of the type-casting machine measures the type with a micrometer

A CORNER OF THE PRESS ROOM
Showing the automatic cylinder press on which NATURAL HISTORY and most of the Guide Leaflets are printed

THE CYLINDER AND THE TYPE BED
It is in this section of the press that the actual contact is made between paper and type. On the cylinder is a freshly printed sheet of the July-August issue of NATURAL HISTORY



ON THE WAY TO THE STACKING PILE

After the NATURAL HISTORY sheets are printed, they are delivered along the tapes to the platform underneath the end of the machine, where they are automatically straightened and stacked

literature that has done so much to muster armies of bird-lovers, while many others—through their writings—have vastly quickened knowledge and appreciation of Nature. Akeley, Andrews, Anthony, Beebe, Breder, Brown, Burden, Chapin, Clark, Dean, Fisher, Gregory, Gudger, Johnson, Kunz, Lutz, Mead, Miner, Morden, Murphy, Nelson, Noble, Reeds, Wissler—these are a few of the familiar names.

Though less direct in their dissemination of general knowledge, the technical scientific publications of the Museum and its staff, nearly all issued by the Museum Press, have an influence that is far-flung. Distributed regularly to 952 learned societies in nearly all lands, they become an integral part of the working knowledge of world-science. They are known and used to such an extent that in a number of fields scarcely any scientific project is undertaken without reference to them.

These publications, usually the work of curators of the Museum, customarily have been issued in three forms: The *Novitates*, tersely outlining new discoveries or descriptions, which generally establish a priority and form the basis of more elaborate treatment later; the *Bulletins*, papers on zoölogical, geological, and palæontological subjects given detailed handling, and the *Memoirs*, in quarto volume size, in which important subjects are given extensive handling and copious illustration with an impressive massing of established evidence. Classified separately are the papers on anthropological subjects, regularly issued, and important special volumes, including a monograph, *A Review of the Primates*, by D. G. Elliott; and the Bashford Dean *Bibliography of Fishes*, in three volumes, with a fourth awaiting publication.

Among important works being published are an outstanding Memoir by President Osborn on *Evolution of the*

Proboscidea, now largely in type after twenty-three years of preparation but awaiting before going to press the evaluation of material discovered in recent months; and a *Bashford Dean Memorial Volume*, which will give in about ten parts, to be issued over a period of years, an appreciation of the life and American Museum work of this distinguished former curator of ichthyology, with scientific studies of unpublished drawings and material left by him.

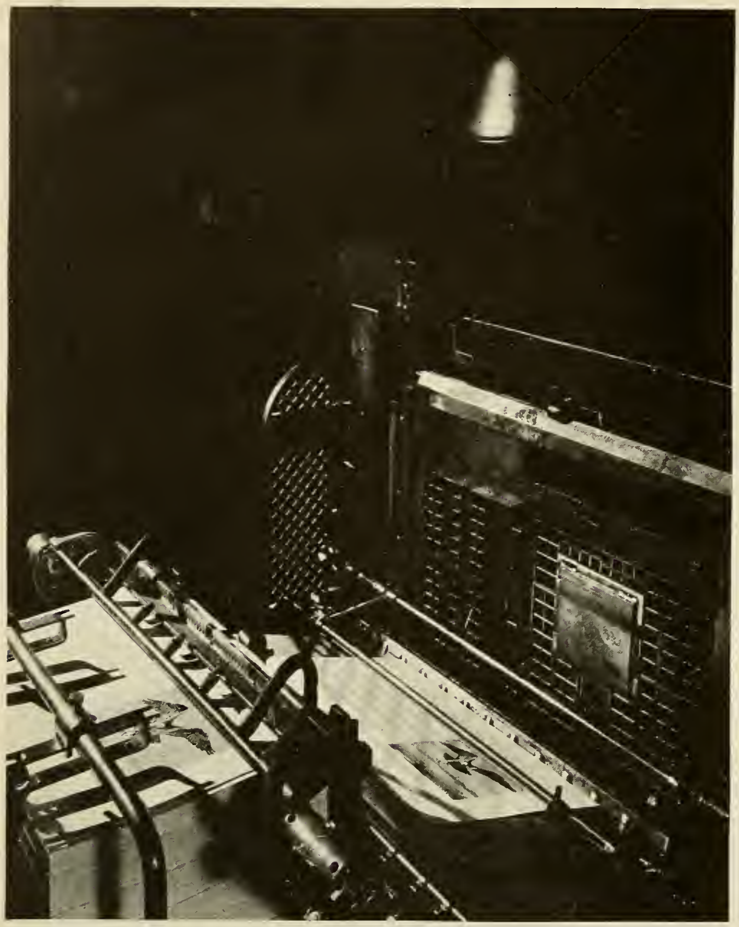
It is a commentary upon both the exploration and research of the Museum that, since 1921, discoveries or new scientific findings have been announced in 427 *Novitates*. Since 1881, which marked their start, the *Bulletins*, soon to number 61 volumes of 600 to 700 pages each, have contained about 1000 articles. The *Anthropological Papers*, now approaching their 32d volume since they were instituted as such, and the 17 volumes of *Memoirs*, bring to about 1600 the total of scientific articles issued through the Museum's regular channels.

This total, impressive though it be to one who examines the titles, does not represent the Museum's potential contribution to science publication. Only through an increase in the editorial staff, which is charged with the responsible task of editing and reading proof, and in the mechanical forces, could the quickly available material be sent to press, while only through an increase in scientific assistants could the curators, shorthanded and handicapped by routine duties, be released to work up great quantities of other material that should receive publication.

So exacting are the requirements of science—which must work continuously, and with no margin of error, from established facts toward the previously unknown or unproved—that preparation of some of these works represents a lifetime of gleaning in a single field. The total labor upon many others can be measured only in months and years. *The Titanotheres of Ancient Wyoming, Dakota, and Nebraska*, (prepared for Government printing by President Osborn as vertebrate palæontologist of the United States Geological Survey) with its two volumes, 953 pages, 236 plates, and 797 figures, occupied nearly thirty years from the start of the work to its issuance in bound form last year.

With meticulousness the first requisite in the literary preparation of scientific publications, "following copy" is no less imperative, though it lead through a maze of scientific names, foreign names, special scripts and characters, formulæ, equations and signs, which try the sureness and inventiveness of the printer. For this

A SECTION OF A TYPE CASE
These cases are filled with type from the monotype caster. This type is used for making corrections by hand



THE VERTICAL AUTOMATIC JOB PRESS
Here is a NATURAL HISTORY cover being fed into the vertical press

first, often used as textbooks, deal with subjects illustrated by collections in the Museum; the second, with exhibits, series of exhibits, or whole halls of the Museum. Numbering at present some 75 catalogued cloth and paper-bound booklets and leaflets, these, with the large *General Guide to the Exhibition Hall,* have an important part in the educative function of the Museum as a whole, just as a score of publications of its department of education further the more formal teaching activities.

For acquainting the Museum's friends with its scientific and financial condition as an institution, reliance is placed mainly upon a very complete and detailed *Annual Report,* issued by the Museum Press. All holders of Museum memberships—distributed throughout the Union and sixty-six foreign countries—receive also one of the most valuable and effective of all Museum publications—NATURAL HISTORY.

This Journal of the American Museum of Natural History is, indeed, the largest individual task of the publishing department. Established in 1900, and hence in its thirtieth volume, NATURAL HISTORY six times a year takes to readers in all parts of the world articles by ex-

reason, as well as to fill the general printing requirements of so large an institution, the Museum has its own printing plant and bindery. Started in 1903 with one man and a hand press, the printing plant now has a foreman (the original printer) and fifteen men, and the bindery a foreman and six men. It is significant that of the printers all but four received their entire training in the American Museum Press.

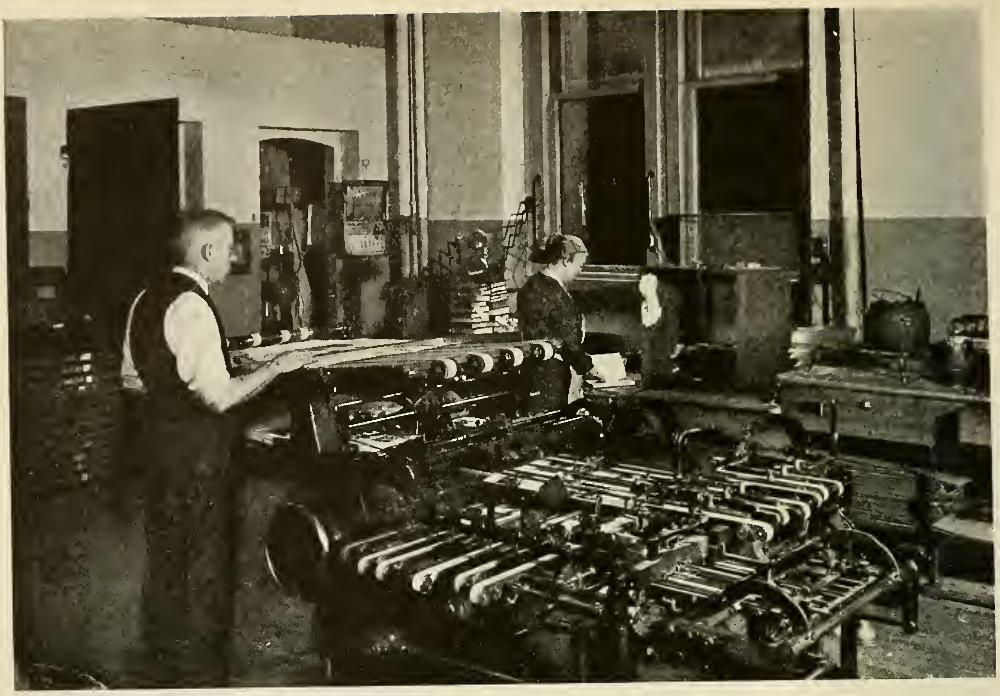
From this plant, after preparation by members of the Museum staff, also issue the popular publications of the Museum—including the *Handbooks, Guide Leaflets* and NATURAL HISTORY. The plorers, travelers, and men of science—many of them of the first eminence—which in their treatment, readable but sound, and in their copious illustration, are "popular" in the best sense of the term. They cover scientific research, exploration, and discovery, development of museum exhibition, museum influence upon education, and other pertinent subjects.

Primarily they are based on American Museum activities but often include other significant work and observation. In the files of NATURAL HISTORY are to be found lucid and thoughtful treatment of most great explorations and research developments of the past thirty years, as well as widely quoted and reprinted material from the pens of Museum authors, and some of the best products of the brushes and pencils of Museum artists.

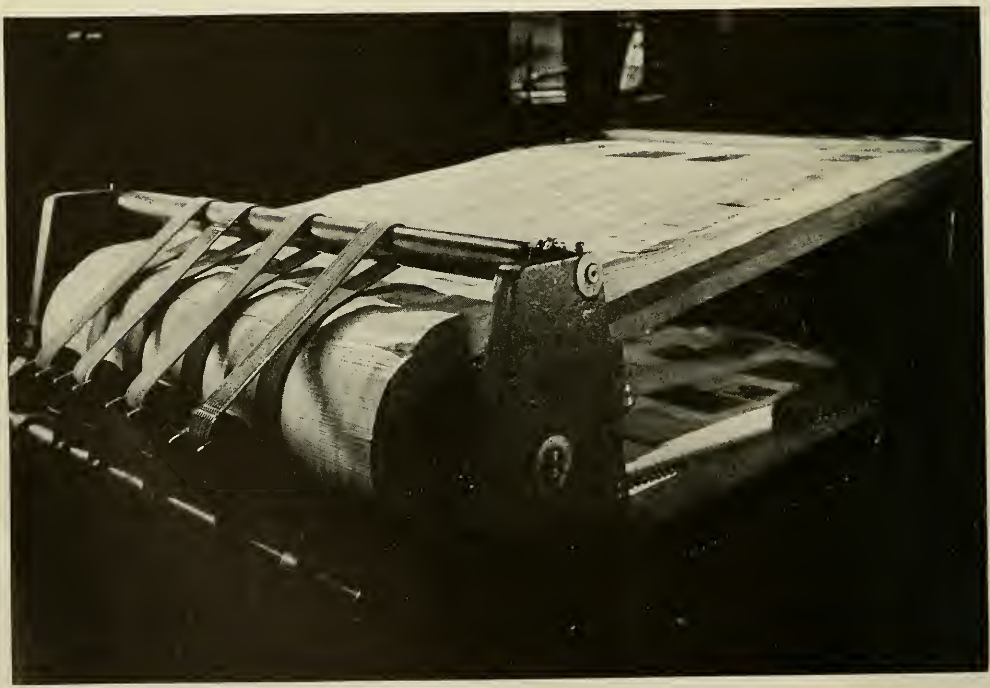
For the printing of the great variety of scientific and popular publications of the Museum, as well as its administrative matter and "job work" the Museum Press is finely equipped and conveniently laid out. It occupies four large rooms in the basement, with a spacious and equally well-equipped bindery adjacent. The Museum Press, familiar with the requirements of the scientific writer, sets all its own type, mainly with its two monotype keyboard machines and three type casters,—equipment which makes for speed of production and eliminates the expensive burden of distributing large blocks of type after the press run is over. Every sound device of the printer to produce a good finished result is used. The casting is so accurate that when a letter mold becomes worn a thousandth of an inch it is replaced. Just as accurate is the "type high" machine which shaves the type to the exact 918–1000 inches required. A saw trimmer enables the plant to do its

AFTER PRINTING

The finished cover being delivered from the vertical automatic job press



A GLIMPSE INTO THE BINDERY
With this folding machine it is possible to fold a sixteen-page section of NATURAL HISTORY at a speed of 3000 an hour



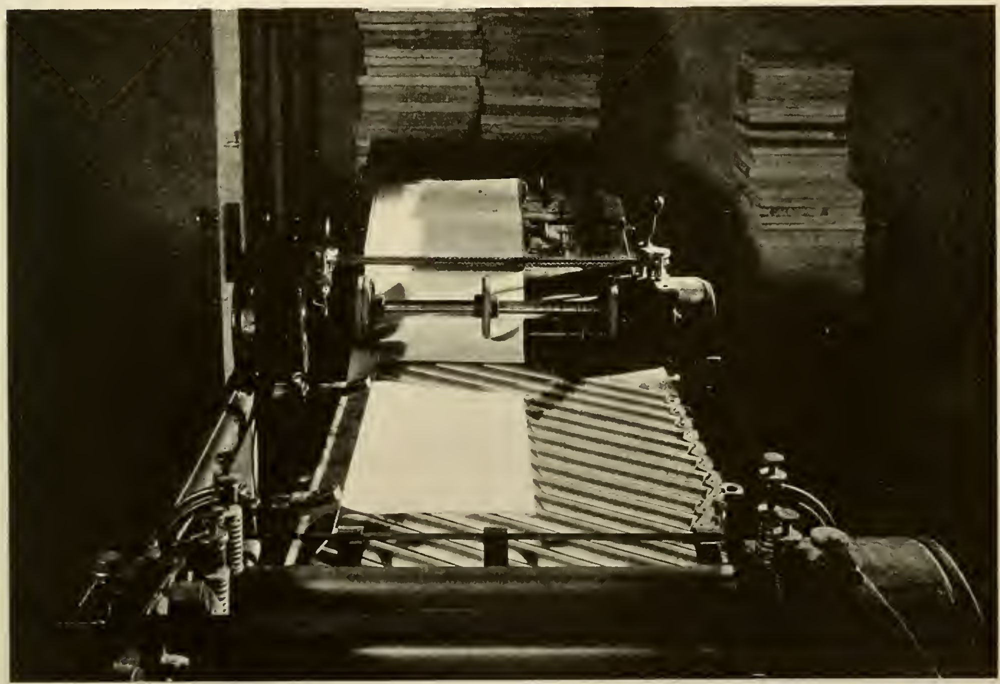
FEEDING BY AIR PRESSURE
A view of the continuous air feeder of the folding machine shown at the top of this page. Each sheet is lifted by air pressure to a vacuum, which draws the sheet into the folder

own trimming and routing of cuts and blocks.

In the spacious press room are three job presses of usual type and an automatic vertical press of great precision and speed which best turns out certain classes of Museum work. The larger publications, including NATURAL HISTORY, are run off on two ten-ton cylinder presses, of 33×44 inch printing surface. One of these has a labor-saving automatic feed, which makes possible putting two tons of paper through the press, without attention, before renewal is necessary. In the bindery, with its high-speed machinery for folding, stitching, counting, and other processes, there is the same attention to the achievement of high-grade results with a minimum of labor.

Records of the department of printing and publishing show a steady increase in demands upon this plant—a half year's tally, up to June 30, for instance, showing an increase of 12.5 per cent. over the corresponding six months of 1929.

Last year the Museum Press set up and printed 3925 pages of scientific material, 352 pages of guide leaflets, 328 pages of department of education material, 100 pages of department of administration material, 672 pages of NATURAL HISTORY, and 600 pages of reprints. The regular issues of NATURAL HISTORY ran to 100,000 with 6720 reprints additional. The usefulness of the press to the Museum, aside from publication of scientific, popular, and administrative books, booklets, and leaflets, is best shown by the fact that in the same year it had an output of a million pieces of printed matter for use in running the multitudinous activities of the great American Museum.



FEEDING BY FRICTION

In this machine each sheet is drawn by friction between rubber wheels and is then guided over rapidly revolving diagonal rollers into position for folding

THE AMERICAN MUSEUM LIBRARY

A Treasure House of Scientific and Natural History Lore which Plays an Important Part in the Activities of the Whole Museum and Serves a Large Reading Public

By IDA RICHARDSON HOOD

Acting Curator of Books and Publications, American Museum

WHILE the excellent library service of the American Museum is not classified among the main functions outlined in the foregoing articles, it is an indispensable facility upon which all departments depend heavily. So great is the recourse to it in the furtherance of virtually every project that it becomes a central point in the scientific activity of the whole institution.

The chief function of the Library is to provide for the scientists on the Museum staff the literature necessary for their research work and to keep them informed of scientific progress in general. It also supplies to other scientists opportunity to consult such publications as are not available in their own institutions. The excellence and completeness of the Museum collection of books often make it urgent for even those living at long distances to bring their problems here. Many of the well known scientists of the vicinity are frequently seen in our Library. Effort is always made to find the desired references, even though the clues are often obscure. Again, the Library serves a host of transient readers, artists, illustrators, students, newspaper and other writers, representatives of commercial firms and many others whose search for unusual information, a picture, an elusive reference not to be found elsewhere, or general information on some natural history subject, brings them to our reading room. The Library is also the distributing agent for the Museum's publications, both scientific and popular, a great number of which are sent out on exchange, in return for which valuable material is received from all corners of the globe.

The Library is unusually fortunate in possessing an excellent foundation of early files of scientific periodicals and rare standard natural history classics, upon which a superstructure of equal value is gradually being built. Each year other rare items and new files of periodicals are acquired, as funds or gifts make possible, until the Library has become one of the finest of its kind in the country, in scope second to but one or two, which had the advantage of a much earlier foundation and accordingly have a larger collection of older series. Aside from its actual value as a source of information to a wide circle of readers, the Library, therefore, is also an important factor in reflecting the high standards and wide vision of the institution of which it is a part.

Since the primary object of the Library is to serve the staff and so aid in the proper functioning of each department, it must necessarily cover a wide range of subjects and maintain a variety of material. Such series as the *Zoological Record*, *British Museum Catalogue*, *Union List of Periodicals*, and a score of others facilitate the finding of references and are in constant use. Those monographs, textbooks, or periodicals which the respective departments need for reference may be borrowed by members of the staff and kept for an indefinite period in the offices and laboratories. The books, in short, are where they are most needed but are always available upon short notice.

The Library is at the disposal of the public for reference purposes, with trained librarians in attendance ready to assist them in their search for information, for unusual pictures, or for a few hours of pleasurable reading on a natural history subject.

Exploration is one of the important activities in which the Library is of assistance. Preparatory work of the most intensive kind is necessary before an individual can enter a region whose climatic, geologic, and hygienic conditions are unfamiliar to him, and even the well informed scientist must familiarize himself thoroughly with all that has been noted of the known fauna and flora. Meeting this need forms the Library's share in expedition preparation. For instance, Admiral Byrd filled a room at the American Museum with volumes from the Library, to be used by his staff prior to departing for Antarctica. William Beebe also before his departure for parts unknown makes constant use of the Library. The members of the Crocker-land Expedition, of the Whitney South Sea Expedition, of the Central Asiatic Expeditions, and many others have frequented the Library, not only prior to their departure but for comparative work upon their return.

As has already been stated, the Library's share in research is the far from small service of providing the workers with desired references, often obscure or incomplete. This demands the services of librarians especially trained in scientific reference work. The Library has even checked and corrected bibliographies sent by authors through the mail, when they were unable to revisit the Library to do

THE READING ROOM OF THE AMERICAN MUSEUM LIBRARY
In this pleasant and well-lighted reading room visitors are welcome to read and study the reference books arranged in the racks along the walls. Other books on specific subjects and periodicals may be obtained from the librarians in attendance

the work personally. Such services have called forth unstinted praise from those familiar with the country's larger libraries.

The Library is sometimes resorted to for a check upon moot points regarding poses and color of animals, and settings and foliage for groups. Thus, through its many beautifully illustrated volumes, the Library makes a definite contribution to the preparation of exhibits.

An attractive and well lighted reading room, whose walls are lined with shelves containing the more general reference works, invites the visitor to do his research here, or to follow up, with the assistance of a librarian, study which may have begun at one of the various reading tables in the exhibition halls. These tables, with specially constructed cases containing books pertinent to the respective exhibits, are a recent suggestion of President Osborn and are making a direct contact between the material of the exhibition hall and the literature on the subject. They have proved of strong popular appeal and of value in stimulating the public to read with a purpose.

In a certain sense, all Library work is educational. Yet, specifically, the Library coöperates with the schools and colleges of New York and vicinity by helping students with their research references. Although those from the institutions of higher learning predominate, the younger student is often sent here, or comes voluntarily, to get material for a nature note book, or to follow up some youthful interest in birds, butterflies, snakes, rocks, minerals, or Indians. The School Service Library handles the major portion of these young people but, even during vacation, they find their way to the main Library and often spend hours absorbed in reading. The Osborn Library of Vertebrate Palæontology is constantly used by students of that subject.

With the rapid advance of the Museum, service to the ever-widening interests of an increasing staff and a larger public is the main object; therefore the most imperative need of the Library is, while maintaining its standard, to keep pace with this rapid and diversified Museum growth. Nevertheless, in the last few years, the Library has been forced to face a serious insufficiency of funds. The purchase of books has been limited to the utmost, and, as a result, each department which uses the Library feels itself handicapped. Cost of scientific periodicals and books has increased in the past eleven years from 100 to 300 per cent., while the department's budget has been static. With Europe and America recovered from the paralysis of war, the scientific world is being showered with literature, brimming with important information, little of which can be safely overlooked, and the Library finds that the call for books has increased more than 50 per cent.

Equally serious is the situation regarding the "second-hand" books of science now out of print. Competition and scarcity each year are driving up the prices, and it is both a scientific and an economic obligation to seize present opportunities to fill gaps in our shelves. Lack of available purchase funds recently lost to us valuable items which had not previously been quoted on the market for twenty-five years and may not be located again in a generation.

Often strange requests—generally arising from a need for information to be used practically—are received in the Library. Here again the Library renders a little known service of the Museum to the public at large. Artists, commissioned to make cover designs or illustrate literary works, come to us seeking such material as "jungles in Java," "a landscape in Palestine with definite kinds of cattle grazing," "a peacock in color and in a certain position," "a picture of flying swans," "an angora goat in color," and "the foal of a horse only a few days old.."

A magazine cover design resulted from an inquiry concerning an "Aurora Polaris at the South Pole."

Museum Library coöperation facilitated the issue of two expensive catalogs, respectively by a motor car manufacturer and by a silk manufacturer, advertising unique new colors based upon exotic birds, fish, minerals, gems, and other natural objects. The Library once told a motion picture producer upon request what kind of cart should be used by Rudolph Valentino in a certain South American locale. Industrial research laboratories, writers of railroad and other travel literature, compilers of encyclopædias (including the latest *Encyclopædia Britannica*), newspapers, scientific editors are but a few of those who use our facilities with an evident gratitude that they exist.

It has been a great satisfaction to recognize among visitors seeking inspiration in our Library famous artists, sculptors, Indian painters and writers, for if we are able to supply correct and authentic data for a motion picture, a painting, an illustration, or a piece of sculpture, we are indirectly educating the public, by making available exact information to many more thousands than can come to the Library in person.

THE OSBORN LIBRARY OF VERTEBRATE PALÆONTOLOGY

Established by its patron, President Henry Fairfield Osborn. In this beautiful room is housed one of the most unique and important collections of books on its specific subject to be found in the United States

© B. A. E.

Hauling supplies by dog team from ship to camp

OVER THE SOUTH POLE BY AIR

Some Phases of the Polar Region Survey of 1928–30 Achieved with All the Practicable Appurtenances of Modern Science

By REAR ADMIRAL RICHARD E. BYRD
As Told to Albert D. Barker

WHENEVER I discuss with strangers the discovery of new territory by the Byrd Antarctic Expedition, I brace myself for the inevitable inquiry, "What use is it, now that you have found it?" Always I reply that whatever man finds, he finds a use for. This application of new knowledge to human needs or wants may require a short time, or it may require a century or more—but it inevitably comes.

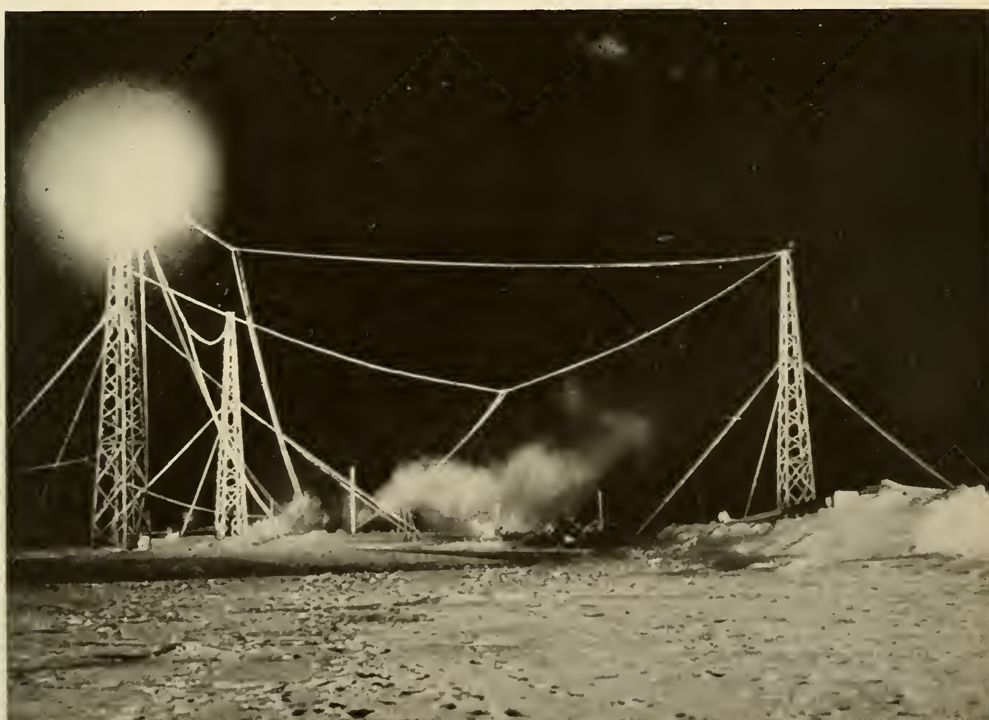
Just as a museum searches, collects, and identifies as a task of pure science, so does the explorer answer the challenge to push into the great unknown areas of an ice-locked continent to see what man has not seen before, and thus add to the sum of human knowledge. The use he leaves in all confidence to time.

In two hundred years of Antarctic exploration, the questions that have been raised about this great expanse of land buried beneath the earth's largest remnant of the Ice Age are as many as the blocks of ice in the vast, floating pack that encircles it. To seek solution of a few of these problems and to do the seeking with all the practicable appurtenances of modern science was the chief aim of the expedition, though, as was inevitable, the first flight by airplane ever made over the South Pole was bound to receive the public's principal notice.

Obviously I cannot in brief space chronicle the many events of an expedition that required three years of preparation; that left New York in August, 1928, and did not return until June, 1930; that was moved about 20,000 miles in two ships, that built its own village upon the ice and lived in it, usually buried by snow, 2300 miles from the nearest human dwelling; that for nearly fourteen months thrived in an almost lifeless land, in temperatures averaging about 16 degrees above zero in the warmest month and about 42 below in the coldest, did its work and returned without mishap. To tell a fraction of this story is impossible, but I may well touch upon some of the ways in which this big undertaking differed from expeditions of the past and pointed to the modern methods that will greatly hasten the future scientific surveying of Antarctica.

Perhaps first comes to mind the extensive use made of the airplane by this expedition, which landed three on the ice barrier and flew them with entire success both before and after the winter night and in temperatures that were always low and often severe. The significance of the airplane in exploration like that done from Little America as a base is two-fold: It covers distance in minutes and hours instead of days and months, and it broadens the horizon five-fold. Hardly less important is a third related consideration. Using an aërial camera, the explorer now for the first time is able to bring back indisputable evidence of what is seen over wide areas.

There is no better illustration of these points than the South Pole flight. Amundsen, in his heroic "dash" to the Pole by dog team and afoot, required nearly 98 days to go and come. The "Floyd Bennett" took us there and back, with a minimum of physical hardship, in 19 hours. While Amundsen at the best was observing a terrain visible on either side for a distance of 8 miles only, our horizon averaged more than 50 miles. On level snow he commanded a panoramic view of 75 square miles; at 10,000



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LITTLE AMERICA AT NIGHT

This view, taken in the light of flares, shows the base camp of the expedition, with towers and wires covered with hoar frost. At the left is the beacon light that guided parties home to camp

© B. A. E.

THE WATER SUPPLY

This photograph, taken in the winter night, shows part of the labor of obtaining water at Little America. The snow is being shovelled into a melting tank connected with the kitchen range

feet of altitude, we looked down on a visible world of more than 50,000 square miles, and at much lesser altitudes still immensely exceeded his range of vision. Further, as this expanse of milky snow and ice and looming mountains unfolded, Capt. Ashley C. McKinley, third in command of the expedition and its aërial surveyor, was taking—instead of mental or pencil notes—an overlapping photographic record. The area covered in that one flight of less than a day's duration was about 150,000 square miles, the new and less known portions of which almost literally were brought back to New York on photographic negatives. In the various flights 150,000 square miles were surveyed by camera, an area which, if you are curious to visualize it, almost equals that of West Virginia, Ohio, Indiana, and Illinois combined.

The expedition made in all 23 flights and traveled by airplane about 7085 miles. Through use of this modern aid, the airplane, it covered an area of 500,000 square miles, of which 250,000 had no overlaps and 200,000 square miles, it is estimated, never before had been seen by man.

At the South Pole we were some 800 miles south of Little America, which, as I have said, was 2300 miles from any dwelling. An airline between our plane and New York would have measured nearly 10,000 miles. Below was nothing but a level plateau of dazzling snow—which as the camera records it, looks like a sheet of pebbled white paper. So we might, in all truth, have considered ourselves to be stark alone at the "end of the earth." Yet, in point of fact, my message that we were in the vicinity of the South Pole was almost instantly received at Little America, and quickly relayed to *The New York Times*. News that under former methods of polar exploration might have reached "the outside" in a year or more, thus became the property of the civilized world within a few hours. With the radio, "the outside" has been moved right into camp and into the kit of every airplane and sledge party. No exploring or survey party left Little America on an extensive trip without the means of communicating with the base by radio. Indeed, on one flight an operator, listening in at the *Times* station in New York, caught the exchange of messages between plane and camp. At another time, business messages were relayed from New York to Little America and thence to me in the air, and a reply relayed back to New York.

Shortly after we celebrated Christmas, 1928, by reaching the barrier ice in the Bay of Whales from our outside base at Dunedin, New Zealand, we had selected a permanent camp site on this great ice shelf a few miles inland, and hauled by dog sledge the 650 tons of supplies and material brought by the "City of New York" and the "Eleanor Bolling." The planes were one of our first concerns; as was the radio. Soon we had erected the three metal 60-foot towers and set up the mechanism of the Adolph S. Ochs station. Communication established, not a day elapsed whose events were not reported to the public. For the first time, a remote expedition was regularly breakfast-table news; for the first time, the members of such an expedition listened to radio broadcasts from a big city station and received word from their families; for the first time, business could be transacted between such an expedition and its headquarters 9000 miles away in an air line.

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WINTERING THE POLAR PLANE

In its snow hangar the "Floyd Bennett," airplane in which Admiral Byrd flew to the South Pole, rested snugly from March until November

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THE BARRIER FROM THE AIR

Despite its appearance in the photograph, the ice edge at this point rises from 50 to 90 feet out of the sea, into which great chunks fall to float away

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ON THE EASTERN FLIGHT

A study in light, shadow, and focus of an unusual formation of ice tongues in King Edward's Land; pressure ridges and crevasses in the foreground

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THE "CITY OF NEW YORK" AT DOCK

An air photograph of the scene in the Bay of Whales soon after arrival, with the "City" docked at the ice edge, here 5 feet high, and convenient for unloading the 650 tons of supplies sledged to the base

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ON THE POLAR FLIGHT

Ice masses and peaks—view from the "Floyd Bennett" when the plane was over Live Glacier seeking to avoid the higher peaks guarding the south polar plateau

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STARTING THE "SUBWAY"

Digging one of the snow tunnels for communication between the buildings of Little America

From a snow-buried building of Little America—from the midst of a network of snow "subways"—to a steel building reared high above the roaring subways of Big America's biggest city were sent more than 300,000 words of press reports, detailing each scientific accomplishment and recounting the daily lives of the 42 men on the barrier. This achievement—due to the enterprise and scientific interest of a great newspaper, which could not hope for a return commensurate with the expense of arranging and maintaining this unique communication—seems all the greater when the business side of the expedition is considered. Through the air also 15,000 messages were exchanged between myself and Capt. H. H. Railey, my personal representative in New York, whose necessary activities in behalf of the expedition back home resulted at times in as many as 40 messages a day and an average wordage of 25,000 a month. The total words exchanged between the now silent Station WFA, Little America and New York—press, business and personal—exceeded 1,000,000.

The radio, however, was not limited in its functions on this expedition to the practical uses that proved so immediately valuable. Many phases of radio reception and sending under the unusual conditions that were inherent in the location were studied and recorded—for instance, the varying phases of the local heaviside layer throughout the seasons.

But radio and airplane were only two of an array of modern aids to scientific investigation contained in the expedition's equipment, which was unusually complete. All the instruments requisite for geological, weather, and other studies were at hand and put to thorough use. The data records are being worked up and studied—a labor which will require months more.

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ALWAYS IN TOUCH

The operator's ski serves as pole for this radio set used on sledge trips away from base

Reporting officially by radio in June, 1929, to the Secretary of the Navy on our discovery of the Rockefeller Range of mountains, I said, "Aviation has discovered a new land, surveyed it and landed on it for scientific investigation." Prof. Laurence M. Gould, second in command of the expedition, its geologist and a leader in various scientific endeavors, went by plane to the base of this range, made extensive ground surveys with which to check the air survey, and with his party climbed the mountains to study the rock formations and take specimens from several of the 40 peaks and ridges, the highest 2075 feet. Next season, Doctor Gould, using sledge teams— and let me say that the sledge dog, despite advances in science, is still indispensable in the Antarctic—laid a line of food and supply bases to the foot of the Queen Maude Range, and made a thorough geological study of the mountains and other formations at that point. Doctor Gould on this trip found sandstone and carbonaceous material, though his earlier findings had been mainly confined to granite.

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PLUMBING THE DEPTHS

Taking soundings off the ice barrier in the Bay of Whales, 1400 feet deep, close to Little America

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GETTING THE ANGLES

Admiral Byrd and Prof. Frank T. Davies, expedition physicist, surveying on the barrier

For nine months the expedition made continuous photographic records of the magnetic elements, supplemented by absolute measurements with instruments. This work, done under severe conditions in snow and canvas houses where the temperature averaged 20 degrees below zero, showed greatly disturbed magnetic conditions. The observations covered the maximum of a sun spot cycle of considerable importance. A very complete part of the magnetic study was the record—as to types, intensity, direction, and color movement—kept of the auroras, which occurred on 90 per cent. of clear nights.

As the Antarctic is one of the greatest birthplaces of "weather," we had the equipment of a first order Government

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READY TO COLLECT

Gould geological camp at the base of Queen Maude Range, from which the party ascended the glacier to the exposed strata above to take rock samples and to study formations

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SIXTY BELOW ZERO!

Prof. Laurence M. Gould, geologist and second in command of the expedition, finds his theodolite covered with hoar frost when he emerges to get a star sight

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CROSSING A CREVASSE

A dog team of the geological survey party halts at one of the numerous fissures that make travel hazardous on ice of the Bay of Whales

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MUSIC FROM HOME

Members of the expedition under the snows of Little America listen to a radio broadcast from Big America. The activity in the foreground is the old Navy game of "Acy-Ducy"

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YAWNING IN EASE

A baby Weddell seal on the ice at Bay of Whales. One of the few forms of animal life at Little America, these seals, very tame, made an interesting study

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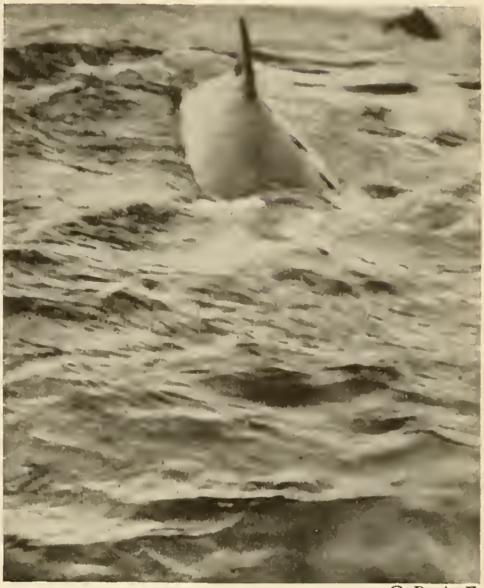
PERSONALLY POSED

This whale, caught in an ice crack half a mile from Little America, and hesitating to dive under the ice, came repeatedly to the surface, a few feet from the camera

weather observation station in charge of William C. Haines, meteorologist, but carried our studies also into channels not usually entered. Hourly, day and night, we took a systematic record of barometric pressure, temperature, cloudiness and precipitation, wind direction and velocity, humidity, visibility, and other phenomena. With kites and pilot balloons we made investigations of the upper air, reaching in these soundings altitudes of more than 30,000 feet. To obtain wind velocities and directions at various altitudes we made about 400 pilot balloon observations. These were of immediate use in determining the advisability of making flights, but their significance is far greater, for they in all probability will throw most valuable light upon atmospheric circulation in high southern latitudes. An interesting 40-day continuous record, taken during the last of our stay, provides in detail temperature, pressure and humidity at various levels.

Living upon a great ice shelf, we of course were curious as to how far below us was the solid land. Soundings with a sonic depth finder in the Bay of Whales close to Little America gave a depth of about 1600 feet, others to the south and east between 900 and 1000 feet. Other hydrographic work included study of sea life, and depositing message bottles, the recovery of which may some day add to our knowledge of Antarctic currents.

In addition to the meteorological temperature records, the expedition came away with data on the temperature of the ice barrier itself in relation to its physical makeup. Readings below the surface, checked against air temperatures and heat of sun, showed many interesting changes with the varying of the seasons. These records were made in snow



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DIVING AGAIN

A finback whale sounds after coming to the surface in an ice fissure which he has decided is too small for comfort. These whales sometimes attain a length of eighty feet

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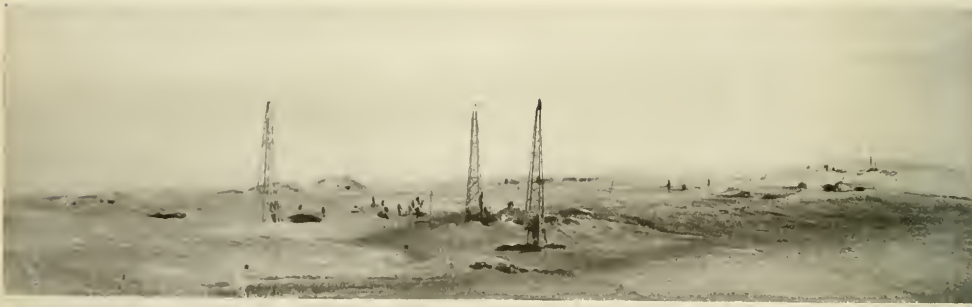
AFTER THE BLIZZARD

One of the expedition's sledge dogs asleep in the open, oblivious to a temperature of forty degrees below zero tunnels, snow huts, crevasses, and at other subsurface locations where sun and air penetration might be expected to have an effect, or the extent of conductivity of the snow might be checked. Conditions at Little America gave splendid opportunity to measure the dust content of the air, which was determined to be about one half that found over the Pacific Ocean.

With the uniformly low air temperatures—almost never above the freezing point—it is rather surprising to examine figures obtained by our black bulb thermometer, insulated to register the amount of heat radiated by the sun, and find that it went as high as 115 degrees Fahrenheit above zero. A rule of thumb indication of the power that can be exerted by the sun in this bleak land was given by a black tarpaulin fifteen feet square, which sank nine inches into the snow in two sunny days.

At this writing nine men of the expedition besides myself are engaged in a study and arrangement of the scientific material that will require about a year to complete. These men are: Doctor Gould, geology and glaciology; Captain McKinley, aërial survey; Haines, meterology; Lieut. Malcolm P. Hanson, chief radio operator, radio engineering; Henry J. Harrison, Jr., aërology; Prof. Frank T. Davies, physics; Quin A. Blackburn, topography; George A. Thorne, surveys; and Dr. Francis D. Coman, biology. A compilation of this data is being put in book form, and may run to several volumes.



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HOME FOR FORTY-TWO MEN

The Byrd Antarctic Expedition's camp "Little America," for nearly fourteen months was the home in constant snow and cold of forty-two men. The air view (below) shows the camp nearing completion, the radio towers up, and snow excavated for placement of the photographic laboratory. The (top) picture, showing the completed camp in detail, is of a model of "Little America," executed by Mr. Leslie Morgan under the supervision of the American Museum's department of preparation

EXPEDITION CAMELS BEING WATERED IN THE SARI-SU

SAIGA ANTELOPE AND LONG-HAIRED TIGER

The American Museum Sends an Expedition to Asia to Collect Animals for Two Groups To Be Installed in the New North Asiatic Hall

BY WILLIAM J. MORDEN

Field Associate, Mammal Department, American Museum

The Morden-Graves North Asiatic Expedition of which Mr. Morden was leader, and George C. Graves, 2d, and George G. Goodwin the other members, arrived in the Soviet Union the twelfth of September, 1929. On a preliminary trip to Russia in 1928, Mr. Morden had made arrangements with governmental authorities and the Russian Academy of Sciences for visas, permits to operate, and letters of introduction, so that on arrival at Leningrad, the expedition baggage, consisting of about a ton of equipment and supplies, was quickly passed through the Custom House, and they themselves through the passport control at the pier. In Leningrad, as everywhere the expedition went in the Soviet Union, its members were treated courteously, and full assistance given them. From Leningrad the party went to Moscow where final arrangements were made for the first part of the expedition's work, the journey into the prohibited territory of Middle Asia, to collect an exhibition group of Saiga tatarica. ("Middle Asia" is the term used by the Russians when referring to Russian Territory. "Central Asia" is applied by them only to Chinese Turkestan.) Their object accomplished, the party moved on to the region of the Amur and Ussuri rivers for specimens of the Siberian long-haired tiger.—THE EDITORS.

THE saiga is a peculiar-looking chap. Perhaps the most striking part of his appearance is his big, floppy nose, which is prolonged into a sort of downwardly bent proboscis, with the nostrils opening downward. In addition to his weird-looking face, the saiga has a characteristic sneaking gait, and whether at a walk, trot, or run always holds his head low. Even when startled, he never raises his head, but peers at the object of his attention as though looking over the tops of spectacles. But though his gait is shambling, and his movements are far from graceful, the saiga will easily outrun a horse, and can cover several miles at good speed. He is a member of the antelope family, is rather slenderly built, and stands about thirty inches high at the shoulder. His summer coat is dull yellowish, becoming grayish in the fall and almost white in winter. *Saiga tartarica* once ranged over much of the steppe country of Central and Middle Asia and southern Europe as far west as the present borders of Poland. Today, however, they are found only in limited areas in Kazakstan, part of which used to be Russian

CAMELS OF A NATIVE CARAVAN

Natives of Kazakstan are nomadic. During the summer they live in yurts, felt tents commonly used in Central Asia. At the approach of winter all their belongings, including the yurts, are packed on camels, and the family moves on to a place where its herds can graze. The camel leading the procession shown in this picture, has on his back the heavy felt of a yurt. Women and children ride surrounded by these stiff folds, which protect them from the wind

Turkestan, and the Soviet government has strict regulations prohibiting their killing. The decimation of the once numerous herds is due largely to the fact that the amber-colored horns of the bucks, when ground into powder, constitute a much-prized ingredient in Chinese medicine. A pair of these horns will sell for from $100 to $150 (gold) in the bazaars, so saiga hunting has long been a lucrative business in parts of Middle and Central Asia.

There are few saiga in the museums of the world, and nowhere is there a habitat group of them, showing the animals in a setting that is, as nearly as careful observations and notes can make it, an exact reproduction of the country where the animal lives.

On my 1928 trip to Russia I was unable to learn exactly where I might expect to locate saiga, nor was I able now to obtain accurate information in Moscow. Some whom I questioned said saiga ranged in the region about the Aral Sea; others, near the Persian border in Turkmenistan; still others, in the Semiretchensk region of the western Altai near the borders of Chinese Turkestan. We were told that we might get more accurate information at the State University in Tashkent, so, having been granted special visas for Middle Asia, we went there, a four-day train ride from Moscow.

In Tashkent we were told that saiga had been seen the previous year on the desert steppes of central Kazakstan, but that it would be necessary to travel several hundred miles by camel caravan in order to reach their range. Our starting point was to be Kizil Orda, a small town on the railway some 250 miles north of

Tashkent, but first it was necessary for us to go to Samarkand and Bokhara, to obtain permits to hunt the animals.

At each of our stops in Middle Asia government officials met us, and motor cars were placed at our disposal during our stays in Tashkent, Samarkand, and Bokhara.

At Samarkand, the ancient capital of Tamerlane, and present capital of the Soviet Republic of Uzbekistan, we were fortunate to find one of the monthly bazaars in progress, to which natives of the surrounding country come for trading. In the bazaar, which is held in the old part of the city, were sections for trade in meats, sheep, donkeys, horses, hay, green alfalfa, rice, flour, peppers, miscellaneous vegetables such as potatoes, beans, peas, and tomatoes; in the fruit "department" I noticed blue Concord and green grapes, melons, pomegranates, raisins, prunes, and apples. There were sections for rugs and felts, brass and copper-ware, leather and hides, shoes and boots, clothing and caps, harness and saddlery, tinware, ironware, parts for the big-wheeled native carts known as *arbais*, horseshoes, locks and padlocks, and hinges for doors. Horseshoers, wheelwrights, and many other craftsmen each had their separate sections. Barbers shaved and clipped their victims alongside a wall. Hawkers of various small articles passed through the crowds, while camels, carts, Uzbeks on horses and Uzbeks on donkeys jostled with Uzbeks on foot, until it was almost impossible to move. The sun shone through a haze of dust on the gaily colored crowd, and trading went merrily on.

In the horse market, a runway of about a hundred yards in length gave opportunity to judge of an animal's gait, though so far as I could see, the horses

A WATER MILL IN SAMARKAND

This device for hulling rice grains is used in Russian Middle Asia, saving the heavy manual labor of pounding rice with a stone. Water from the stream turns the wooden wheel, causing weights fastened to the two heavy beams to fall into pits which are filled with grains of rice

ROASTING A GOAT'S HEAD

En route it was sometimes necessary to augment the food supply with domestic meat. This goat's head was skinned and roasted by a guide and presented to Mr. Morden as a choice morsel

moved only at the usual running walk of the Central Asian and Chinese pony. We were told that after the dickering which always precedes a sale, the buyer takes the seller by the hand if he decides to make the purchase, if not, he pulls his ear. We somehow doubted the latter, although we did see several buyers shaking hands and seeming well satisfied.

Here and there in the bazaar, as elsewhere in the city, were *chai-khanas* or tea houses, where crowds sat about on mat-covered raised platforms, and drank tea from china bowls. Several of the *chai-khanas* also sold *cheslik*, pieces of mutton skewered on thin, pointed rods, and roasted over a charcoal fire.

The Uzbeks, the inhabitants of Uzbekistan, are more Semitic than Mongoloid in facial characteristics. Their summer dress is of cotton, and many of the *khalats*, or loose outer cloaks worn by the men, are striped with gay colors. Small, round, skull caps are the usual headgear, although many of the older men wear turbans of either white or blue cloth.

The noise and confusion of the bazaar, where cries of vendors mingled with shouts of cart drivers and riders, the occasional gurgling scream of a camel, the milling crowd of gaily dressed Uzbeks, and the inevitable dust hanging over the scene, made a composite picture of Asiatic activity which in all probability has been little changed through hundreds of years.

During our month's travel in the desert on the trail of the saiga, we lived entirely in Kazak yurts, the domed, felt-covered tents used extensively by the nomad peoples of Central and Middle Asia. The present Kazaks, or more properly, Kirghiz-Kazaks, who inhabit the desert steppes of Kazakstan where our work took us, are of Turkish Mongoloid extraction,

A LOCAL HUNTER

He is holding the head of the prize saiga obtained by the expedition. As saiga horns are used for Chinese medicine and are worth $150 a pair, this animal is becoming very scarce

A NATIVE GUIDE

This guide had the reputation of being very skilful with a gun, but when he borrowed one of the expedition's rifles, he had to use a hinged, forked rest at the muzzle to steady it

and except where they have settled in comparatively small towns near the railways, are almost entirely nomadic. Many of them own rather large herds of camels and horses, and we saw some tremendous flocks of sheep and goats during our trek through the desert north of Kizil Orda.

It was necessary for us to employ guides who knew the water holes and where encampments of Kazaks could be located, as without local knowledge it would be quite impossible for a traveler to find his way in that trackless area.

The saiga are entirely desert dwellers, and though we were told that there would be little difficulty in locating bands of them in the country to which we went, actually when we arrived there we found that we were on the very edge of their range, and it was with the greatest difficulty that we finally located a band of the animals. When we questioned the local people we were told that saiga could be found everywhere; but it finally developed that the word *saigak* in Russian is a general term for any antelope or gazelle, and that while *jairon*, or goitered gazelle, were fairly plentiful in that area, saiga were almost unknown.

We were told many stories regarding the saiga and the prowess of local hunters. Some of these tales were rather amusing in the light of actual facts. Once we heard that saiga travelled in herds of a hundred or more; again, that they were never seen in bands of more than two or three; we heard that the natives killed them by driving the animals past a point where other hunters, armed with rifles, lay in concealment and killed them at short range; next day we were told that saiga were never shot at ranges less than several hundred yards. We learned that long and difficult stalks were necessary and were told that a usual method was to

TUNGUS HUNTING CAMP
The tents of these natives on a tributary of Ussuri, Eastern Siberia, are roughly similar to the tipis of the North American Indian

fire beyond the animals, so that they would become confused and stampede toward the concealed hunters. The best story of all, however, concerned the local hunter who was finally engaged as guide.

The story was to the effect that this chap was accustomed to chase saiga on horseback, and that his skill with a rifle was so great that on at least two occasions he had, while riding at a dead run, fired from his saddle and creased the animals, stunning without killing them. When the man arrived at our camp, I lent him my spare rifle. but until he had fitted a hinged rest to the muzzle, he could hit nothing but the broad desert, even when lying prone. Stories of this sort, while amusing, did not greatly assist us in gathering information. Accurate data regarding the animals and their habits were hard to obtain.

In hunting the saiga one rides across the tremendous plains which at a distance seem entirely flat but which actually are very gently rolling. At each slight elevation the hunter dismounts, and through field glasses scans the country. The work is more difficult because the sun's heat causes a mirage, which makes all objects at a distance seem to waver and float in the air. If any animals are seen, a long and careful stalk is necessary before the hunter can come within range, for the saiga, like most plains animals, keeps as far as possible out on flat areas where no cover for an enemy exists.

We considered ourselves very fortunate in obtaining one buck, two females, and three young animals for the Museum group. With these specimens, we brought back a sufficient amount of the low sagelike growth and other dried desert plants to make the foreground of the habitat group which will be installed in the North Asiatic Hall of the American Museum.

Due to bad water, I had a severe attack of dysentery, and this, combined with a rather seriously infected hand, and the necessity for constant hunting and long marches, wore me down pretty badly. Upon our return to Moscow in November, I was told that if I went to Siberia with the expedition at that time, I would, in all probability, stay in Siberia permanently. Doctors in Moscow advised me to go to Paris for examination and treatment, and this I did, sending Mr. Goodwin east via the Trans-Siberian Railway to meet Mr. Graves, who was due in Vladivostok in December. I was able to rejoin the expedition in January, however, and to continue with it until the finish of the work.

When I rejoined them, Graves and Goodwin were working in the Amur river district where we planned to collect an exhibition group of the tiger, (popularly known as the "long-haired tiger") which is found there and in parts of Manchuria.

Tigers are usually associated with India and other regions of Southern Asia, as it is in these lands that they are most frequently met and hunted. But there are reasons for the belief that the tiger is comparatively a newcomer to South Asia and that the genus originally inhabited much cooler areas. All tigers, wherever found, belong to the same genus, though they are subject to considerable variations in size, coloration, and length of coat.

It is a nine-day ride on the Trans-Siberian Railway from Moscow to Khabarovsk, the point from which we traveled by sleighs about 150 miles down the Amur River to the country where tiger were reported. Although it was midwinter when I reached Khabarovsk, the weather, while cold, was not as bitter as we had expected. Minimum temperatures ran to 40° below zero Fahrenheit, but there was little wind in the forests and the air was very dry, so these temperatures were not particularly uncomfortable. Working with unprotected hands for more than a moment or two was out of the question, but we used the tents with which the expedi-

MR. MORDEN USING AN EYEMO MOTION PICTURE CAMERA

Recording scenes in a native village on the Amur River. Mr. Morden is wearing native-made fishskin shoes that are stuffed with grass for warmth

TRANSPORTATION IN THE SNOW

Dog sledges were used for carrying equipment and supplies when the expedition entered the forest of the Amur River section. From four to seven dogs were the usual number for each sledge. The driver is also in harness and can help the dogs to pull over difficult places

tion was provided, and at night our reindeer-skin sleeping bags kept us comfortable. We had brought with us reindeer-skin double parkas and fur trousers, but these were found too heavy when we were traveling on foot. They were useful, however, when we were riding in sleighs.

Our transportation, when moving from place to place along the Amur River or its larger tributaries, was horse-drawn sleighs, but when we went farther into the interior and took the frozen surface of the smaller streams, dog sledges were necessary. At these times we ourselves traveled on foot.

We found the snow from two to three-and-a-half feet deep, and when it was necessary to travel anywhere but on the ice of the rivers, we needed skis. We had brought along Norwegian skis and Yukon snow-shoes, for before arriving in the country it was impossible to learn what conditions we might find. Upon arrival, however, we discovered that the Norwegian skis were almost useless, due to the fact that in the forests the underbrush was so dense that these otherwise very useful articles could not be handled. We might have used our Yukon snow-shoes, but found that the native skis were faster and more easily handled in the thick timber. The native skis are made of ash or other hard woods and are about six inches wide by about six feet long. The bottoms are covered with moose hide with the hair pointing toward the rear, so that the wearer is able to travel uphill with ease, an item of importance when much of the travel is over rough country.

When using the skis, we wore native-made shoes of fishskin, so designed that the toes are pointed and turned sharply upward. This shape allows the toe of the shoe to be hooked under the cross piece of the lashing, and helps to hold the ski on the foot. Inside the shoes we wore two pairs of heavy wool stockings, and in addition, the shoes were packed with a dry grass which grows in that country. This grass, called by the natives *naukhta*, is a very efficient insulator, and except when wet, keeps the feet quite warm even in the coldest weather. Watching a native pack his fishskin shoes with *naukhta*, one has the feeling that he will never be able to get the mass of loose grass into the shoes and still have room left for his feet. He very cleverly works it in, however, and packs it down, and I did not see a single one make a miscalculation in the amount of grass needed. The fishskin from which this rather crude-looking footgear is made, is taken from the salmon which abound in the Amur River. The natives of the region are largely fish eaters, and fishing is the principal activity of the Goldi tribe which lives along that section of the Amur and for some distance up its tributaries.

The Goldis are a branch of the Tungus and are related to the Manchus, the people of Manchuria, whom they resemble in facial characteristics. Their religion is Shamanism, and the Shaman or "medicine man," as we would term him, plays an important part in the life of the villages. Their small houses are usually constructed of logs, plastered over with clay. A visit to the interior of one of these houses is interesting, particularly after the visitor has become accustomed to the violent odor of fish, which at first is almost over-powering. The houses usually have two rooms, one of which is used as a kitchen and the other for sleeping and general living purposes. Two small open fireplaces, one on each side of the door leading from the kitchen into the sleeping compartment, serve the double purpose of cooking, and of warming the sleeping room, as flues from them pass under sleeping platforms in the larger

CAMP IN THE "TAIGA"

The expedition spent three months in the "taiga" or "the Siberian forest," where the temperature sometimes dropped to thirty and forty degrees below zero room. The platforms, which are covered with straw matting, are raised about two feet from the mud floor of the building, and the smoke and heat from the fires, passing through the flues, keep them quite warm even in the depth of winter. On these platforms the whole family and any guests sleep side by side. Guests are not, presumably, supposed to look too closely at what is under the matting. We did on one occasion, and found it rather densely populated, with the result that our night's rest was not as peaceful as it might otherwise have been. After passing under the sleeping platforms, the smoke from the fireplaces is led underground to a tall stack, which rises some ten feet beyond the end of the house. These detached chimneys are characteristic of all Goldi villages.

To the Goldis, as to other tribes of the region, the tiger is a deity, and we sometimes had difficulty in finding natives who would agree to lead us to the country where tigers were known to be. For a consideration we were able to obtain guides and dog drivers, but all of them went without any great enthusiasm. In one instance the Shaman of the village danced for hours to propitiate the tiger deity, so that no misfortune might befall the village because one of its members had engaged himself to a party which might possibly encompass the destruction of one of these holy animals.

The Russians in that section are, almost to a man, afraid of tigers. We hired one Russian who had a local reputation as a hunter, but he finally refused to go into the forest until we had hired another Russian hunter as a companion. Both of these men, we learned later, were squirrel hunters by profession, and from the beginning it was quite apparent that neither of them had, as we would say, "lost any tigers." We decided that both

A SIBERIAN TIGER

This tiger, photographed in the Moscow Zoo, was in its summer coat. In the winter the hair on some parts of the body of this species is three inches long were much more afraid of meeting a tiger than of not finding one.

When we first arrived in the country, we heard the usual tales. Many of them were to the effect that the Siberian tigers were often man-eaters, and most were unanimous that a tiger, when followed, would invariably circle and lie in wait near its trail to ambush the tracker. These last stories cheered us greatly, for if they were true, it seemed to us that we might have a first-class chance of meeting and killing a tiger which was waiting to bite us. As a matter of fact, we found that while tigers sometimes do circle, and may for a time watch their own back trails, ordinarily the tiger, when he finds himself followed, will clear out. One non-Russian whom we met, a trapper who had been in that country for several years, told us that he had trailed tigers on numerous occasions, but had never been able to come up with one. He said that at one time he was evidently not more than an hour behind a tiger which had passed near one of his trap lines, but though he followed this animal on skis all day, he was unable to catch up with it. So far as he could see, he said, the tiger had never tried to ambush him.

DEEP FOREST NEAR EXPEDITION CAMP

The trees at this point along one of the tributaries of the Amur River are larch. Deeper in the "taiga" pine and spruce, which grow to considerably larger diameters than larch, are more abundant

Although doubtless the Siberian tiger is responsible for a few deaths, as nearly as we could learn, many of the stories of man-eating tigers are fabrications. Some of these tales apparently have been told to cover up murders. In one or two stories that came to us, murders had been committed and the deaths of the victims had been laid to attacks by tigers. It seemed probable to us that while the Siberian tiger, if starving, or if wounded or cornered, would be very savage, under ordinary circumstances when game was plentiful, he would be no more likely to turn man-eater than would be his relative, the tiger of South Asia.

We found a great many tiger trails, and the freshest ones of these we followed, but the forest was so thick and the snow was so deep that we could never cover more than a few miles a day. Further-

A "DEADFALL" TRAP
Used by the local Russian trappers for small mammals. Yellow mink is the most frequent catch, and the pelts are taken to near-by villages for sale

more, it was quite impossible to travel silently, and a tiger could very easily hear us and could, of course, move much faster than we. With a pack of trained dogs, it might be possible to come up with one of the animals, for well-trained dogs would follow a fresh trail much faster than we could, and upon coming up to a tiger, would keep it occupied until the party arrived. This method, we heard, had been used, but there were no dogs available in the sections in which we worked.

The three specimens (two large males and one female) that we finally obtained for the North Asiatic Hall in the Museum, were killed with trap guns, or more properly, gun traps. These are smooth-bore, single-barreled shot guns, set up on stakes a few feet from a trail where animals are known to pass occasionally. The gun is lashed on the stakes and is so aimed that the bullet will cross the trail about eighteen inches above the snow level. A piece of wood, pivoted to the stock of the gun, has a bit of string extending from its upper end to the trigger. From the lower end another piece of string or fine wire is stretched across the trail about a foot above the snow and fastened to a tree. The action of this gun trap is simple. When a large animal, following the trail, strikes the string, the pull is transmitted through the pivoted piece of wood to the trigger and the gun is discharged. The alignment is carefully worked out so that the slug will strike the animal at the shoulder or just behind it. These trap guns are set up mainly for wild pig, roe-deer, stag, and other forest animals, although a few tigers are killed by them.

When a tiger is killed, the hunter is fortunate, for a tiger will bring the lucky trapper as much as $400 and this amount he can take out in supplies at the Soviet trading store, if he wishes. Inasmuch as food supplies and manufactured articles are very scarce, and comparatively little can be bought on a ration card, a credit of several hundred dollars which can be applied directly to the purchase of food and manufactured articles is of even more value than the same amount would otherwise be.

We had heard reports of the tremendous size of the tigers of the Amur River region. The two big males which we obtained were nine feet seven inches, and ten feet in length, respectively, measured from nose to tip of tail, and these lengths are no longer than those of big Bengali specimens. Our Siberian tigers, however, were heavier and more powerfully built than any Indian tiger that I have seen. One of our big fellows weighed 480 pounds and the other 550 pounds. Both of them were slightly less than three feet high at the shoulder. The heavy coat of hair that this animal grows in winter, which gives the Siberian its popular name of "long-haired tiger," makes him considerably more bulky in appearance than the smooth-coated tiger of more southern countries.

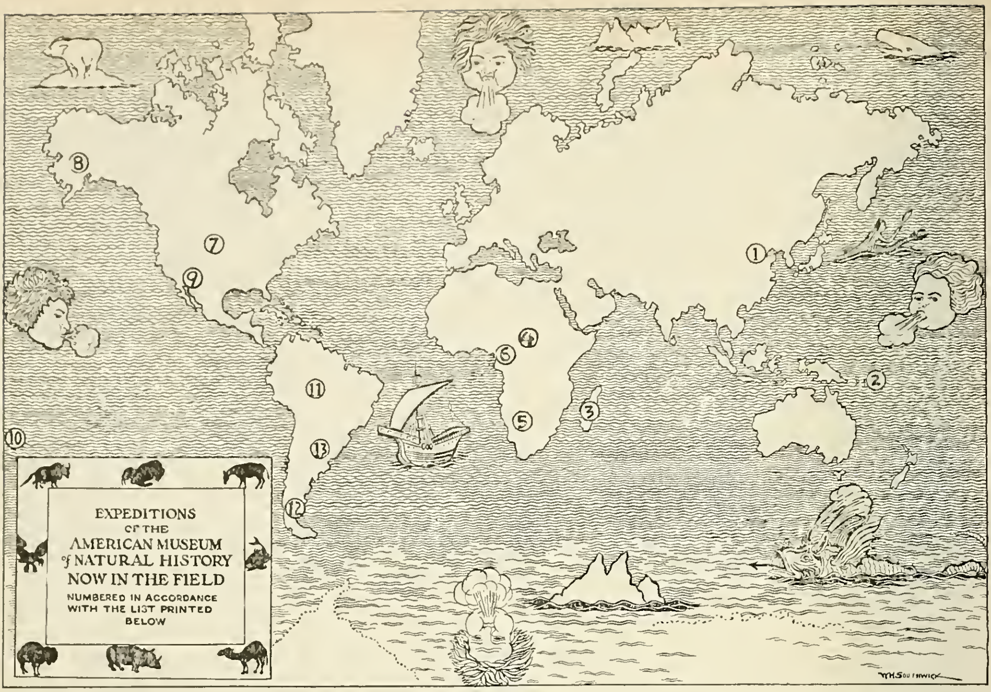
I have seen it stated that the tigers of the Amur River are lighter in color than those found in South Asia. Our experience and information show, however, that these northern tigers are subject to rather wide variation in the ground color of their coats. One of our big specimens was a rich dark yellow, while the other, which came from exactly the same region, was quite light. Inquiries at the trading company's office indicated that there are as many of one as of the other. The Siberian, however, often has considerably more white on face, sides, and underbody, than has its relative from South Asia.

Ordinarily the favorite food of the tiger is wild pig, of which there are many in the forests where it ranges. These pigs, in turn, feed upon the small cones of the stone-pine, which form a considerable part of the forest. We were told that some winters, when there is a poor crop of pine cones, the pigs will leave a particular section, and that that year almost no tiger tracks are seen there. Tigers also kill a number of other animals. We found one freshly-killed carcass of a stag, which a tiger had pulled down and partly eaten, and one of the specimens which our expedition obtained had a piece of horse meat and hide in its stomach. We were told that once in a while a tiger becomes a cattle killer and makes such a great nuisance of itself that the whole neighborhood has to combine forces to kill it.

At the end of April we left the Soviet Union with our original program accomplished. We had obtained two groups, the saiga and the Siberian tiger, together with about three hundred specimens of small animals and birds. Some of the latter were quite rare and many of them were new to the collections of the Museum.

The skis, which are six feet long and six inches wide, are made of ash. The bottoms are covered with moose hide, with the hair extending toward the rear, thus enabling the wearer to travel uphill

GUIDE AND DOG DRIVER WITH SKIS



1. Central Asiatic Expeditions; 2. Whitney, South Sea, Solomon Islands, for birds; 3. Madagascar, for birds, mammals, and fossils, 4. Chapin, Congo, for birds; 5. Vernay, Africa, for mammals; 6. Columbia University-American Museum, to Africa for anatomical study; 7. Frick-Falkenbach, Nebraska, for fossils; 8. Kaisen, Alaska, for fossils; 9. Frick-Rak, New Mexico, for fossils; 10. Shapiro, race mixture studies in Hawaii; 11. Olalla Brothers, Brazil, for birds and mammals; 12. Scarritt, Patagonia, for fossil mammals; 13. Naumburg-Kaempfer, Southeastern Brazil, for birds

AMERICAN MUSEUM EXPEDITIONS AND NOTES

Edited By A. KATHERINE BERGER

It is the purpose of this department to keep readers of Natural History *informed as to the latest news of the Museum expeditions in the field at the time the magazine goes to press. In many instances, however, the sources of information are so distant that it is not possible to include up-to-date data*

Central Asiatic Expeditions.—Since the latter part of May, the Central Asiatic Expedition has been engaged in field work in the Gobi Desert and will probably continue there until the first of October. Already Roy Chapman Andrews, the leader, has reported a successful season. The remains of the shovel-jawed mastodon and a few other animals of the Pliocene age have already been secured.

In the meantime the manuscript for the volume on the Permian of Mongolia by A. W. Grabau has been compiled and sent to the printer. It is expected that this will appear sometime early in the winter.

The Thorne-Correia Expedition.—During July Mr. and Mrs. J. G. Correia returned to the United States from the Spanish Island of Fernando Po in the Gulf of Guinea. They were unable at the present time to complete their field work as planned through the generosity of the late S. Brinckerhoff Thorne because Mr. Correia was confined to the hospital at Santa Ysabel from December until March with an attack of African sleeping sickness. During his illness he received the best medical treatment in an institution notably well equipped for combating tropical diseases. He has come through without any serious aftermath, although a number of patients stricken at the same time did not recover.

Fortunately, the expedition had succeeded in carrying out most of the plans at the four principal islands in the Gulf of Guinea. The collection of birds from this region is the first comprehensive one in America. These, together with photographs and notes will serve as a basis for an ornithological report upon the region. It is hoped, moreover, that at some future date, Mr. and Mrs. Correia will have an opportunity to complete their comprehensive survey in the higher zone of Fernando Po, and at the same levels of the mountains in Cameroon on the adjacent African mainland.

THE SCARRITT PATAGONIA EXPEDITION.—Dr. G. G. Simpson left New York in August for Patagonia, to collect fossil mammals in the oldest South American geologic strata of the Age of Mammals. Mr. Coleman S. Williams, scientific assistant, and Doctor Simpson will meet other members of the expedition in South America. The party will be absent about a year, and while planning to spend most of that time in the field, also expect to study the collections in the Argentine Museum.

THE MYRON I. GRANGER ARCHÆOLOGICAL EXPEDITION.—After an interruption of twenty-seven years, the American Museum was this year able to resume its field work in South American archæology and ethnology. The project undertaken this time was an archæological reconnaissance in Peru and Ecuador, made possible through the generous assistance of Mr. Myron I. Granger.

Dr. Ronald L. Olson, assistant curator of South American archæology, has returned from seven months of preliminary exploration and excavation. The major portion of the work was done in the highlands and in Ecuador. Excavations were made in the coastal valleys of Nazca, Ica, Chincha, Cañete, Ancon, Huarmey, Viru, and Chancay, and in the valley of the Utcubamba (an eastern affluent of the Rio Marañon). The specimens obtained will be of great service in the study of older collections in the Museum, many of which are without adequate data. Of particular interest are the items from the Ica-Nazca and Trujillo regions. The interrelations of the several epochs of the old civilizations of Peru are as yet almost unknown, but hints were secured which should prove valuable leads in such future work as the Museum hopes to undertake.

ARCHÆOLOGICAL WORK IN THE SOUTHWEST.—Clark Wissler, curator-in-chief of the department of anthropology made a field trip to southwestern United States during the summer. A few days were spent in Arkansas in the vicinity of Hot Springs, where, under the guidance of J. R. Fordyce, a number of archæological sites were examined. Also a visit was made to the State University at Fayetteville to study the collections in the University Museum. The next stop was at Carlsbad, New Mexico, where the country around the famous caves of that name was covered. A number of interesting sites on the Park property were visited and in company with Mr. Carl Livingston a number of Basket Maker caves in an adjoining canyon were examined. The remainder of the season was spent in the neighborhood of Santa Fé, New Mexico. Ceremonies were observed in several Indian villages and opportunity taken to study the collections in Santa Fé. While a guest of the Director of the Laboratory, Mr. Jesse L. Nusbaum, Doctor Wissler, as a member of the Board of Directors of the newly established Laboratory of Anthropology, reviewed the program for construction of buildings and improvement of the grounds.

Finally, Mr. Richard M. Snodgrasse, a member of the field staff of the Department, was visited in eastern Colorado. Mr. Snodgrasse is following up traces of the peculiar culture first coming to notice in association with skeletons of extinct bison found at Folsom, New Mexico, several years ago. He reports that excavations are now in progress at two promising sites.

THE AMERICAN MUSEUM-MADAGASCAR EXPEDITION.—Richard Archbold has just returned from the Mission Zoologique Franco-Anglo-Americaine in Madagascar. Up to the time of his leaving, there had been collected in all about 8000 birds and 1000 mammals. Among these there is one specimen of the rare hawk (*Eutriorchis astur*) and a series of *Monias benschi* a rail-like bird whose position is not as yet clearly known. Four specimens were obtained of the large catlike *Fossa*, as well as a fair series of the large tailless lemuroide *Indris*. Rand and Du Mont, Mr. Archbold's assistants, remained to finish working the north and northwest of the island. The mission has actually been in the field a year and three months, and has worked the whole of the island south of Tananarive with the exception of Fort Dauphin.

THE COLUMBIA UNIVERSITY-AMERICAN MUSEUM ANATOMICAL EXPEDITION.—Mr. H. C. Raven is still in the interior of the French Cameroon in charge of the joint expedition from Columbia University and the American Museum of Natural History.

AS a member of the Bermuda Oceanographic Expedition of the New York Zoological Society, in charge of Dr. William Beebe, Dr. William K. Gregory spent a month at Nonsuch Island, Bermuda. In collaboration with Doctor Beebe he secured many valuable notes and drawings illustrating the architecture of the skull of deep sea fishes, for their joint report on this subject.

THE SALAMANDERS OF WEST VIRGINIA.—During the summer, Dr. G. Kingsley Noble made a short expedition to the mountains of West Virginia to study the ecology of salamanders. His investigations included the altitudinal study of life on Spruce Knob, the highest mountain in West Virginia, and he brought back with him a large collection of living salamanders for further study under controlled conditions.

MAMMALS OF CONNECTICUT.—During August Mr. George G. Goodwin of the American Museum spent three weeks collecting mammals at Macedonia Park, Connecticut. This concludes the field work started two years ago by Mr. Goodwin in connection with a study of the mammals of that state, for a Bulletin he is preparing for the Connecticut Geological Natural History Survey. The collections made this summer, together with those obtained in 1928, now number 430 specimens.

The special object of this last trip was to secure the rare *Synaptomys* or bog lemming, two of which were obtained in a bog on a mountain-side. These are the first recorded for the State.

The American Museum collection now contains, with the exception of a few extirpated fur-bearing animals, all the species known to exist in Connecticut.

CHAPIN CONGO EXPEDITION.—In a letter dated July 17, Dr. James P. Chapin writes from Léopoldville on the Congo to Dr. Frank M. Chapman, that, thanks to the cöoperation of government officials, his work in connection with collections of material for the faunal habitat groups representing bird life of tropical African forests is progressing most satisfactorily.

It will be recalled that Doctor Chapin previously spent six years in the Congo on American Museum field work, leaving there in 1915. In his present letter he says in part:

> The changes in this part of the Congo since 1915 are very striking. Matadi is about three times as large as it was—they were aided by a fire that burned down part of the business quarter. Kinshasa is a mushroom town, but very well built for the most part. In 1909 it was merely a group of baobab trees—I see them still from the hotel verandah—with four or five brick buildings belonging to the State, and one trading company.

NOTES

LUCRETIA PERRY OSBORN

ON August 26 last, Lucretia Perry Osborn, the wife of Henry Fairfield Osborn, President of the American Museum, died at Garrison, N. Y.

The many friends and colleagues of President Osborn sorrow with him at this great loss, and extend to him their heartfelt sympathy.

At a meeting of the administrative and scientific staffs of the American Museum of Natural History, held on August 26, 1930, the following minute was adopted:

> The staff of the American Museum of Natural History learns with deep sorrow of the passing away of Lucretia Perry Osborn, wife of our beloved president, Henry Fairfield Osborn.
>
> Throughout President Osborn's long and distinguished career as a palæontologist and as a leader in this Museum and allied institutions, Mrs. Osborn has been his greatest inspiration, his most loyal and ardent supporter. In their charming homes at Garrison, N. Y., and in New York City she was an ideal hostess to President Osborn's innumerable official and informal guests and thus did much to establish friendly contacts for the Museum. She accompanied Professor Osborn to the various scientific meetings both at home and abroad and played a prominent and most gracious part in the social amenities of these occasions. She was intensely interested in Professor Osborn's scientific discoveries and her own book on evolution entitled *The Chain of Life* is a lucid summary of his views on this subject.
>
> Mrs. Osborn's friends will cherish delightful memories of her brilliance and keenness, of the nobility of her character and of her courage in defense of her ideals.
>
> We therefore beg to convey to President Osborn and to his family this expression of our deep sympathy.

AMERICAN MUSEUM HALLS

THE SOUTH ASIATIC HALL.—During the past few years there have appeared in NATURAL HISTORY from time to time articles and notes concerning the new South Asiatic Hall, the material for which was collected by the late Col. J. C. Faunthorpe and Arthur S. Vernay and presented to the American Museum by Mr. Vernay. At last the Hall is nearing completion, and it will be formally opened on November 17. This occasion will be a gala one, and various dignitaries of England and India have been invited to be present.

In the November-December issue of NATURAL HISTORY will appear photographs of the many striking and impressive groups of this new hall.

NEW AMERICAN MUSEUM BUILDINGS.—Excellent progress is being made on the new American Museum buildings which have been provided for by appropriations from the City and State, and through a gift of Harry Payne Whitney. The Power and Service Building which will house the heating and lighting departments and also the department of preparation, is so far advanced that it is expected it will be ready for occupancy the first of January.

The Akeley-African Hall will be completed, it is hoped, by the first of April. Plans and specifications for the Whitney Hall of Birds have been compiled and are being submitted to City authorities for final approval and for the letting of contracts.

The State Roosevelt Memorial Hall, being erected by the State of New York, which immediately adjoins the South Asiatic Wing, the African Hall, and the Whitney Wing, is now under construction. It is expected that this will be completed in 1932.

CONSERVATION

RETURN OF THE SEAL.—It is extremely encouraging to conservationists who are downcast and hopeless at times to record certain triumphs of conservation of animal life, such as the revival of the American bison and the increasingly bright prospects for saving the American antelope. Neither of these animals is of commercial value. We are hopeful that the great international movement for the commercially valuable whale will be crowned with success similar to that which has rewarded the efforts to save the seals.

In a recent radio talk, July 16, 1930, Doctor Charles H. Townsend of the New York Aquarium gave some outstanding figures, as follows:

> It was my fortune to see the great fur seal rookeries of the Pribilofs many years ago, before the destructive ocean sealing industry began. The seals were then roughly estimated at a few "millions." In the late Nineties, when the herd had been greatly reduced in numbers, I participated in the actual counting of seals occupying the breeding grounds. With the herd on the increase the annual "census" of breeders that has been made since then, will become more difficult and will eventually become impracticable. As I saw them in 1885 they were considered "countless" in the sense that buffalo on the western plains, and antelope in Africa were countless.
>
> At one time there were more than sixty vessels engaged in killing fur seals at sea. As the seals killed were largely females, the business was destined to break down for lack of seals to keep it going. When ocean sealing was suppressed by international treaty, fur seals began to increase. It is greatly to be regretted that islands in the southern hemisphere inhabited by fur seals have not been protected like those of the Bering Sea. Had it not been for indiscriminate and wasteful killing, the supply of skins of fur seals need not have failed as it did. It is altogether likely that under the present methods of conservation, the supply of skins of fur seals may be increased to even greater numbers than were available forty-five years ago.
>
> As a result of *long continued* seal killing *at sea* by British, Japanese, and United States vessels, the *Pribilof herd* of seals had been brought to a very *low ebb* by the year *1910*. Sealing by *vessels at sea* had almost *ceased* to be *profitable* and the killing of *surplus male* seals on the islands by the *United States Government* had been *greatly reduced*. A *treaty* providing for the *cessation of ocean sealing* for a term of *fifteen years*, was entered into by the United States, Great Britain, and Japan, including also *Russia* to whom the *Asiatic fur seal* herd inhabiting the *Commander Islands*, belonged. Under the *protection* thus afforded the *tide* of *seal life* rose steadily. The United States *Bureau of Fisheries* announces that about forty-five thousand skins will be taken this year.
>
> The *benefit* to the *breeding herd* resulted from the great saving of *female* seals which had always constituted *the bulk* of the catch made *at sea*. As the stock of seals increased on the *islands*, it became possible to take more skins of *superfluous males* of these highly *polygamous* animals.
>
> The once common *sealskin cloak* is *reappearing* and will afford some *respite* to the *small fur bearing* animals already *threatened with extinction* all over the world, by reason of the insistent *demands* of the *fur trade*. The outlook for the restoration of the Asiatic herd to its *former commercial importance*, is *unfortunately*, not *promising*. During the world war the Commander Islands received little *protection* from Russia, with the *result* that the seal rookeries of *those islands* were often *raided* by *sealing vessels*, with disastrous results to the stock of *breeding animals*.
>
> If complete protection can be secured, there are small groups of breeding seals remaining on the rookeries of the Commander Islands that might be sufficient for the eventual *restoration* of the sealing *industry* on those islands.
>
> The fur seal herd of the small Robben Island in the Okhotsk sea, belonging to Japan, is reported (census of 1926) as consisting of 24,373 animals. The number of surplus males taken in that year by the Japanese government was 1,332.

THE CHILDREN'S FAIR

THE American Institute Children's Fair is to be held at the American Museum this year from December 4 to December 10. Entry classes are planned to cover all fields of science of interest to young people, and all school children eighteen years of age or younger are eligible to become exhibitors. The fair is arranged by the School Nature League of which Mrs. W. C. Popper is president. Entry blanks and full information may be obtained from Mrs. Marjorie G. Coit, School Nature League, Room 206, American Museum of Natural History, 77th Street and Central Park West, New York City.

FOSSIL MAN

MANY recent excavations, in Greenland, Moravia, Palestine, Africa, China, Italy and Germany, and several important discoveries, make occasion for a fascinating review of the subject of fossil man by Sir Arthur Keith in *Nature* for June 21, 1930.

First, though probably not most important, is the finding of a fossil human skull, at Gardarene, Greenland. This skull, with a jaw more massive than has ever before been found in a human specimen, has led to a reopening of the discussion of the characters of the ancestral type. Prof. F. C. C. Hansen, of the University of Copenhagen, who describes this skull (*Homo gardarensis*) believes it to be an atavism rather than a unique survival of the type, while Keith offers an alternative explanation, supported by the evidence of similar skulls preserved in the Royal College of Surgeons, that it represents merely an acromegalic condition of the individual.

Keith makes note of the enormous strength of the lower jaw, the platelike buttresses of bone at the base of the skull, the sharp bending of the occipital part of the skull (as in *Pithecanthropus*, Peking man, and the Rhodesian skull), the expansion of the temporal muscles of mastication upward until they almost meet on the top of the head (as in the female gorilla), the evidence that the forehead was low and receding, the unique length of the skull (nearly an inch longer than the longest fossil human skull known), the length of the face (two inches longer than that of the average Norseman). The conditions are all characteristic of acromegaly and Keith finds appearances in the bone structure that suggest the abnormal nature of the growth.

Excavations in Moravia reveal a type with only local differences from the Cromagnon of France, the Predmost type being shorter, stouter and of more muscular build than the tall Cromagnons. Keith finds the racial kinship of these early whites neither in Africa, Australia, nor Asia. "They are Europeans or proto-Europeans," the differences being expressed chiefly in size of jaw and robust development of face and of thigh bone. He believes their descendants may still survive in Europe, though much modified by the stresses through which their ancestors passed during the third phase of the Ice Age, when stature was shortened and jaws took on the strength shown by those of modern Eskimo. Yet skulls of that period are still Caucasian in nose, forehead, chin, and face. Later, under modern climatic conditions, these early massive characters were lost. The race as a whole was small-boned, of small stature, and large heads and strong jaws were exceptions. The question raised is whether the modern races were the degenerate descendants of the Cromagnons or new invaders of Europe. Keith thinks the latter more likely.

Excavations in Palestine show the same succession between the old Neanderthal and the neanthropic (modern) types of culture as in Europe. Remains found in caves on the west shore of Lake Galilee, at Shukbah, and on the western slope of Mt. Carmel, reveal the ancient Mousterian stone culture either directly overlain by the Aurignacian or found in near-by caves. In the Galilee cave a skull of Neanderthal type was found; at Shukbah among later Aurignacian strata all the remains were of neanthropic type. In the Carmelite cave a small-sized type was found, neither Neanderthal nor Cromagnon, neither Jew nor Arab. These people had the low-bridged, flat negroid nose but they were European both in shape of skull and proportions of limbs. Keith suggests their derivation from North Africa or affinity with inhabitants of Algiers or Tunis in Capsian times. These researches in Palestine are of great value as they carry human history into a far more remote past than do the records of neighboring countries.

Fossil man in Africa presents mixed traits that make a baffling problem. Keith mentions three types represented by skulls in the Royal College of Surgeons. The first, the skeleton of a man, is from Kenya Colony and shows points of resemblance to the Cromagnon type; the stone implements used by this race are also similar to those of the earliest Cromagnons. This seems to favor the idea that the latter may have migrated to Europe from Africa, but Keith thinks the migration may have been *into* Africa from some other point, possibly from Arabia or southwest Asia, as all the country between Kartoum and Kenya is now occupied by Negro tribes and the ancient Kenyans were not Negroes. Keith suggests that they may have been an early Hamitic race and he follows the trail of modern Hamitic man toward the straits of Bab-el-Mandeb and Arabia, which in Cromagnon times were fertile. It is here that Keith looks for the source of the common cultural and racial traits of early Europeans and Africans.

The second African skull represents an early stage of the Bushman skull, while the third is of the Australoid type and is probably an offshoot of the same stock as the fossil skeleton discovered in the northern Transvaal and described by Doctor Broom (*Nature*, March 16, 1929).

All these discoveries reveal great development of body and brain in Palæolithic man but that the modern loss in size and strength is not wholly chargeable to modern civilization is proved by a comparison of the early Bushman skull with that of modern Bushmen. His descendants retain his hunting mode of life and yet have undergone the same reduction in size of jaws and face that is seen in a comparison of the modern European with the Cromagnon type.

The discovery of remains of man at Chou Kou Tien, thirty-seven miles southwest of Peking, is noted by Keith as of special interest because nothing has been known before of the prehistoric type in Asia and because it shows the evolutionary stage reached by Asiatic man at the beginning of the Pleistocene period. Three previous discoveries in other parts of the world had shown us three other types of man belonging to this period,—*Pithecanthropus* in Java, *Eoanthropus* (Piltdown man) in England, and *Palæanthropus* (Heidelberg man) in Germany. Of these three, Keith finds the closest relationship of *Sinanthropus* (Peking man) with *Pithecanthropus* but there is also some resemblance to Heidelberg man. The latest evidence indicates that the formation in which *Sinanthropus* was found is early Pleistocene and the stage of evolution is shown by the complete absence of hearths or any signs of fire and of all worked stones or shaped bones. One difficulty in dating the specimen is that the brain capacity of *Sinanthropus*, which is just within the minimum human standard and a little larger than that of *Pithecan-*

thropus, makes necessary either a very rapid evolution of the brain during the Pleistocene or else the assignment of a much longer time than has been given to that period; for even the maximum estimate allowed to it (one and one-half million years) seems very short to account for the difference between the brain of *Sinanthropus* at the beginning and that of La Chapelle man at the end. Keith suggests as a possible explanation that the races represented by *Pithecanthropus* and *Sinanthropus* may not have represented the highest stage in brain development in their own time. While *Sinanthropus* lived at the eastern end of the Old World, Piltdown man lived at the western end and is much nearer to the modern type.

Comparison of the two types shows that Peking man has the flattened head (seen before only in *Pithecanthropus*), the great bony beam across the forehead (found in Neanderthal man), a chin transitional between simian and human, teeth with a mixture of very ancient and very modern characters and many other traits which make him, according to Doctor Black, a possible ancestor of the Neanderthal races. Piltdown man, on the other hand, has no resemblances to *Pithecanthropus* nor to the Neanderthal and the conformation of skull bones and of head foreshadow features of modern man. Keith maintains that he was not of low type of organization of brain and even the lowest estimates of his brain capacity bring him well within the modern standard. Keith also adduces the artefacts found by Reid Moir in Pliocene deposits of East Anglia as evidence that Piltdown man was a skillful maker and user of tools, and thus makes claim for England as leading the world in Pleistocene times according to our present knowledge.

Coming to preglacial times, six Mousterian stations have been uncovered, with ancient types of stone implements, within ten miles of Rome. In 1929 a skull of Neanderthal man was found in deposits of the river Aniene with fossil bones of the elephant, rhinoceros, hippopotamus and horse, of species living in Italy before the last Ice Age. The skull as described by S. Sergi is altogether different from that of modern man and appears almost a duplicate of the Gibraltar skull found in 1848, also that of a woman. The brain capacity of each is less than 1200 c.c. The faces are long and gorilline, with large noses and strong bony tori above the eye-sockets. The discovery shows that in Italy as in France Mousterian culture was Neanderthal culture and that this race probably occupied all of Italy as well as other parts of Europe.

In Germany at Taubach and Ehringsdorf other preglacial remains have been found, notably part of a human skull described by Weidenreich in 1928. Keith notes the chief differences from later Neanderthals as a high vaulted skull and certain primitive features of the jaws. The fact that severe wounds had been inflicted on the forehead of the fresh skull is interpreted by Weidenreich as evidence of cannibalism in the ancient Ehringsdorf people.

Another still incomplete announcement has been made of a more recent discovery of fossil man at a site fifty miles northeast of Sebastopol, which has been confirmed by Boule as of Neanderthal type.

Neanderthal man's first appearance is an open question like that of his final disappearance, although in certain features he was foreshadowed in Heidelberg man. Keith finds strong evidence from the fossil skull of a boy found at Gibraltar that the race did not decline for lack of brains. He summarizes our present knowledge of the subject somewhat as follows:

Neanderthal man ranged from Weimar in the north to Malta in the south, from Jersey in the west to Palestine in the east. Over this range were several local races, some going back to the early part of the last interglacial period, others to the first part of the last glaciation. For a long part of the Pleistocene all inhabitants of Europe were members of this race. An unanswered question is whether they became transformed into modern man or died out completely. Keith disagrees with Hrdlicka, who holds the first view, and thinks it more likely that Neanderthal and modern man were "not father and son but cousins." He gives as reasons the fact that no skulls have ever been found which show mixtures of the two races or can be regarded as transitional and that no trace of Neanderthal man is found in any deposit later than those of Mousterian culture.

The question to which all discoveries so far made contribute an incomplete and tantalizing reply is: where did the first white (Caucasian) races come from when they made their first apparently sudden entrance into Europe at or near the beginning of the middle period of the last Ice Age,—an entrance followed by as sudden an extinction of the Neanderthals, up to that time in sole possession of Europe? Keith thinks the evidence favors the view that the first arrivals of these races came from Asia rather than from Africa.—W. K. Gregory

Early Discoveries of Tertiary Man.—It appears that proofs of the existence of man in Tertiary time were discovered no less than thirty-nine years ago but not recognized as such. In Professor Osborn's presidential address before the American Association for the Advancement of Science,[1] December 27, 1929, he attributed prior credit to Mr. J. Reid Moir of Ipswich and Sir Ray Lankester in view of the discoveries set forth in their papers of 1909–1911. It seems, however, that the first flint implement from the Foxhall pit was found as far back as 1888.

Mr. Lewis Abbott (*Nature*, July 19, 1930, p. 104) dwells upon the importance of the East Anglia evidence in any discussion relating to the antiquity of man, and especially of Tertiary man, and enumerates some of the finds which might have gone to strengthen Professor Osborn's case. He refers to the first "indubitable" find—the stiletto made from the base of a deer's antler found in the Corraline Crag at Allborough, Suffolk, some fifty years ago. A well-made flint implement was found in the Foxhall Crag pit, Ipswich, in 1888. This is the pit which was afterwards the site of Mr. Reid Moir's discoveries. At Thorpe Neswick several worked flints were found while men were digging out the rib of an elephant, and were accepted by the late H. B. Woodward—a very cautious observer—as of human workmanship. Mr. Abbott also refers to the finds made by Mr. Savin and others in the Cromer Forest Bed. These flints were first brought to light at Runton in 1888 on the same occasion as the finds at the Foxhall pit, during the East Anglian Excursion of the International Congress of Geologists, when the party had been joined by the principal East Anglian geologists. Mr. Savin resumed work on the Cromer Forest Bed in 1895, and an exhibition of his finds was held at Burlington House, arousing much interest. These finds, Mr. Abbott points out, show that evidence for Tertiary man had been obtained from the Forest Bed thirty-one years, and from the Corraline Crag thirty-nine years, before the date claimed by Professor Osborn.

Sir Edwin Ray Lankester took, during nearly the whole of his life, a deep and abiding interest in prehistoric archæology. . . When, between 1860 and 1890, the extensive diggings in search of "coprolite" were being made in Suffolk below the Red Crag, Lankester's attention was drawn to the remarkable series of mammalian, and other fossils, contained in the Bone Bed at the base of the Crag. The examination which he carried out of these remains resulted in the publication, in 1870, of a paper in the *Quarterly Journal of the Geological Society*, in which, for the first time, a detailed and lucid account was given of the varying age, and nature of the contents of the Suffolk Bone Bed. Lankester was, in fact, the greatest authority upon this deposit and its associated problems, and, to the last, his interest in it never waned. During the year 1909 Reid Moir discovered beneath the Upper Pliocene Red Crag at Ipswich a number of flints which, after due consideration, he decided had been flaked by man. If this conclusion were correct, it meant that the long-debated question as to whether human beings were present on this earth in Pliocene times was at last to be settled. It meant, also, that, in all probability, a long and heated controversy would be inaugurated when Moir's claim to have discovered the flint implements of Pliocene man was made public. Moir made known his claim by means of a letter to the *Times* which was published on October 17, 1910. Lankester was much impressed and in a paper before the Royal Society in November, 1911, laid great and—as has since appeared— justifiable stress upon the beak-like implements, to which he gave the descriptive name "rostro-carinate," and drew attention to the fact that this type had been hitherto unrecognised by archæologists. His examination of these particular specimens from below the Red Crag had enabled him to realise the ideal design which the flint flakers of Pliocene times had, as it were, set before themselves, and this ideal was closely approached in a wonderfully symmetrical rostro-carinate found in the Stone Bed beneath the Norwich Crag. This implement, discovered by the late W. G. Clarke, was named by Lankester "The Norwich Test Specimen," and described by him in an elaborate monograph published as an "Occasional Paper" by the Royal Anthropological Institute.[1]

[1] "Discovery of Tertiary Man." *Science*, n.s., Vol. LXXI, No. 1827, pp. 1–7, Jan. 3, 1930.

[1] Excerpts from J. Reid Moir: Obituary Notice of Sir E. Ray Lankester. *Proceedings of the Prehistoric Society of East Anglia*, Vol. VI, Part II, pp. 140–2.

MARINE LIFE

During July Dr. Roy Waldo Miner, accompanied by Arthur A. Jansson, was engaged in securing photographic and motion-picture studies of the inter-tidal zones on the shore of Nahant, Massachusetts, in connection with work planned for the Hall of Ocean Life.

OTHER MUSEUMS

A Biological Station for the Southern Appalachians.—Mr. Clifford H. Pope has recently returned from a vacation spent at Highlands, N. C., where he participated in a conference of biologists held at the Highlands Museum. This conference was led by Clark Foreman and was attended by fifteen scientists representing thirteen important institutions. It was decided at the meeting to promote the establishment of a biological research station in the southern Appalachians and to this end the Museum has become incorporated as The Highlands Museum and Biological Laboratory.

Highlands was chosen as a site for the proposed station because of its natural advantages. Most important of these is the rich life of the region representative of the Transitional and even the Canadian zones. The flora and fauna have been well preserved because deforestation has not occurred, while the permanence of the forests is assured by the fact that Highlands itself is surrounded by National Forests. The Highlands region is a plateau with an average elevation of 4000 feet, while surrounding peaks reach an altitude of more than 5000 feet. These figures show that a station situated here would be in the very midst of the interesting biota characteristic of the southern Appalachians. The physiographic features of the plateau are extremely varied, cascades, streams, gorges, lakes, swamps, etc., being much in evidence. Finally, Highlands itself is not only easily reached from the North as well as from the extreme South, but also from this point one can readily visit such places as the Smoky Mountain National Park, the Nantahala, Pisgah, and Balsam ranges. Also, by a very quick gradient, one descends to the Piedmont Plateau and from thence to the Coastal Plain.

On the advice of Dr. E. G. Conklin, who was also present at the conference, it was decided to adopt a program of a five-year experimental period in order thoroughly to test Highlands as the most suitable locality and to prove the desirability of a mountain biological station in the southern Appalachians. Funds are now in hand to build the first laboratory unit. The present Museum building was erected in 1928. The director, Dr. E. E. Reinke, professor of biology at Vanderbilt University, has, with the help of two assistants, carried on the work of the Museum through the last two seasons.

BOTANICAL SURVEY OF CANADA.—Dr. M. O. Malte, chief botanist, National Herbarium of the National Museum Branch of the Dominion Department of Mines, Ottawa, attended the International Botanical Congress, which was held at Cambridge, England, from August 16 to August 23. Before and after the Congress Doctor Malte visited the British Museum and the Kew Botanical Gardens in London, England, to study collections of Arctic flora in these museums. Doctor Malte also visited the Botanical Museum at Copenhagen, Denmark, for the same purpose.

For several years Doctor Malte has been engaged in an investigation of the flora of Arctic Canada, in coöperation with Dr. C. H. Ostenfeld, director of the Botanical Gardens, Copenhagen, Denmark. The report on the flora of Arctic Canada, which is in course of preparation, is the first of a series comprising the results of a botanical survey of the whole of Canada.

SCIENCE OF MAN

THE RECENT DEATH of Dr. G. L. Wilson was a source of great regret to his friends and associates at the American Museum. For many years Doctor Wilson, who was a special field worker in the department of anthropology, made collections among the Village Indians (Hidatsa-Mandan) of North Dakota which now constitute most of the American Museum's exhibit for those tribes. The model of an earth-lodge in the Plains Indian Hall was constructed from plans and data supplied by him. His field studies were chiefly among the Hidatsa and it is generally recognized that these were rigidly scientific, in fact, setting a high standard in such work. Among his publications are a series of books on the American Indians, written for young readers and for school use. In the Anthropological Series of the Museum there have appeared two important papers, one on the domestication of the dog and horse by the Hidatsa and the other on the capture and confinement of eagles for ceremonial purposes. These papers are the most exhaustive and authoritative of their kind and still stand as the chief source of reference for the Indians of the Plains. Doctor Wilson's best known work is a study of Hidatsa agriculture, a type study for the aboriginal tribes of the Missouri Valley. He leaves a number of unfinished papers, fortunately in such form that they can be published.

VOSS BEQUEST FOR ANTHROPOLOGICAL RESEARCH.—By the will of the late Frederick G. Voss there has come to the American Museum a special fund, the income of which is to be applied to research in anthropology. This generous bequest will enable the department of anthropology to take up several new investigations and to send out several field parties. Thus, this season's archæological work will be undertaken in Colorado, making excavations and surveys, relative to the so-called Folsom culture, a type of early prehistoric Plains Indian culture associated with an extinct species of bison. The results of this undertaking promise to be of importance in determining the prehistory of man in America. Another project supported by this fund is the collection of palæolithic and neolithic specimens from Central Europe under the direction of Curator N. C. Nelson. The data and collections resulting from this project will greatly improve Museum exhibits and facilities for the study of early man in Europe. Plans for other projects are now being formed looking toward a continued and fruitful program of anthropological research. The Voss Bequest is thus one of the turning points in the history of anthropology in this Museum.

A VISITOR'S IMPRESSION OF THE AMERICAN MUSEUM

IN the July, 1930, issue of *Natur und Museum* appears the following travel letter by Fritz Dreverman, giving his impression of the American Museum of Natural History, after his trip through the natural history museums of North America in the early part of 1930:

> The Natural History Museum in New York is the proper climax to a short trip through the natural history museums of the United States. Here criticism is silenced, for so great is one's admiration that all to which one might perchance take exception is lost in the general impression. The fact that the size of the exhibits makes it almost impossible to note and lay stress upon all the details, may serve as an

excuse for the incompleteness and brevity of this report. The general impression is and will remian unforgettal le.

The entrance hall with the meteorites, Darwin Hall, the Hall of Ocean Life, in course of preparation, numerous bird and mammal groups in which, despite the excellence of the older presentations, one recognizes everywhere progress and intelligent effort—all this fascinates the museum man. Luminescent deep sea fishes, a towering cliff at the ocean's edge with nesting and flying birds, areespecially remembered, and every Museum visitor will find pleasure in seeing the distant land and the dark, deep sea here brought before his eyes. One senses how the thoughts of the explorer, the teacher, the preparator, and the artist have become harmoniously blended, one feels the love for the poor children of the huge city who never get out where they can revel in the love ot nature. An effort to produce the very best can be felt everywhere.

The palæontologist is particularly captivated by the fourth floor. The thrills which ran up and down my back in the Hall of Dinosaurs, the enthusiastic admiration for the results of the Central Asiatic excavations, and the pleasant sensation that nowhere a rigid pattern holds sway, but that, for example, one can take an animal, as in the case of the horse, and connect its past and present, a thing which is apparently also being planned in the case of the elephant and which has been so successfully done in the presentation of man—all this makes the visit a pleasure. It must be glorious, for example to be able, unrestrained by financial or other considerations, to place a galloping greyhound beside a galloping horse! Here I would insert a motion picture.

The intellectual life of the Museum goes far beyond the exhibitions. The School Service Division, the coöperation of the Staff in animal conservation, in the establishment of conservation parks, etc., are examples of the activities which show that here the exhibits are but a nucleus around which everything is arranged which joins mankind with nature and maintains the connection. I do not like to mention names, but that of Henry Fairfield Osborn must be mentioned. For in him the great investigator is combined with the solicitous financier and the kindly man with a genuine love for those who cannot see the whole, as nature gives it to them, but to whom the substituted Museum must drive home the magnitude of creation.

One thing, however, I will say for those who believe that the exhibits are the most important factor of a museum: nowhere does the excellent comparison of a museum with an iceberg come so true to the mark as in New York! In the latter, as in the former, only an eighth is visible, seven eighths however are invisible—there in the gray-green ocean—here in ten thousand drawers at which Research is working.

Whoever wishes to make a trip through the natural history museums of North America, let him not stop in New York but go right on. He will then, when he finally sees the Natural History Museum in New York, after all the others, have the feeling, as did I, of a mountain climber to whom the last peak scaled brings all the joy of beauty and perfection.

ERRATUM

IN an article on "Altamira" which appeared in the July-August issue of NATURAL HISTORY, the word "one" on the fifteenth line of the last paragraph, page 434, was incorrect. It should have read "no."

"TRUMPETING THE ADVANCE"

THE cover design of this issue, entitled "Trumpeting the Advance," is from a painting by Arthur A. Jansson of the American Museum's department of preparation. It shows an enlargement proposed for the elephant group which is to be the dominating centerpiece in the forthcoming African Hall. To Carl Akeley's existing group, "The Alarm," as a nucleus, would be added, if the proposal were carried through, the two elephants shown in the foreground and the two in the background—thus making a group appropriate to the proportions of the hall. The subject of the cover was chosen for this issue because its forward moving, vital power is symbolic of the Museum's present and potential contributions to the knowledge of Nature.

NEW MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum, making the total membership 12,121.

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

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

MEMBERS' CLUB ROOM AND GUIDE SERVICE

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

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THE NEW SCHOOL SERVICE BUILDING, with the increased facilities it offers, makes it possible to augment greatly the Museum's work not only in New York City schools but also throughout the country. About thirteen million contacts were made during 1929 with boys and girls in the public schools of New York and the vicinity alone. Inquiries from all over the United States, and even from many foreign countries, are constantly coming to the School Service Department. Information is supplied to, and thousands of lantern slides are prepared at cost for distant educational institutions, and the American Museum, because of this and other phases of its work, can properly be considered not a local, but a national—even an international—institution. Through its loan collections, or "traveling museums," which are circulated locally, 557 schools were reached last year, and 1,857,729 direct contacts were made with the pupils. More than a million lantern slides were lent to the New York City schools, and 4,297 reels of the Museum's motion pictures were shown in 271 public schools and other educational institutions in Greater New York, reaching 1,725,865 children.

COLLEGE AND UNIVERSITY SERVICE. The President and the Curator of Public Education have extended and intensified the courses of college and university instruction. Among the institutions with which the Museum is coöperating are Columbia University, New York University, College of the City of New York, Hunter College, Rutgers College, University of Vermont, Lafayette College, and Yale University.

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

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

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

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

EXPEDITIONS from the American Museum are constantly in the field, gathering information in many odd corners of the world. During 1929 thirty expeditions visited scores of different spots in North, South, and Central America, Europe, Asia, Africa, and Polynesia, and nearly as many are now in the field continuing last year's work or beginning new studies.

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

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CONTENTS

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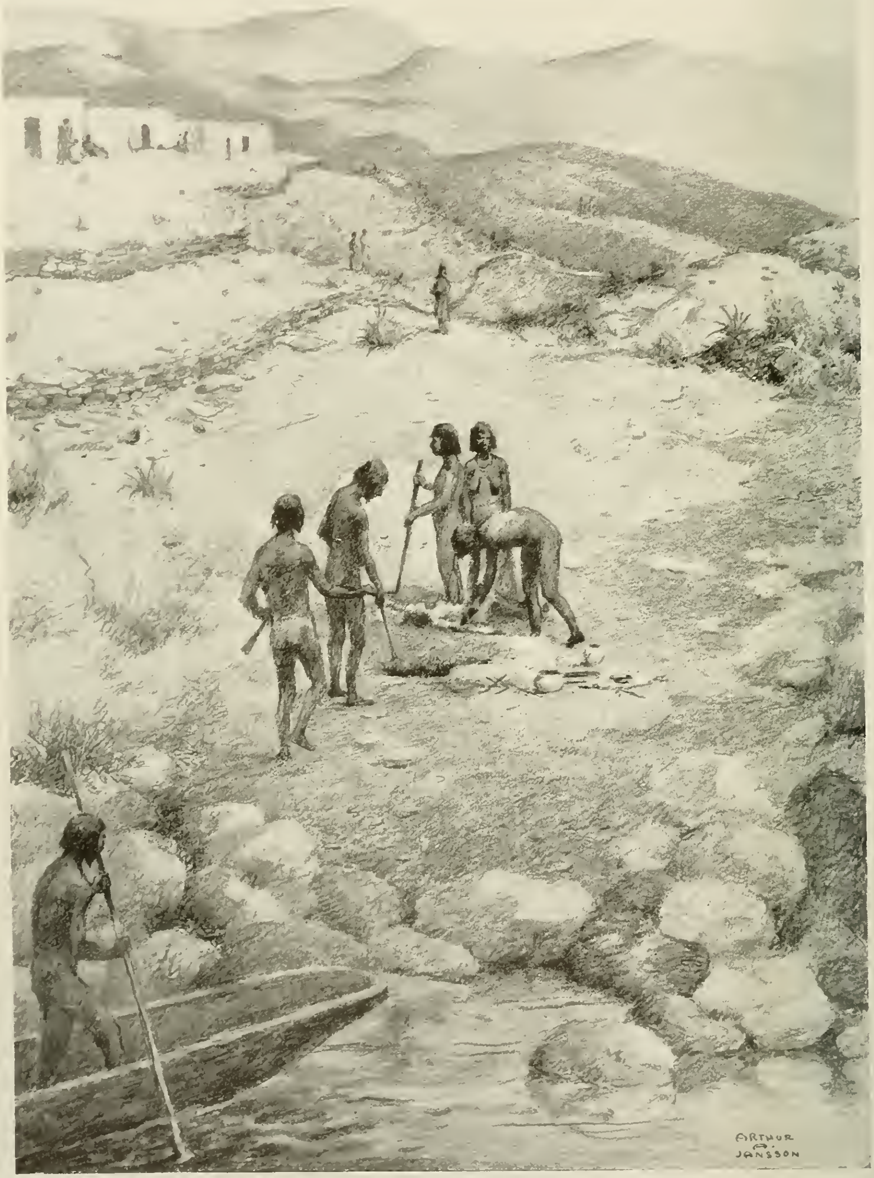


A BURIAL AT PREHISTORIC TICOMAN

The exploration of graves is one of the most rewarding means of discovering the life and habits of forgotten peoples. The simplicity of the burial ceremony at Ticoman shows that the early cultures of the Valley of Mexico could not have had an elaborately ritualistic religion. This picture is a reconstruction by Arthur A. Jansson

(See "Reconstructing the Beginnings of a History," Page 606)

VOLUME XXX

NATURAL HISTORY

NUMBER SIX

NOVEMBER–DECEMBER, 1930

ICELAND

AND ITS ONE-THOUSAND-YEAR OLD PARLIAMENT

The Great Subarctic Island of the North Atlantic Ocean

By CLYDE FISHER

Curator of Visual Instruction in the American Museum of Natural History, and President of the New York Bird and Tree Club

ICELAND is off the beaten track. No steamship line connects this Arctic outpost with America, and consequently it has the lure of the little known,—this in spite of the fact that an Icelander and his followers set foot on our shores nearly five hundred years before the arrival of Columbus.

First settled in 874 by Ingolf of Norway, Iceland later became a dependency of Denmark. In 1874 a millennial celebration of the first settlement was held, opened by King Christian IX of Denmark. Bayard Taylor, attending this ceremony as a correspondent of the *New York Tribune,* has given us a very readable account of it in his *Egypt and Iceland.*

During the last week of June, 1930, another millennial celebration was held in Iceland, this one to mark the founding of the parliament, or Althing, the ceremonies being opened by King Christian X of Denmark and Iceland. When we recall that this legislative body was formed in 930, it makes us feel that our institutions in America are indeed youthful.

Unexpectedly there came to me an opportunity to attend this recent celebration, on a combined mission for the American Museum of Natural History and the New York Bird and Tree Club. For the American Museum I was to gather information and to make photographs for use in our work with the schools of New York City. For the New York Bird and Tree Club it was my mission to present to the government of Iceland a gift of trees in a reforestation project.

Soon after the World War, the New York Bird and Tree Club presented several thousand fruit trees to France, which were planted in devastated areas. This project was so favorably received,—among the letters of appreciation was a memorable one from General Foch,—that the club has been alert for an opportunity to do something of a similar nature in some other corner of the world. After a visit to Iceland a year or two ago, Mrs. Helen B. Norton, one of our members, suggested a gift of one thousand trees

SNÆFELLSJÖKULL
In the western end of Iceland is this beautiful mountain covered with eternal snow, and rising nearly 5000 feet

with a fund to finance the reforestation experiment, and further suggested that the plan be launched at the millennial celebration in 1930. The project was organized and carried to a successful issue by the secretary of the club, Mrs. T. Carlyle Jones.

After careful consideration of the trees that now grow in Iceland, either native or introduced, and after consulting several tree specialists of American botanical gardens and arboretums, as well as expert private nurserymen, it was decided to try several species, among them one or two northern pines, two or three spruces, Canada Balsam, and two northern oaks. During my visit to this sub-arctic island, I examined two plantations of pines, one near Reykjavik, the capital, and one at Thingvellir. These trees had been planted two years ago, but showed not the least signs of winter-injury. In fact, I did not expect to find such evidence, for the climate of this oceanic island laved by the Gulf Stream is not rigorous but surprisingly moderate.

In 1874 Bayard Taylor made the following relevant comment:

> It is a question whether Iceland was ever wooded, as some of the sagas indicate. No large tree-trunks have been found in the peat-beds, and there are no local traditions of woodland. I am convinced that the hardier trees, such as birch, Scotch fir, mountain-ash, and alder, might be raised in sheltered places, with a little care. Yet almost the only tree in Iceland is a mountain-ash, about twenty-five feet high, at Akureyri, on the north coast. Neither temperature nor the prevailing winds are sufficient to prevent the growth of timber; it is more probable that the people never seriously thought of trying the experiment.

Sailing from New York on June 17, 1930, on the S. S. "Polonia," we proceeded directly to Iceland as our first port of call. Our cruise was specially conducted by the Danish American Women's Association under the leadership of Baroness Dahlerup.

Among the passengers, of whom there was an interesting list, was Hon. O. P. B. Jacobsen of Minneapolis, one of President Hoover's five delegates to the millennial celebration. Besides a preliminary shipment of trees, there was on board a bronze bust of Vilhjalmur Stefansson, by the Icelandic sculptress, Nina Saemundsson, a gift to the government of Iceland from the Danish American Women's Association. By vote of Congress, the United States Government presented a bust of Leif Ericson.

With the interest of an all-round naturalist, I was on the look-out for all manifestation of nature from phosphorescent organisms stirred up by the ship to whales that might come near our path; from icebergs to beautiful sunsets. The commonest bird in mid-ocean in the North Atlantic, as has been my experience on previous trips, was the fulmar, a bird that resembles a gull, but which is related to the petrels, shearwaters, and albatrosses. We saw both the light and dark phases. When still nearly two days from Iceland, there came aboard the ship a stone-chat, a small land-bird of the thrush family, which I later saw nesting in Iceland, and which I had previously seen in Arctic Lapland. Near Iceland we saw gannets, murres, great black-back gulls, kittiwakes, and Arctic terns, the last being referred to by the late Prof. Wells W. Cooke as the world's greatest travelers, since many of them nest in the Arctic regions and then go south clear to the Antarctic regions to spend the period of our winter.

On the evening of June 25 we entered the harbor of Reykjavik, the capital of Iceland, and anchored just outside the breakwater. Iceland is almost entirely south of the Arctic Circle, only the northeast corner projecting very slightly beyond.

REYKJAVIK FROM THE HARBOR
Reykjavik, the capital of Iceland, is a thoroughly modern city, equipped with telephones, electric lights, and automobiles

GRYLA, ONE OF THE FAITHFUL GEYSERS OF ICELAND

Besides the hundred or more volcanoes in Iceland there are numerous geysers and small mud volcanoes. The geysers of Iceland were the first ever discovered

Photograph by Hans Peterson

ICELAND PEASANTS AND THEIR HOMES

These houses are built of wood, or wood and volcanic rock, and are covered with roofs of grass-covered sod

AN IMPORTANT ICELANDIC INDUSTRY
Most of the fishing is done during the first four or five months of the year, and cod and herring are the principal catch. The chief market for the exported fish is Spain

THE FOREST OF HALLORMSSTAD
On the east coast of Iceland. Some of these northern white birch are said to be nearly forty feet in height

Photograph by Clyde Fisher

ALMANNAGJA OR "THE CHASM OF ALL MEN"
A rift in the volcanic lava leading from the upper plain down to the Law Rock at Thingvellir

city. The meaning of this name reminded me of the nickname of Edinburgh, Scotland, "Auld Reekie" (Old Smoky), and I recalled that, although Iceland was settled by early Norwegians, there occurred during the early years an influx of Celts, and I wondered whether the first part of the name, *Reykjavik*, and *Reekie* did not have the same origin. In fact, the name "viking," applied to those early Norsemen who lived on the creeks and fjords of Scandinavia, has the same derivation as the last syllable of "Reykjavik."

It was impressive to see the warships in Reykjavik harbor, namely, English ("Rodney"), Swedish ("Oskar II"), Danish, French, Norwegian, and two belonging to Iceland. The foreign warships had come for the millennial celebration of the founding of the Icelandic parliament. This was our second "white night." In fact, all of our nights in Iceland were "white nights." One feels that it must get dark, but it doesn't. This is difficult to believe even after one has experienced it. We were so near the Arctic Circle that the sun did not set on this date until after eleven o'clock, and of course it rose again soon after midnight.

Iceland's volcanic constitution is evident from the harbor. There are a score of volcanoes on the island that have erupted in historic times, but all are quiet now. However, there have been eruptions within the last few years. Hekla

The midnight sun can never be seen at Reykjavik, which is located in the southwestern corner of the island. But the northern border of Iceland is so near to the Arctic Circle that the midnight sun can be seen there for about a week, that is, for about three days before and three days after the summer solstice. There are two reasons why the midnight sun can be seen a little way south of the Arctic Circle; first, the sun is not a point, but a disk; and second, on account of refraction by the earth's atmosphere.

The name Reykjavik, means "smoky valley" or "smoky bay," and was applied because of the steaming of the hot springs which are in the outskirts of the has erupted twenty-two times in the last thousand years. To straighten out any geological problems, I naturally turned to my associate, Mr. Nels C. Nelson, curator of prehistoric archæology in the American Museum, who was a member of our party, and he never disappointed me. Much of the lava is very old, and great grass-covered plains and slopes have derived their soil from decayed larva. One is impressed with the abundance of luxuriant grass. The cultivated grass, or hay fields about Reykjavik were tinged with yellow, as seen from the harbor, due, as I learned later in the evening, to a species of buttercup.

Iceland is about 300 miles long east and west and 200 miles wide north and south, but on account of a very irregular coastline the area is between 41,000 and 42,000 square miles,—almost exactly the same as the area of Ohio. On account of the abundance of grass in Iceland and the relatively small amount of glacial ice, it has been suggested that it would be much more appropriate if the names of Iceland and Greenland were interchanged.

We went ashore in the life-boats of the ship, and found Reykjavik to be a modern city with telephones, electric lights, and automobiles. However, the street lights were not needed during our stay. The population is about 26,000, including more than one-fourth of all the inhabitants of Iceland. There are an excellent library, a fine cultural museum, and a representative museum of natural history, well housed in one building. There are a university and a museum of sculpture. The latter is noteworthy because it contains only the work of the greatest Icelandic sculptor, Einar Jonsson. The spacious concrete building provides a home and a studio for the artist as well as museum space for the

MILLENNIAL CELEBRATION OF THE FOUNDING OF ICELAND'S PARLIAMENT

It was at Thingvellir, about thirty miles from the present capital of Iceland, that the Icelandic parliament was founded in 930

SUNSET OVER THE HARBOR OF REYKJAVIK

In this harbor warships of many countries anchored during Iceland's millenial celebration

SELJALANDSFOSS

One of the many beautiful waterfalls of Iceland. The man and horse at the foot give an idea of its height

ALFTAVATN OR SWAN LAKE

Near the Sog, not far from Thingvellir. The trees of the so-called forests of Iceland are hardly more than shrubs

ÖXARARFOSS

A waterfall at Thingvellir that lent beauty to the setting for Iceland's millenial celebration

Photograph by Mary Bamberger

ON THE PARLIAMENT'S THOUSANDTH BIRTHDAY

One of the characters in the pageant reënacting the organization of the parliament

display of his work, and it was built by the government. This laudable bit of encouragement is well deserved, for Jonsson's sculpture reflects the very spirit of Iceland. It is strong and original. Especially was I impressed by "The Outlaw," "Remorse," and "Sorrow." One of his pieces, "Thorfinnur Karsefni," the viking who attempted to colonize America in 1007–1011, is in Fairmount Park, Philadelphia. In this connection, I was interested to learn that Thorwaldsen, the great Danish sculptor, was of Icelandic extraction, his father having been an Icelander.

The most important occupation of the people of Iceland is fishing, cod and herring being the principal kinds taken. The chief market for the exported fish is Spain. Dairying is also an important industry. Not only cattle, but also sheep and Iceland ponies are raised. The cattle look like modern European or American breeds, but the Iceland sheep are unique. The scientists have given them a special name, *Ovis brachyura borealis pall.* Both sexes have horns, and the wool, varying in color from white to black, is very long and silky.

The Iceland ponies are most attractive, ranging in color from dun and light gray to dark brown or black, some of them being spotted. They have the most gorgeous manes and forelocks I have ever seen in the horse tribe. The finest specimens, seen head-on, remind one of great maned lions. Some of the manes have a median streak of black bordered by light color, while others have a streak of light color bordered by black. These bi-colored manes are most beautiful.

The Iceland pony, or Celtic horse, as it is known to scientists, is believed by the

AN ICELANDIC GIRL

This colorful national costume with tasseled cap, bodice embroidered in silver and gold, silk apron, and shawl resembling a paisley, is now worn only on special occasions

A LAUNDRY NEAR REYKJAVIK

Water from the hot springs in Iceland is used not only for laundry purposes, but for heating dwellings and greenhouses

best authorities to be the direct descendant of a very hardy northern species which has come down through the ages in an almost pure state, having been changed but little by man's influence. It seems certain that it is more nearly like the first domesticated horses of Europe than any in the world. Those of the prevailing dun color resemble not only in color, but also somewhat in shape, the Mongolian wild horse or Prjevalsky horse. It seems highly probable that this species branched off at an early period from the North African or Arabian stem and spread northward, becoming smaller and more adapted to a severe climate, but retaining many of the Arabian characteristics in anatomy and temperament. It is said that there are 50,000 ponies in Iceland, that is, one for each two human inhabitants. The principal markets outside of Iceland have been the collieries of England and the farms of Denmark.

In the early days, in fact until the Fourteenth Century, horse-fights were considered fine sport in Norway as well as in Iceland. There are lively descriptions in some of the sagas of how the old vikings pitted their stallions one against the other, and of how these horse-fights often led to a bloody feud. In these contests the horses rear up on their hind feet, strike each other with their fore feet, and bite viciously.

Reindeer were introduced into Iceland from Norway in 1771, but they have not been domesticated there as they have been in Lapland. It is estimated that there are now about 700 wild reindeer in Iceland, and they are protected by law.

On the plains of Iceland we saw many interesting birds, among which were curlews, whimbrels, golden plovers, ptarmigan (which turn as white as snow in winter), ravens (so lacking in fear of man that we approached to within a few yards), wagtails, stone-chats, long-tailed jaeger, oyster-catchers, eider ducks (on a lake), and a thrush whose song resembled that of a veery. The eider duck is carefully protected by law because of the eider-down, the collecting of which constitutes a minor industry in Iceland. I was interested to learn that the last great auk ever seen in any part of the world was killed in 1844 off Cape Reykjanes, southwest of Reykjavik.

A unique sport in Iceland is the peasant-wrestling, or *Glima*, first exhibited to the outside world at the millennial celebration of 1874. This is now included in the Olympic Games, and the champion of *Glima* in Iceland is, of course, champion of the world. Contests were held during the recent millennial celebration, some of which were attended by the King of Iceland and Denmark, who congratulated the victors.

There are many hot springs in Iceland and the people use the water for laundry purposes, as in the outskirts of Reykjavik; for heating dwelling houses, as observed between Reykjavik and Thingvellir; and for heating green-houses in which vegetables and small fruits are grown. The last promises to become an important industry in the island. The name "Geysir" is an original Icelandic word, an onomatopoetic word similar to our word "gusher," and it was first applied to one of the big geysers in Iceland. The name, by extension, has since been applied to the geysers of Yellowstone Park and of New Zealand. The first geysers to be discovered were those in Iceland.

The millennial celebration was held during the three days, June 26, 27, and 28, at Thingvellir, which is located about thirty miles from Reykjavik. It was at Thingvellir that the Icelandic parliament

Photograph by Clyde Fisher

A PLANTATION OF PINES AT THINGVELLIR

They were thriving and unimpaired by the cold of winter. Mr. Bassett Jones, who has had much experience in growing pines in exposed situations, identified these as Swiss mountain pine, (*Pinus montana*)

ICELAND PONIES
The nearest relative of the original domesticated horse of the Old World. They have gorgeous manes and forelocks, and seen head-on, remind one of great maned lions

was founded in 930,—one thousand years ago. The place selected is so unusual that one can easily imagine that he is on the moon or some other planet. The road leading to the Law Rock (Lögberg) passes through a great rift or gorge in the lava. During the three days there was much speech-making on the Law Rock by representatives from many countries of the world. Senator Norbeck spoke for the delegation sent by President Hoover from the United States. Several of our individual states also sent special representatives, among them being Minnesota, Wisconsin, Illinois, North Dakota, South Dakota, and Maryland. This was also true of several provinces of Canada.

Much of the speaking was in the Icelandic language, which is old Norse, changed but very little since the foundation of the government. Immigration has been forbidden, so that outside influences have been almost negligible. It is said that the Iceland people of today can read the sagas of the viking times with greater ease than an Englishman can read Chaucer or Shakespeare.

Several of the representatives from the United States and Canada, being of Icelandic birth or extraction, gave a part or all of their addresses in Icelandic.

Shortly preceding my little speech was one by a representative from Holland. I could not understand at all what he said. I assumed he was speaking in Dutch. Later I sat beside him at luncheon, and I said to him,

"I heard your speech this morning, but not being familiar with Dutch I did not understand it."

He replied, "I am a philologist, and I spoke in Icelandic." I then changed the subject.

No doubt because I had brought a gift to the government of Iceland, I had the honor of being invited to the dinner given by the Prime Minister to the King. At this function the Queen as well as the ladies of Iceland wore the Icelandic national costume. The waitresses wore a characteristic gray modification of this costume. At this dinner we were cognizant of the repeal of Iceland's prohibition law, under pressure from Spain, who refused to buy Iceland fish unless Iceland bought Spanish wines. The Swedish Crown Prince, Gustaf Adolf, was the only member of Royalty besides the King and Queen of Iceland and Denmark, who was present at the King's dinner and at the entire three days' ceremonies.

One day during the celebration, in speaking with the Swedish Crown Prince, I reminded him that I had photographed him and his father six years ago at the Royal Palace in Stockholm, and I asked him whether I could photograph him in Iceland. He replied, "Get your camera." When I snapped him he asked the Bishop of Iceland to pose with him. We had a little chat about his visit to the American Museum a few years ago, a visit remembered with pleasure by the members of our scientific staff, because of his pleasant personality and his intelligent interest in a wide range of natural history subjects, especially in archæology. He is a fine, human person.

Iceland shares the King with Denmark. In Denmark they say Christian X is King of Denmark and Iceland; in Iceland they say he is King of Iceland and Denmark. But Iceland pays no taxes to Denmark. The island has its own money, its own postage stamps, its own flag, and its own warships for the protection of its fishing industry.

The strength of character of the Icelandic people impresses one. Their seriousness is probably a result of their environment,—long winters and typical hummock soil of the Arctic prairies. They are progressing in the ways of modern western life by rapid strides.

INGOLF ARNARSON

The first Norwegian colonist of Iceland. Situated on the highest point in Reykjavik is this heroic bronze by Iceland's greatest sculptor, Einar Jonsson

SCREEN AT ENTRANCE TO HALL, WITH MAP TO SHOW WHERE THE GROUPS WERE COLLECTED

SOUTHERN ASIA IN THE AMERICAN MUSEUM

The New Vernay-Faunthorpe Hall of South Asiatic Mammals

By H. E. ANTHONY

Curator of Mammals, American Museum

Owing to the fact that this article had to go to press while finishing touches were still being added here and there in the new hall, it has not been possible to show in the illustrations all of the groups that were exhibited on the opening night. For the same reason no mention can be made at this time of the details of the official opening to the public on the evening of November 17. An account of the exercises attending the formal presentation of the hall, its acceptance, and the remarks of the speakers will be given in the next number of Natural History.—The Editors.

In 1918 the late Lt. Col. J. C. Faunthorpe, a member of the British War Mission to the United States, visited the American Museum of Natural History where, to quote his own words, he said (Natural History, March–April, 1924):

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 India 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 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.

The offer of Colonel Faunthorpe to collect Asiatic mammals for a hall in the projected Southeast Wing was welcomed by President Henry Fairfield Osborn. Early in 1922, when the ideas for the new hall of Asiatic mammals began to crystallize, one of the stumbling blocks in the

INDIAN ELEPHANTS IN THE CENTER OF THE HALL

Dominating the entire center of the hall is an open group composed of a male and a female Indian elephant. For permission to take these wild specimens in Southern Mysore, the Museum is indebted to His Highness the Maharajah of Mysore, G. C. S. I., G. C. I. E., G.B.E.

ARCHITECTURAL DETAILS ABOUT THE MAIN COLUMNS

The ornamentation in the hall is unobtrusive, but the designs have been very carefully selected and executed, and are faithful representations of the older Indian architecture. This photograph was taken before the hall was completed, and the empty case is now occupied by four-horned antelope

A DETAIL OF THE LATERAL ALCOVES
Showing an ornamental bench of teak, and the effective bamboo pattern of the window screens

path of the project was the raising of funds for the field work.

Colonel Faunthorpe had generously donated his services, but transportation and field expenses had to be met, and the outlay involved was considerable. The offer of Mr. Arthur S. Vernay to finance the undertaking removed the last obstacle to consummation of the plans. He not only assumed all of the costs of the collection of the mammals—like Colonel Faunthorpe devoting his personal efforts to the field work—but manifested great interest in every aspect of the plans and contributed substantially toward the expense of mounting specimens after they reached the Museum.

At first the new hall had been intended to contain representative mammals from the entire continent of Asia. When the support of Vernay and Faunthorpe began to be felt, it was obvious that the mammals of southern Asia alone would suffice to fill the hall. In consequence, President Osborn determined to devote the second floor of the new Southeast Wing to the mammals of southern Asia, and on the plans withdrew the mammals of northern or boreal Asia to the adjacent hall of the old Museum wing.

The large mammals of Asia, like those of the other continents, are being rapidly reduced in numbers, and in the case of certain species are practically on the verge of extinction. Indeed, there are a few, such as Schomburgk's deer and the Sonda rhinoceros, which may have completely disappeared. The Indian lion has long been known only from a small number to be found in a very restricted area. If the American Museum was to possess a hall containing any very complete representation of the large mammals of southern Asia, there was no time to be lost.

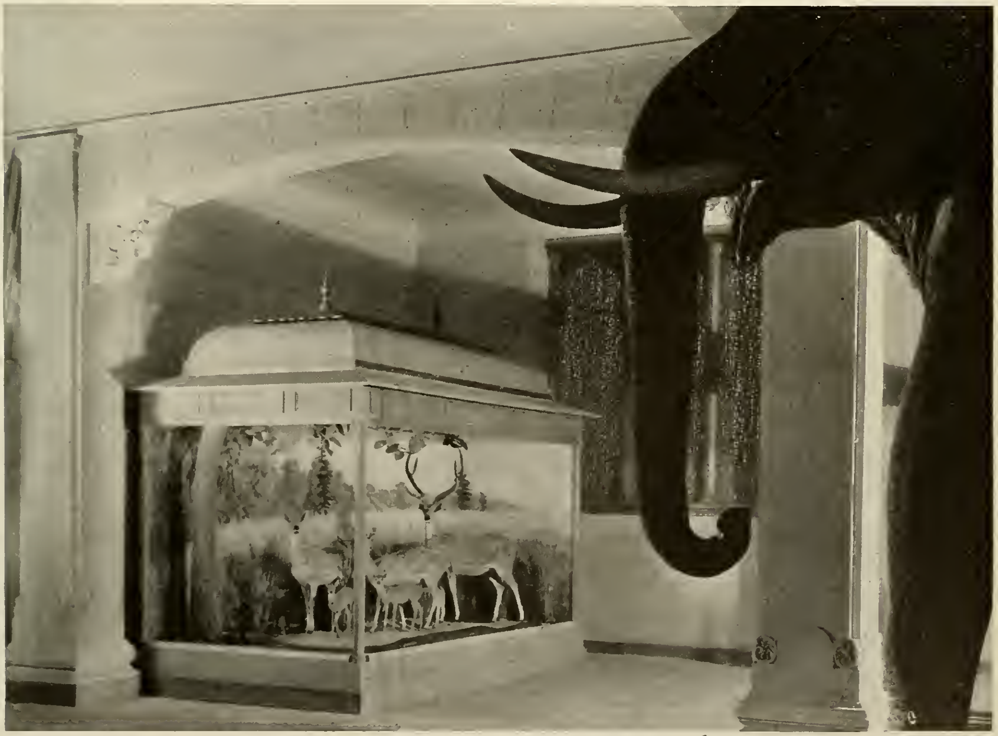
It was an especially fortunate circumstance for the Museum that the men undertaking the collection of these specimens had such a wide knowledge of conditions in India and adjacent states and were *persona grata* to those individuals best able to aid in the enterprise. Through the influence of Colonel Faunthorpe and Mr. Vernay, the needs of the Museum were brought to the attention of the authorities entrusted with the conservation of the rapidly diminishing species, and exceptional privileges were extended to permit the taking of animals otherwise rigidly protected. In the years to come the American public will have the opportunity of viewing species which in a short time will have vanished from the face of the earth.

The coöperation which Faunthorpe and Vernay received in southern Asia was the one touch which could alone make or ruin the expeditions. Experienced hunters, and filled with an enthusiastic interest in their project, their efforts would have fallen far short of the success they achieved without the support received from such men as His Excellency the Viceroy Lord Reading, Sir Harcourt Butler, and the Indian Princes, particularly the Maharajah of Mysore, the Maharani of Khairigarh, the Kunwar Dillipat of Khairigarh, the Maharajah of Bikaner, and the Nawab of Junagadh. Apart from this, great assistance was given by the Indian Office, particularly by Sir Malcolm Seton.

The first of the Vernay-Faunthorpe Expeditions began late in the year of 1922 and continued until June, 1923. The field work was remarkably successful, and groups of all the larger mammals of the plains of India, except the buffalo, the Sumatran rhinoceros, and the lion, were obtained.[1] Work was begun on this material soon after it reached the Museum and a part, at least, of the Museum staff of preparators has been continuously engaged since that time upon the multitudinous details connected with the creation of a great hall.

This was the first of a series of expeditions for Asiatic mammals, and either Mr. Vernay or Colonel Faunthorpe, or both, have continued to make long trips into the field to secure groups not hitherto represented, or to replace earlier specimens with better material.

[1]See articles in NATURAL HISTORY March-April, 1924, by J. C. Faunthorpe and Arthur Vernay.



THE CHITAL DEER, ONE OF THE FOUR LESSER HABITAT GROUPS
In harmony with the architecture seen elsewhere in the hall, the cases for these groups have been designed to carry out the Indian motif

THE WATER BUFFALO

There are eight large habitat groups in the hall, and this one of the Indian or water buffalo shows a scene in the Central Provinces. These are the wild representatives of the ox which had been so widely domesticated throughout southern Asia. The water buffalo frequents the lowlands and prefers the vicinity of streams

A PAIR OF LEOPARDS IN SOUTHERN MYSORE

In a *shola* or wooded glen, a leopard has just captured a peacock and the two survivors of the flock are flying off through the trees. Pea fowls are a favorite prey of the leopard. Their presence in the group adds an effective color contrast to the rich markings of the leopards

THE GREAT INDIAN RHINOCEROS

In a thicket of tall grasses near the border of Nepal, a pair of the great Indian one-horned rhinoceroses stand in all the impressiveness of their dermal armor-plate. For permission to take these specimens the Museum is greatly indebted to the late General His Highness Sir Chandra Shumshere Jung Bahadur Rana, G. C. B., G. C. S. I., G. C. M. G., G. C. V. O., D. C. L.

THE BANTING OR TSINE

These wild oxen were taken in Lower Burma, and the dense thicket of bamboo depicts a favorite haunt of this handsome game-mammal. For permission to take these specimens the Museum is greatly indebted to Sir Harcourt Butler, G. C. S. I., G. C. I. E., D. C. L., I. C. S.

SAMBAR DEER AND SWAMP DEER

In a marshy tract in the Tarai, along the foothills of the Himalayas, the sambar deer (left) are grazing close to the swamp deer. For permission to collect these mammals the Museum is greatly indebted to the late Nawab Sultan Jahan, Begum of Bhopal, G. C. S. I., G. C. I. E., C. I., G. B. E., for the sambar, and to Maharani Surat Kunwar, O. B. E., of Kharigarh, Oudh, for the swamp deer

THE STAG AT BAY

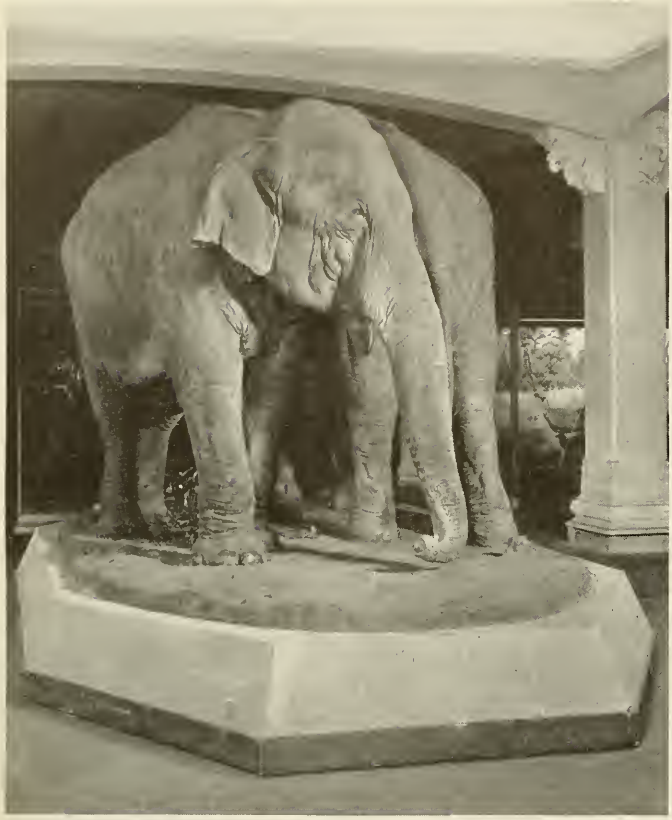
In the Billigirirangan Hills a band of wild dogs have bayed a sambar stag and are grouped about their prey in a dramatic pose

A GROUP OF BENGAL TIGERS

In the Kheri forest a female tiger has just brought her cubs to water at the same moment that a large male appears through the trees attracted to the same stream. For permission to collect these specimens the Museum is greatly indebted to The Most Honourable the Marquess of Reading, P. C., G. C. B., G. C. S. I., G. C. I. E., G. C. V. O., D. C. L., LL.D.

MALE AND FEMALE GAUR

The gaur is one of the most impressive of all the wild oxen. This pair have just come up from a ravine in the Billigirirangan Hills to graze along a grassy ridge



THE GROUP OF INDIAN ELEPHANTS
In this species the tusks of the females are frequently too small to project beyond the margin of the lip

and Clarence C. Rosenkranz, an artist, to make background studies. This material, and the experience gained by the preparators, added greatly to the value of the specimens collected previously, for it now became possible to build background habitat groups in accordance with best modern practise. The major groups in this hall are now all based upon careful paintings of actual localities chosen, both because they were the natural habitats of the species to be exhibited, and because they illustrate an important type of topography or ecological area. The vegetation is the actual plant life collected on the spot or a facsimile copy in certain cases where preservation was impossible.

On December 1, 1929, Colonel Faunthorpe died of pneumonia, at Lucknow, India, without having seen the great progress made during that year upon the material he had been so earnestly gathering. His passing was a great loss to the Museum, and it was one of the ironies of fate that he should be taken just as the hall was entering upon the final stages of completion and assuming a grandeur of character and proportion which justified his early faith and vision.

The most productive expedition, in many respects, was that of 1927–28, when Mr. Vernay took two members of the Museum department of preparation, A. E. Butler, assistant chief of the department, who collected accessory material,

In all, some six expeditions have been necessary to assemble the field materials for the Vernay-Faunthorpe Hall of South Asiatic Mammals. The transformation of these, from hard hides, dried plants, and small canvases into lifelike animals, growing vegetation, and expansive vistas, has been an enormous task and one calling for all the artistry and ability of Mr. James L. Clark, assistant director, in charge of preparation, and of his staff. He has had as an ideal the exhibition of groups that are biologically sound, that show the mammals as they are best known to competent observers, and that will convince the visitor that he is looking upon a transported bit of Asia. Having taken into consideration every known

BLACK BUCK AND INDIAN GAZELLE

On the sunlit Nasik Plains a small group of black buck (left), escorted by a strutting male, encounter a small band of Indian gazelles. For permission to collect these specimens of Indian gazelles the Museum is greatly indebted to Major-General His Highness the Maharajah of Bikanir, G. C. S. I., G. C. I. E., G. C. V. O., G. B. E., A. D. C., LL.D.

THE CHITAL OR AXIS DEER

In the Province of Khairigarh a beautiful group of this handsomely marked deer are crossing a park-like opening in the forest. For permission to collect these specimens the Museum is greatly indebted to Maharani Surat Kunwar, O. B. E., of Kharigarh, Oudh

A FAMILY GROUP OF SLOTH BEARS

The sloth bear is of surly and uncertain temperament, more aggressive than the other species of small bears. This group is prowling about a termite nest near the Nepal border

SUMATRAN RHINOCEROS WITH YOUNG

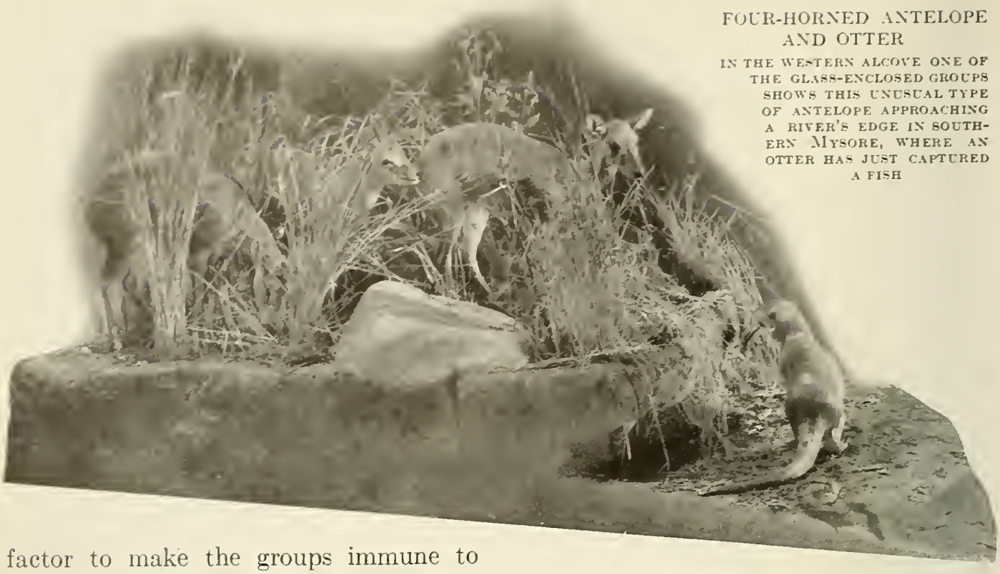
One of the open groups in the eastern alcove displays these smallest of the species of rhinoceroses which was collected in Lower Burma. For permission to take these specimens the Museum is greatly indebted to Sir Harcourt Butler, G. C. S. I., G. C. I. E., D. C. L., I. C. S.

A PAIR OF THE RARE INDIAN LIONS

To many it will be news that the lion occurs in Asia, and as a matter of fact it is almost extinct there. These specimens were taken at Junagarh, Bombay Presidency, and for permission to collect this valuable pair of a fast disappearing species, the Museum is greatly indebted to His Highness Sir Mahabat Khan, K. C. S. I., Nawab of Jungadh

THE NILGAI OR BLUE BUCK

This is the largest of the Indian antelopes and stands in a glass-enclosed case in the center of the hall



FOUR-HORNED ANTELOPE AND OTTER

IN THE WESTERN ALCOVE ONE OF THE GLASS-ENCLOSED GROUPS SHOWS THIS UNUSUAL TYPE OF ANTELOPE APPROACHING A RIVER'S EDGE IN SOUTHERN MYSORE, WHERE AN OTTER HAS JUST CAPTURED A FISH

factor to make the groups immune to reasonable criticism, he has attempted to treat the hall as a whole in such a manner that the Indian motif will be carried out by architectural details and the decorations of case-fronts, pillars, benches, windows, etc.

The success of this idea is apparent the moment one enters the hall. The light from the windows filtering through thickets of bamboo, the employment of teak wherever wood is used throughout the hall, and the suggestive Indian designs, all help to create an atmosphere that is in harmony with the mammals the visitor expects to see. Two large teak screens and two benches, richly carved and figured, were designed and executed by Arthur S. Vernay, Inc., and donated to the hall by Mr. Vernay personally. They add greatly to the attractiveness of the hall.

The general plan of the new Vernay-Faunthorpe Hall of South Asiatic Mammals provides for an adequate display of all of the dominant mammal types to be found in the region lying between the Himalayas and the islands south of the Malay Peninsula. Even in a hall of this size it would be impossible properly to exhibit specimens of all the distinct species—the South Asiatic fauna is far too large—but the selection includes the mammals which will be of the greatest interest to most visitors.

Long experience with the problems of daylight illumination has demonstrated the undesirability of sunlight in halls containing natural history material. Colors are soon faded, light values are continually varying, and illumination from outside the groups introduces troublesome reflections on the glass case-fronts. Therefore, the generally accepted ideal is a hall where groups are illuminated by electric lights from within and where the only sunlight admitted is a controlled minimum for certain limited areas. In the Vernay-Faunthorpe Hall of South Asiatic Mammals the large groups are handled as individual concepts entirely distinct from anything else in the hall. They have independent lighting, and no intrusive details are permitted to work against the creation of an illusion which will transport the visitor into the heart of India.

The biological data to be demonstrated by the group have naturally been given the first consideration, but other factors have been allowed to enter into the plans, and it is hoped that the new hall may serve to give instruction in fields other than zoölogical. For example, the topographic and geological features shown are all based upon careful field studies; the same may be said of the botanical details, and the architectural designs are faithful to the older Indian culture. The labels accompanying each group have been written to point out the most salient habits or to satisfy the questions most likely to be asked about the species in question. Special discussion of topics which involve biological principles more or less common to mammals throughout the world is reserved for the labels in the Synoptic Hall of Mammals.

There are certain factors which govern the planning of life-history groups such as are exhibited in the new hall. The general public has shown that it is partial to a group which features male, female, and young; the sportsman views a group with a critical eye and judges the animals first as to size, whether the specimen is as large as one he has killed (usually it is not!), and whether the action shows the species as he has found it in his personal experience; and a very limited number of visitors will weigh the exhibit in the light of what it shows to the specialist, what it tells or fails to tell of fundamental biological principles. Not all of these various visitors can be satisfied; no single group will meet all of these requirements.

Southern Asia has an extensive and interesting mammal fauna. A family group of any of the large species will prove eminently satisfying to the average visitor, for the specimens and habitat differ strikingly from his local associations. Such a group will answer graphically the greatest number of questions which might

THAMIN OR ELD'S DEER

Near Taungdwingyi, in Lower Burma, a handsome buck, with his harem, is shown in a region of open shrubbery. For permission to collect these specimens the Museum is greatly indebted to Sir Harcourt Butler, G. C. S. I., G. C. I. E., D. C. L., I. C. S.

arise, and will direct attention to the most salient features, such as color or size differences between sexes, sex-linked characters like horns or antlers, and the many varied details which are centered about the most important season of mammalian existence. It is not always easy to collect the material for a group of this type, for sometimes young of the desired age are difficult to secure. The intimate details of the family life of many species are only imperfectly known, and in building the group nothing can be taken for granted.

As one enters the Vernay-Faunthorpe Hall of South Asiatic Mammals, through the J. A. Allen Hall of North American Mammals and the projected Hall of North Asiatic Mammals, the first bit of India to meet the eye is a tiger-hunting scene copied upon a large screen. This illustration was taken from an old sporting print. From the entrance to the new hall the visitor notes a spacious passageway guarded near the southern end by a pair of lions and dominated throughout the central section by two Indian elephants upon which a subdued light pours from overhead. Flanking the wide passageway are four large case-fronts at either end, two on a side, and through the nearest of these windows one glimpses the environs of another world.

Beyond the threshold of the hall the spectator enters Southern Asia and he needs no great amount of imagination to be convinced of this fact.

SCREEN AT ENTRANCE TO HALL, WITH COPY OF OLD SPORTING PRINT OF TIGER HUNT

ABOVE AND BELOW BAHAMAN WATERS

An American Museum Expedition in the West Indies

By ROY WALDO MINER
Curator of Marine Life, American Museum

THE "Escape" gingerly worked her way out from Sands's dock between the mooring hawser of a huge scow and the bowsprit of a native sponger. Johnson, standing on the bow with boat-hook poised, his mahogany profile intent, fended us expertly away from the white sides and shining brass work of a yacht tied to the end of the pier. Swinging to the left, we gathered speed and cut across the basin past the end of St. George's wharf out into the open waters of the harbor. We skirted the miscellaneous shipping of Nassau's picturesque water-front and passed low sheds with long rows of assorted sponges spread out on palmetto fronds. Now we were opposite the fruit and vegetable market, and could see tables piled high with melons, oranges, tomatoes, and limes from the "out islands," around which crowded white-clad figures of both whites and natives intent upon buying and selling. We drew rapidly away from the shore, heading westward with the harbor entrance at our right, guarded by Hog Island Light, standing like a white sentinel against the deep blue of the northern sky and the still deeper blue of the Atlantic. The waves surged against the dangerous rocks at the point and sent clouds of snowy spray halfway up the sides of the light-tower.

Commodore Daniel Bacon, our host, held the wheel steady with one hand and turned toward us where we sat in the cockpit.

"That's what last October's hurricane did to the 'Princess Montague,'" he said, pointing toward a large steam-vessel, wrecked and canted at a sharp angle, where she lay firmly lodged on a dangerous-looking reef. "We always give Tony's Reef a wide berth," he added, suiting the action to the word. As we circled about, the swell from the harbor entrance gave the "Escape" a few minutes of busy tossing, but her twin screws gathered speed and we slid onward behind the shelter of Silver Cay and headed for an island beyond, where a few small bungalows snuggled among the shrubbery on its rounded summit. Mrs. Bacon rose from her seat beside my wife and, balancing herself precariously on the cockpit bench, leveled a pair of field glasses at the group of buildings.

"There's Fred watching for us on the veranda. I hope he has luncheon ready." She turned toward us. "It's too bad to have to bring you to 'Pirate's Nest' with the island in so sad a condition."

Tony Work, sitting beside me with one knee hunched up under his chin, surveyed the island thoughtfully.

"If you could have seen it before the hurricane, you would certainly never recognise it now," he remarked.

Truly the effects of the recent storm were everywhere apparent. Damages to the buildings had been repaired, but instead of nestling in a bower of coconut palms, casuarian pines, and blooming tropical shrubbery, they stood out naked and bare among the stumps of the twisted coconuts, from the tops of which a few irregular leaf-clusters were struggling to hold their own. The whole crest of the island was a mass of tangled shrubbery, but seared and brown as though it had passed through a northern winter. In fact, the feeling of early spring was heightened by the green leaf-buds which were showing everywhere, but not sufficiently developed to hide the brown lacework of branches beneath. A few irregular and bent pipelike supports were all that remained of the long wharf. So we had to anchor off-shore and land on a narrow sandy beach, with the aid of the dinghy. The beach projected, spitlike, from the bottom of the low cliff which bounded the entire island.

We clambered over the jagged pinnacles of the eroded limestone to a narrow path that wound through the otherwise impenetrable thicket and emerged into a clearing partially surrounded by rough stone walls where, at the summit of the island, a hospitable single-storied bungalow overlooked the harbor. Other buildings — guest bungalow, kitchen, and servants' quarters, together with a boathouse on the rocks at the water's edge, completed the group. Our hosts made us heartily welcome in the cheerful living room of the main bungalow where Fred had spread a delicious luncheon for us. When our appetites had been appeased and we had sufficiently admired the wonderful panorama of the open Atlantic, we started to explore the island.

The American Museum of Natural History had sent me to the Bahamas to continue field work in connection with the coral reef exhibit now being built in the Hall of Ocean Life, and my wife, who is expert in swimming and diving, had volunteered to assist me in that part of the work. We had been invited by the Bacons to make "Pirate's Nest" our headquarters during the month of March, while we were in the neighborhood of Nassau. Early in April I was to join forces with Dr. Charles Fish of the Buffalo Museum of Science to take part in an expedition to the sponge banks of Andros Island, conducted by Professor Field of Princeton University. During the latter part of that month I was to return to

THE "MARMION," EN ROUTE TO ROSE ISLAND
The ketch "Marmion" owned and navigated by Mr. Hugh Matheson of Coconut Grove, Florida, was the headquarters boat during the sea-diving operations at Rose Island, east of Nassau

AN ISLAND OF PETRIFIED SAND DUNES
Long Cay or "Pirate's Nest," near Nassau, is composed of æolian limestone, that is, rock formed from wind-blown limy sands. Wave erosion has exposed the layers of the limestone rock thus formed

Nassau to study the reef at Rose Island with the aid of diving helmets.

Mr. Bacon's island is down on the Admiralty Charts as Long Cay, but he has renamed it "Pirate's Nest" because of legends of buried treasure which still linger about the place. In this respect, however, it is no exception, for such tales cling to all parts of the Bahamas, dating from the days when pirate vessels lurked about the archipelago, preying upon the commerce of the Spanish Main and seeking refuge from the pursuing vessels of His Britannic Majesty behind dangerous coral reefs and in secret waterways and harbors.

The island is interesting from a geological viewpoint. It rises evenly in a long hog-back, about one-half mile in length, and is entirely of æolian limestone; that is, the rock composing it is compacted of wind-blown limy sands. These sands originated from the broken up and finely ground fragments of corals, mollusk shells, and skeletons of microscopic protozoa. A portion of the lime from these sources is also dissolved in sea water and redeposited in solid form. Sands, thus made, are blown about by the winds and heaped up in dunes, often forming islands in which vegetation takes root and acts as holdfasts. A certain amount of carbon dioxide is always absorbed from the atmosphere by rain-water and renders it acid enough to dissolve the limy sands and become saturated with lime in solution. Under the heat of the tropical sun, the water is rapidly evaporated and, the burden of lime being redeposited, cements the sand into limestone, a process which is hastened by the pressure of succeeding layers.

The rock of Pirate's Nest was produced in this way, but forces now acting upon it tend to its destruction. The surf of the Atlantic thunders on its northern side, rushing up the hog-back in powerful surges. The action of the waves fractures the rock and, separating the layers, removes it in flat sections, due to its stratified condition. Sometimes the whole crown of a petrified dune will be removed, leaving the broken edges of the strata surrounding the cavity like an amphitheater. The tropical rains, rushing down in torrents on the rocky surface, dissolve it, forming circular solution pits which are deepened and permeate the rock like the holes in Swiss cheese. These cavities render the rock more fragile and give the waves a greater purchase, thus hastening the process of disintegration. The pits in the higher regions of the shore become pools of rain water after every storm. The water, being supersaturated with lime, evaporates rapidly and redeposits the lime on the bottom and sides of the pit, where it overspreads its irregularities like a smooth blanket. Oftentimes, fragments of coral heads are tossed on the rocky shore by the waves and are cemented solidly to the under-lying rock by redeposited lime, but additions of this kind are not sufficient to balance the disintegrating forces. The western end of the island shows the most advanced state of destruction. Here the rock has been brought close to the level of the waves, which, in fact, have overwhelmed it at certain points, thus separating the island from its westernmost tip. As the tide rises, the surf comes rushing and boiling across this low portion, disintegrating it, and spreading its ground-up fragments over the sea bottom on the harbor side of the island. The shallow sand-flat formed in this way is partly sheltered at low water and here grow great quantities of gorgonians, i.e., sea-feathers, sea-fans, sea-plumes, sea-bushes, "monkey-tails," and sea-whips.

EXAMINING A SEA-FAN FISHED UP NEAR "PIRATE'S NEST"
Mr. and Mrs. Daniel Bacon, at their winter camp, "Pirate's Nest," near Nassau

All these forms are very abundant on the coral reefs and this sheltered flat is a very convenient place for collecting them rapidly and in quantity. They are identical with the growth forms on the submerged reefs, except that the largest specimens are not present. We needed numerous specimens for our Museum group and therefore made this our first collecting locality. Our method was simple. We waded out as far as possible at low tide and, submerging ourselves in the water, wrenched the specimens from the coral fragments to which they were attached, taking care not to injure them. Many beautiful growths were secured in this way.

The gorgonians are a kind of coral growth which forms a core of horny, flexible material instead of laying down a hard skeleton of carbonate of lime, as in the case of stony corals. This structure branches and sub-branches, in some species, sparsely, in others, to a very fine degree. The interior of the trunk and branches is constructed of tough black horn, with the elasticity of coach-whips. In fact, the core of large specimens is often used for this purpose by the Bahaman natives; hence the name, sea-whip. Outside this tough core is a more or less fragile crust, or cortex, with many pin-hole perforations, a felted layer made up of myriads of minute needles, or spicules, of carbonate of lime. Seen under a microscope, the spicules look like shining, transparent oat grains, except that they are covered with tiny knobs and are often irregularly branched. They have a characteristic range of form and color for each species, and therefore are useful in species determination. The cortex of spicules is held together by a cementing substance and by the tissues of the gorgonian animal. It is easily separated from the tough inner core, and tends to break off in sections in a dried specimen. The animals that build this branching skeleton are polyps, like those that form coral. A sea-bush on the ocean bottom, when fully expanded, is seen to be covered with them, each tiny individual protruding from one of the pin-holes in the cortex, expanding its petal-like circlet of eight fern-shaped tentacles surrounding a central mouth, on the end of the tubular body.

SOLUTION PITS ON THE SHORE OF "PIRATE'S NEST"

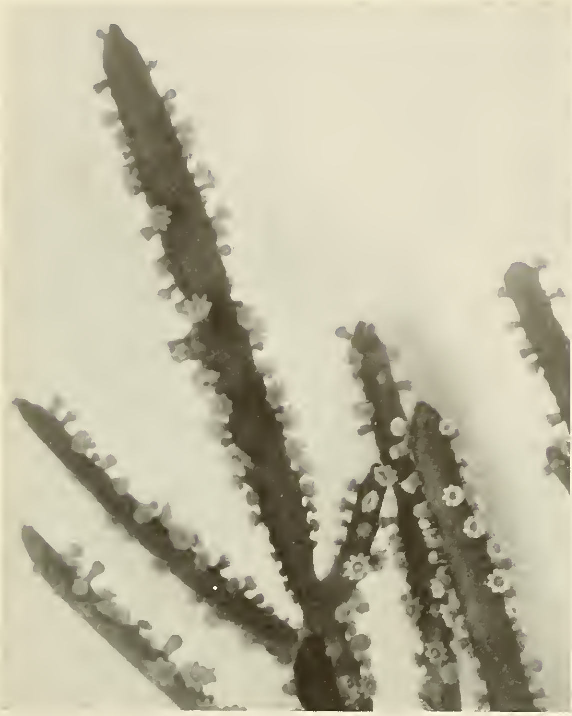
Rain water, which is slightly acid, dissolves the limestone rock, forming thousands of cavities. As the water evaporates, the lime is redeposited on the bottoms and sides of the pits

LIMESTONE-COVERED PLANT ROOTS OF A BYGONE SANDY BEACH

When this rock was a sandy beach ages ago, the plant roots growing in it became encrusted with lime. They are shown here, eroded from the solid limestone by the action of the waves

On account of the fragility of the cortex when dried, it was necessary for us to take special precautions in sending the specimens to the Museum. To prevent them from drying, we packed them in large boxes between layers of wet sponge-clippings and shipped them to New York by each steamer. There they were received by the departmental modeling staff, submerged at once in weak alcohol, and then passed through various solutions to be finally impregnated with wax or liquid celluloid, so that they could be hardened in natural positions and colored for exhibition in the group.

Through the courteous coöperation of Mr. Bacon, we received every facility for this work and succeeded in shipping an abundant collection to the Museum. With his speedy and efficient motor



LIVING GORGONIAN POLYPS

These are the flower-like animals which build the sea-plumes and sea-bushes. Each is a tiny cylinder surmounted by a disc of tentacles around a central mouth. They extend through minute openings on the surface of the sea-bush

cruiser, the "Escape," we visited a wonderful submerged coral reef at Rose Island, where the gorgonians were particularly abundant and of large size. There, with the aid of a native diver, we added many of the larger growths to our collection. A diving helmet was among the facilities at our disposal, but we were greatly hindered by an unprecedented series of northwest storms, which made helmet-diving impossible until I had returned from Andros in April, when we had excellent opportunities which I shall shortly describe.

One fine morning, Mr. and Mrs. Bacon took the "Escape," with Johnson as crew, and went fishing on the north side of the island. Mrs. Miner and I were out at the western end, wading in the shallows and collecting gorgonians and other specimens. We had the cameras cached on a near-by rock and after a while we went ashore and started to take photographs and motion pictures of the surf and the rock formations on that part of the island. Soon we saw the "Escape" making her way into the harbor between the western end of Pirate's Nest and North Cay, finally anchoring on the south side of the latter. We returned to the bungalow for luncheon and afterward resumed our photographing. We saw that the "Escape's" dinghy was drawn up on the beach at North Cay and thought that the Bacons had decided to picnic on the beach. Suddenly we noticed that it was getting very dark on the western horizon and that heavy showers were passing over the sea to the northwest. Hurriedly packing up our cameras and plates, we made our way laboriously over the rough rocks to the bungalow. By the time we had reached it, the sky was very dark and the wind had increased, so, with the help of Fred, we closed all the windows and shutters and then anxiously turned a pair of field-glasses toward North Cay. Apparently the Bacons had just realized the approach of the storm. Afterward, we learned that they had been sitting under the lee of some rocks and low trees and had not noticed it at first. Now they were hastily rowing out to the "Escape," the dinghy tossing like a cockle shell on the sea, which was quite rough.

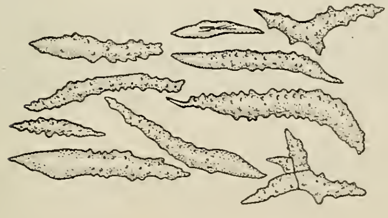
We were standing on the south porch with our mackintoshes wrapped around us, partly protected from the rain which was coming from the northwest, and had a good view of the harbor. The "Escape" was just getting under way when the storm broke. The waves, crested with white, rushed past the wharf, which had been rebuilt since we arrived, and were almost over its top. They were going like wild horses. We could see the "Escape" coming full speed and wondered how our friends were going to pick up the mooring buoy. Soon we saw they did not intend to try, as the boat raced past the end of the pier and headed toward Nassau, the distant buildings of which had become invisible.

Almost immediately, the long shore-line and hills of New Providence completely disappeared from view and at once the "Escape" was swallowed up in the mist. The rain was driving past us in a horizontal flood, while the poor hurricane-whipped coconuts were bending low before the onslaughts of a terrific northwester. While we were much worried about the Bacons, we had the feeling that they could make Nassau.

After a while the storm began to abate visibly, though the wind was still blowing with gale force. The mist lightened somewhat and to our dismay we saw that the two dories which, fitted with masts and with sails furled, had been placidly lying at anchor off the wharf, had dragged their moorings. One of them, Tony Work's boat, was just disappearing in the mist in the direction of New Providence, and the other was several hundred yards away from its anchorage and still going. This gave us a queer feeling of being marooned, as we were now without any boats whatsoever, but we felt that the Bacons were in Nassau by this time and would come out to us when the storm passed by.

And just then we saw them coming! Fighting her way out of the mist against the wind, the "Escape" proudly breasted the waves as the white foam fell gracefully and symmetrically on either side of her bow without wetting her deck. She was close inshore and it was evident that she would try to pick up her mooring. Johnson was standing in the bow like a statue, slightly bent forward with boat-hook poised in his hands, rising and falling with the vessel as it rode the waves, but maintaining his balance apparently without effort.

We rushed out of the house through



(*Above*) A sea plume (*Gorgonia acerosa*). If examined through a hand lens, its outer surface is seen to be perforated with multitudes of pin-holes.
(*Left*) Carbonate of lime spicules, highly magnified

DOCTOR MINER PREPARING TO DIVE
The diving helmet is about to be placed over his shoulders as he prepares to descend to the sea bottom at the Rose Island reef

the driving rain which stung our faces like needles. The wind beat us sidewise as we ran down toward the pier. Just then Johnson plunged his boat-hook into the water and caught the mooring rope. In an instant, the hook was jerked out of his hands and was lost in the tossing waves. We stopped, startled, as we realized what had happened. The "Escape" was now without a mooring, and later we learned what then we did not know. When she had disappeared in the mist during the height of the storm, the floods of rain were so intense that the Commodore, Mr. Bacon, could not see the bow of his boat, and, fearful of running on the dangerous Tony's Reef and the wreck of the "Princess Montague," he steered too far to the left, grounding the "Escape" on Silver Cay. He backed off immediately, but found that his starboard propeller was jammed and out of business. As an aid against possible consequences, all three donned life preservers, for they did not know where they might strike next. Luckily, they were able to fight their way to comparative shelter under the eastern end of "Pirate's Nest," and, when the storm let up a little they made the run for home.

Now, here they were, without a mooring, and with but one effective propeller, on a rock-bound lee shore relieved only by the tiny sand-spit where we had first landed. They chose the spit, and when we saw them heading for it we hastened to be of assistance if possible. Johnson again stood in the bow, this time with anchor ready, apparently with the intention of casting it into the sand as a mooring while the Commodore drove directly at the spit to beach the boat. Just then, as they reached shallow water, the "Escape" lurched, Johnson lost his balance, and in recovering himself, dropped the anchor overboard. Like a flash the anchor rope was carried under the boat, and was cut by the port propeller becoming fouled with it.

MRS. MINER TAKES HER TURN
She has descended a ladder lashed to the side of the "Marmion" and is now sliding down a rope from its bottom rung to the sea floor

The poor "Escape" was now helpless indeed. Mr. Bacon headed her away from the beach, but she immediately began to drift toward the jagged, eroded cliff which bounded the entire shore.

Hurriedly sending Fred back to the boathouse for a rope, Mrs. Miner and I ran along the steeply sloping rocks to keep pace with the boat as she drove inshore. We stumbled and caught our feet on the projecting pinnacles, and on the limestone-encrusted roots of former bushes which projected like snares from the face of the cliff. Heedless of these, we managed to keep opposite the boat while Johnson stood ready to throw us a rope. Soon it came hurtling through the air. Luckily, I caught it and quickly bent it around a rock pinnacle before it snapped taut, and then around the trunk of a low tree near the top of the cliff. The "Escape" stranded and tugged at the rope like a frightened horse, but fortunately it held.

GATHERING SEA-PLUMES ON OCEAN BOTTOM
Standing before the coral reef with its wonderful sea gardens, Mrs. Miner assists in collecting museum specimens at a depth of twenty-five feet

THE DIVING HELMET IN POSITION
Air is now being pumped into the helmet as Doctor Miner disappears beneath the Bahaman waters

By this time Fred had arrived with the other rope and threw it aboard to Mr. Bacon, and Mrs. Miner quickly fastened the other end around a bush, as we helped her hold it. Soon we had the "Escape" moored to the cliff a little distance out. We tried our best to fend her from it as we drew her in closer to enable her passengers to get ashore, but the force of the wind kept driving her against the rock shallows below the water line.

Acting under Mr. Bacon's direction, Johnson now brought the blue dinghy around from the stern between the "Escape" and the shore, while we held her off as best we could. Mrs. Bacon scrambled down into the dinghy and we pulled her up the cliff as she balanced on a thwart and reached toward us. Mr. Bacon followed suit and finally Johnson jumped across. At last, all were ashore, and we made haste to pull the dinghy up the rocks and secure her, for she was now our only boat.

THE GORGONIANS GROW TO UNBELIEVABLE HEIGHTS
Their slender branches wave back and forth in the ocean currents. Each branchlet is outlined by rows of translucent, flower-like polyps

For the first time the tenseness left us and we shook hands all around and expressed thankfulness that everybody was safe. The poor "Escape," however, was banging against the rocks. We tried our best to ease her, but soon saw there was nothing more that we could do. So, there we left her to batter her life out during the night, while we struggled back to the bungalow. Fred ran ahead to get some shoes for Mr. Bacon for his were left on the boat, and walking over the rocks with bare feet was practically impossible. Soon, however, everybody was dry and warm, and after a good supper the returned sailors were none the worse for their thrilling experience.

The next morning, we were just wondering how we would get ashore when we heard the puffing of a motor and saw a Munson launch coming up to the dock. We ran down and our good friend Jimmy Sands stepped off. He had worried about us during the storm, and at daybreak ran his car along the New Providence shore until he was opposite our island. Looking through his glass, he saw the "Escape" on the rocks in distress, and, still more alarmed, hastened back for a launch to come to the rescue. We all went in to Nassau, glad of the chance, and a little later the "Escape" was towed to the shipyard. She had received considerable damage, but afterward was put into shape and now is as good as ever.

About April first it was time to leave the island, so we all packed up and departed with much regret, the Bacons to sail to New York, Johnson to help them aboard, and, after saying "good-bye," to hasten around the corner of the dock buildings so as not to see them sail. Mrs. Miner and I remained in Nassau to await the coming of Mrs. Fish, who was to stay there with her during my trip to Andros with Doctor Fish. A few evenings after she arrived, the good ketch "Marmion" dropped anchor in the harbor and I made the acquaintance of her owner, Hugh Matheson, the beginning of a friendship which I hope will long continue. The events of the voyage to Andros on the "Marmion," the meeting with the launch "Soforth," and the adventures on the sponge-banks and in the interior of Andros with Charley Fish and Maurice Black, to say nothing of the way in which we "scuttled the ship" in the lagoon at Mangrove Cay, form a story which I hope to tell at another time.

Let us jump forward to the day after we had returned to Nassau on the "Marmion." The weather was clear and beautiful and the water was as smooth and calm as one could wish. Hugh Matheson, Charley Fish, and Maurice Black were aboard. Mrs. Miner and Mrs. Fish were with us once more. We were just dropping anchor before a magnificent coral reef off the shore of Rose Island, planning for a day of under-sea work. We warped the boat in close to the reef and moored it fore and aft. We could look down and see clumps of coral, overgrown most luxuriantly with groves of sea-plumes and sea-fans. So we put a ten-foot ladder over the side, lashing it firmly in place.

We had our two helmets in readiness and the air-pumps in working order. The under-sea movie camera was loaded and screwed into its brass box. The front glass was carefully polished and a light rope was secured to the handle on the box-top. It was my turn to go first, so I climbed over the side, the helmet with its weights was adjusted to my shoulders, and the pump started. The clanking noise of the air entering the helmet began with satisfying regularity and I climbed down the ladder until the water-surface was over my head. The helmet, which had weighed heavily on my should-

A PICTURESQUE VISTA ON THE SEA BOTTOM
The reef is entirely composed of these graceful growths, their soft colors illuminated by the sunlight filtering down through the blue waters

SPECIMENS OF SEA-BUSHES

These plantlike animals, collectively known as gorgonians, grow from the crevices between the coral masses, covering them with their waving fronds of purple, magenta, brown, and yellow, giving weird beauty to the coral vista

ers, lost all feeling of gravity. I descended, watching the keel of the "Marmion" come into view, with its rudder and propeller looking very odd as they floated above me.

Now I reached the end of the ladder and, as the sea bottom was still a dozen feet below, I tied a rope, which I had brought with me, to the bottom rung. It insisted on floating up to the water-surface, but as I swung on it, the loop ran through my hand and, almost at once, I stood on the sea floor, feeling as though I had no weight. Twenty feet above me, the bottom of the ketch floated in the midst of a mirror of liquid silver. Clouds of silvery bubbles rose from beneath my helmet and streamed upward to the surface. As I looked, I saw my camera box descending through the water on the end of a cord. It thumped softly in the sand at my feet, sending up little clouds of ooze. I picked it up and waited.

Almost immediately, the legs of Charley Fish showed, as he stood on the ladder half-submerged. Soon he began to descend, his blue bathing suit coming into view. Then his helmet appeared, giving him the aspect of a marine hobgoblin. He slid down the rope and stood before me. I pointed the camera at him and pushed down the lever. He half-walked, half-swam toward the reef and began to examine the corals. After the fifty feet of film ran out, I jerked the cord and the camera rose out of my hands and disappeared above me.

Now I had leisure to look about me. Keeping my feet on the bottom with some effort, I leaned against the current and, moving my hands to aid me, went closer to the reef. It mounted toward the surface in terraces, tier on tier. Forests of waving sea-bushes grew among the heads of coral, yellow, purple, and brown in color. Their thickly-set branches rose vertically, parallel to each other, and swayed back and forth with the current in slow, dignified fashion. Their cylindrical stems—tan, lavender, purple, and brown—blossomed with close-set, flower-like polyps, varying in tint in different species. I touched a branch and immediately the polyps disappeared into their pin-hole dens.

The silver-blue light of the watery atmosphere filtered through the vistas of waving branches, lighting up the purple plumes of sea-feathers and the flat fronds of yellow or magenta sea-fans fretted with lacy perforations.

Athwart my vision darted a gleam of jewelled splendor. It was followed by another and another. Hosts of sapphire-blue *Chromis* fishes were flashing everywhere. I quickly extended my hand toward a particularly handsome individual that swam within my grasp, but found it impossible to touch him. He darted and turned just outside my reach. Blue-heads swam past, adorned with green, white, black, and blue; slippery dicks showed off in calico patterns of light blue and pink; finely striped grunts, conspicuously barred jacks, and gorgeous angel fishes played about or swam in stately processions across my field of view. Reluctantly, I moved over to the rope which had been tied to a marlin spike to keep it down. I pulled at it and rose through the water without effort. When I came to the ladder, I did not need to touch it with my feet. The pressure of my hands on the rungs sent me gently upward. Upon reaching the surface, however, I had to seek support on the ladder, for my helmet suddenly became heavy and was lifted from my shoulders by my companions as I climbed on deck.

While I changed the camera film, Mrs. Fish donned the helmet and disappeared below the surface of the water. I lowered the camera down to Charley and he photographed her as she gathered sea-plumes. Next, Mrs. Miner and I descended and she helped me memorize the positions, colors, attitudes, and groupings of the various sea growths, for use in the coral reef group, as I silently pointed them out. It was possible to stay on the bottom for an indefinite time without inconvenience. In fact, one was conscious of a pronounced feeling of exhilaration during the entire period.

Hugh Matheson and Maurice Black took their turns next and only with the greatest reluctance left the bottom of the sea and its fairyland of form and color for the stern realities of life for we had to weigh anchor and sail away to Nassau to organize our affairs for the voyage home.

GORGONIANS AMONG THE CORALS

THE CORAL POLYPS DEPOSIT CARBONATE OF LIME BENEATH THEIR LIVING TISSUES, THUS BUILDING UP THE RIGID CORAL REEFS OF LIMESTONE. ON THE OTHER HAND, THE GORGONIAN POLYPS, THOUGH SIMILAR TO THE CORAL ANIMALS, BUILD BUSH-LIKE STRUCTURES OF FLEXIBLE HORNY MATERIAL WHICH WAVE, PLANTLIKE, IN THE CURRENTS OF THE SEA

THE SITE OF TICOMAN AS IT APPEARED DURING ITS OCCUPATION

RECONSTRUCTING THE BEGINNING OF A HISTORY

Bringing Back to Life the Material Culture of the Valley of Mexico through Its Archæological Remains—The Inhabitants of Ticoman

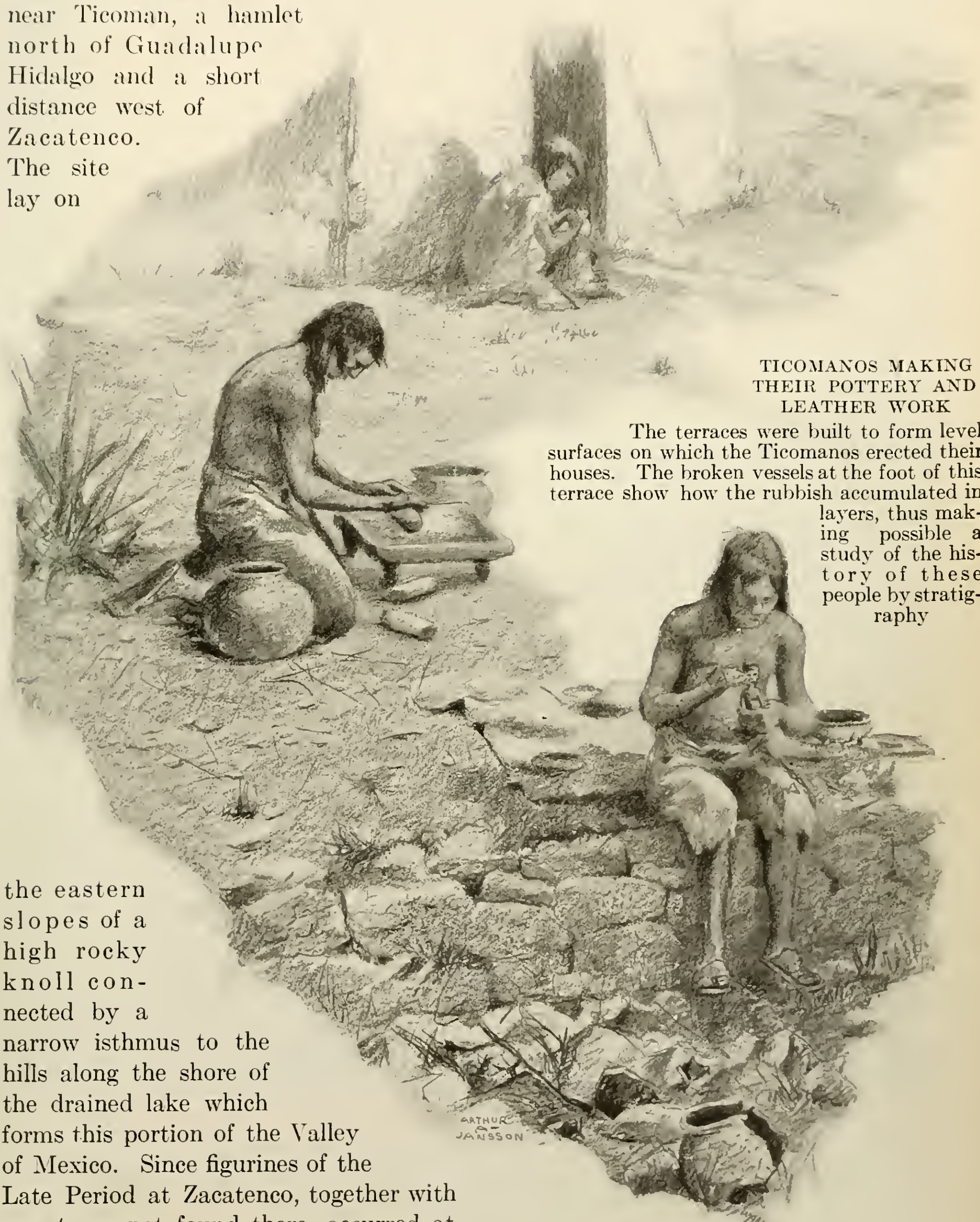
BY GEORGE C. VAILLANT
Associate Curator of Mexican Archæology, American Museum

THE reconstruction of man's past presents two roads for the student to follow. One extends toward chronology and the rigorously scientific treatment of the remains by classification and by their position in the ground. The other route is more interpretative and strives literally to clothe with living flesh the dry bones of the past. Yet each study supplements the other, for the dry classificatory research tries to answer the questions of *when* a given people lived and *who* they were, while the more imaginative study strives to explain *what* they did and *how* they did it. If one remembers these points, the labors of the archæologist appear less devious and bear more directly upon the activities of an institution like the American Museum of Natural History in its presentation of the mysteries of Nature.

For the last three winters the division of anthropology included in its program an effort to reduce the sculptures and pottery of clay found in the Valley of Mexico to an orderly sequence in time and culture as a supplement to the old Spanish and Indian chronicles of Mexican history. By a knowledge of these pottery types it would be possible not only to identify and date sites mentioned in the migration myths, but also to project the history of the Valley further into the past by the recognition of influences and peoples which, having passed from human memory, were unknown to the chroniclers. After a preliminary survey, the officials of the division of anthropology decided to begin with the earliest discovered remains and then work upward in time toward the Toltecs and Aztecs whose histories comprise much of the ancient literature. During the winter of 1928–1929 excavations were made by the writer at Zacatenco just north of Mexico City, and an account of the work is to be found in NATURAL HISTORY for September–October, 1929.

The point selected for excavation in the winter of 1929–1930 was near Ticoman, a hamlet north of Guadalupe Hidalgo and a short distance west of Zacatenco. The site lay on the eastern slopes of a high rocky knoll connected by a narrow isthmus to the hills along the shore of the drained lake which forms this portion of the Valley of Mexico. Since figurines of the Late Period at Zacatenco, together with new types not found there, occurred at Ticoman, and since the two sites were less than an hour apart, the place seemed most suitable for the continuance of our studies. The subsequent operations justified the choice of Ticoman for work.

The inhabitants of Ticoman chose the site for the security of its position and the



TICOMANOS MAKING THEIR POTTERY AND LEATHER WORK

The terraces were built to form level surfaces on which the Ticomanos erected their houses. The broken vessels at the foot of this terrace show how the rubbish accumulated in layers, thus making possible a study of the history of these people by stratigraphy arable ground near it. Since the hill was almost completely surrounded by water, no enemy could approach save by boat or along the narrow, rocky isthmus which could be held by a handful of men. This neck of land was long enough to keep the settlement out of range of missiles discharged by foes on the mainland. The prevalence of low walls of stone showed that the people may have had back-yard gardens near their houses, and the rich soil of the mainland offered excellent fields for the cultivation of corn, the main food staple. The Ticomanos lived first near the top of their knoll, but as time went on, their heaps of débris, strengthened by low walls to make gardens and house foundations, extended to the edge of the lake.

Data on the physical type of the Ticomanos are not now available, for the study of skeletal material has not been completed. But from the evidence at hand they were of moderate stature and had skulls somewhat flattened at the back, more probably from use of the cradle board than from deformation to fulfill an æsthetic ideal. The rigors of a hard life in the field and on the hunt prevented most of them from reaching any great old age, while the lack of sanitation in a primitive community exacted its toll in the premature death of infants and children. Furthermore, like most people of the past and present whose diet is mainly vegetable, they suffered from decayed teeth.

The ordinary activities of the people were pacific. Arable land lay near to the site, and such finds as lava corn grinders set on three oblong legs and vast numbers

A STORAGE OLLA AND FIGURINES, TYPE E

From the early occupation of Ticoman. At this time sculpture in imperishable materials was confined to relatively simple styles, and the pottery was more utilitarian than æsthetic. The vessel shown above is painted red on white and is much restored

BOWL AND FIGURINES, TYPE H
From the late occupation of Ticoman. Note the development of the sculptor's art as shown in the vitality of the expressions and poses of the figures. The small bowl is made of quartzite

of heavy storage vessels attest to their agricultural pursuits, but bird and deer bones show that game supplemented their larder. Their position on the edge of the lake makes it probable that they also ate fish, although owing to the perishable nature of the bones, we found no certain proof of this.

There is little evidence of cultural accretion at Ticoman other than through autochthonous evolution. Pottery, both decorative and for storage, followed utilitarian needs more than it expressed æsthetic ideas. The great storage ollas went through a gradual change in rim form. Decoration of smaller vessels, presumably for the service of food, passed from polished surfaces and relatively simple designs, incised or roughly painted, into more sophisticated experiments, like painting in two colors on the base clay and achieving thereby polychrome decoration. But this style was later abandoned in favor of vessels with polished surfaces, red for the most part. Only a few sporadic examples occurred of painting in lost color, a process in pottery painting resembling batik in textiles.

Baked clay, however, was further utilized for such varied purposes as figurines, probably for ceremonial use, ladles for food, whistles, flutes, balls for games, and even ornaments like beads, and lip and ear plugs, some of which are highly ornate. The ear plugs began as simple solid cylinders and became gradually elaborated as the makers' technique progressed, and they learned to make rings, or having hollowed the interior of the cylinder, to carve the closed end. Pottery balls diminished in quantity as time went on, while stonework showed a slow growth toward perfection and elaboration in manufacture.

Sculpture in imperishable materials was mainly confined to the figurines which

BOWLS FOUND IN BURIALS AT TICOMAN
The upper bowl at the left is early, but the others are mainly from the latter phase of the occupation. In this picture the bowls are shown much restored

began in a relatively simple style (Type E). Almost coincidentally with the practice of painting polychrome pottery the figures became more varied in position and sometimes represented grotesque subjects (Type G), which seem to have arisen from the intention and not from the ineptness of the artist, as we shall see when we come to take up the ceremonial life of the Ticomanos. Other new styles (Types L and I) were taken up, and the surfaces of the figurines came to be polished. Toward the end of the period this variety tended to crystallize into naturalism (Type H). Not only were lifelike postures adopted, but humor, which as a consciously executed trait is almost unknown to primitive art, may be seen in such figures as the little lady hiding her eyes in shame, or the vain little creature roguishly prinking.

Two specimens exist of sculpture in stone, one small very crude kneeling figure and part of an incense vessel, with its bowl supported by a seated figure, a conception known in Aztec times as the Fire God. These two pieces may have been received by barter, but they may, on the other hand, show that the Ticomanos were already on the verge of stone sculpture. Two pebbles were also found that may have been kept because of their resemblance to natural forms.

Stone was in any case used commonly by these people in the making of tools. Long blades for knives were struck off from conical fragments of volcanic glass, and the residue chipped into projectile points. Implements presumably for graining hides were made also from obsidian, and quartz was much used for the same purpose. For heavier work like grinding corn, the Ticomanos made manos and metates from lava. Balls like those of pottery mentioned above were also made from quartz or from lava. In an angle between two walls thirteen of these spheres were found, nine of pottery and four of stone. It is problematical whether they served as missiles or as elements in a game. Axes made from porphyry and jade do not seem indigenous and may have been traded from the State of Guerrero.

Bone and horn were useful for a wide range of utensils, extending from fine needles made of bone to heavy scrapers made from the shank of the horn. A thin bone sliver was even polished and shaped as a pendant. The Ticomanos must have been utilitarian to the point of cold-bloodness or else most naïve about comparative anatomy, for we find a scraper made from a human fibula.

Shells from both coasts of Mexico were much used as ornaments. Sometimes they were merely perforated for suspension, at other times they were cut into disc or tubular form for beads. A pair of shell tinklers were identical with ornaments found at the great city of Chichen Itza in Yucatan, an evidence of the long existence of a satisfactory technique of manufacture.

Beads of jade and chalcedony and a pendant of chert showed by their rarity how much they were prized, and we see even in those distant times how value depends on scarcity and desirability. One man actually wore a necklace of coyote teeth. Several pebbles of moonstone, opal, and chalcedony occurred in the digging, doubtless preserved as medicine stones because of their odd appearance. Ornament seems to increase in variety and in decorative value, for there are many more kinds of objects of every type at the close of the occupation than at the beginning.

A MORTUARY OFFERING

This bowl in the form of a human head was found in a grave of the Middle Period. It is now in the Museo Nacional, Mexico

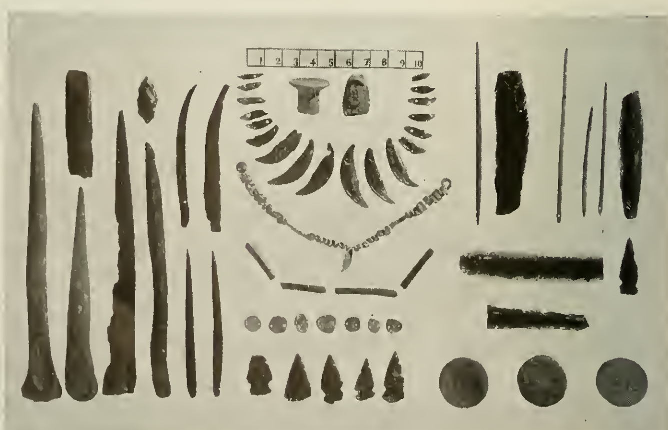
Such were the tools and ornaments of the Ticomanos, which have survived the destruction of time. Many implements of perishable material like wooden spindle whorls and digging sticks have disappeared. The weaving industry may be inferred through the presence of mats lining the graves and by a tiny fragment of a feather robe in another sepulture. It is not then stretching our imaginations or our data so far when we suggest that these people wore woven clothing. Hides they must have used a great deal, for the burials kept yielding evidence of considerable work in leather. One old man was interred with a hammer stone, two horn grainers, and three obsidian scrapers, all useful for the preparation of the skin, three heavy awls for the boring of holes in preparing moccasins, for example, and two bodkins for the finer sewing. Another had a number of beautifully shaped obsidian knives with a full equipment of awls and needles.

Hunting is shown by the presence of bird and animal bones in the dumps, by numerous arrow and dart points, and by an occasional lance head. It looks as though both the bow and the atl-atl or dart-thrower might have been used. Little evidence, however, exists of a warlike spirit, because no stone club heads were found in the débris nor were weapons buried with the dead.

PROJECTILE POINTS OF OBSIDIAN

The crude specimens of the top row are mainly early; of the second row, early and middle with a utilization of flakes of obsidian in contrast to the fragments of the top row. The more perfect specimens of the bottom two rows are late and middle, and the remainder are early occupation examples

The social customs of the Ticomanos are difficult to infer. The population lived together on their knoll, probably communally as do most undeveloped people. If there was a complicated religion with priests, there is no reflection of it architecturally. The architecture of the Ticomanos in fact is conjectural. Long revetment walls terraced the hillside and only at one point did we find a suggestion of house foundations. Doubtless the Ticomanos lived in wattle and daub jacales, but we were unable to ferret out evidence of temples, defense walls, or formal house foundations. The figurine cult flourished, as we have said, and at the middle of the occupation we find figurines with grotesque heads like a gopher. Gopher teeth, moreover, were occasionally buried with the dead. Perhaps some connection might have existed in the minds of the Ticomanos between the dead in the underworld and these little burrowing animals, for the soft ground of an interment would offer a splendid place for a gopher to hollow his lair and the fragments of bone at the mouth of the burrow might have suggested to the Ticomanos an affinity between the gophers and the dead. One figurine showed an animal-headed figure holding in its arms a human being, so that a distinction must have existed in sculptors' minds between human and grotesque forms. Yet at the close of the Middle Period this practice faded. The stone sculpture representing the Fire God, a divinity commonly portrayed in Aztec times, indicates another divinity in the Ticomano pantheon. Moreover, a similar figure having been found at Cuicuilco, the pyramid under the lava, and others at Teotihuacan, this is probably the oldest known characterized presentation of a divinity in Mexico.



GRAVE FURNITURE

With the dead at Ticoman were placed ornaments of bone or shell or tools of bone and obsidian. In the lower right of the picture are three lip or ear plugs. Note the needles in the upper right-hand corner

A conception of the after-world existed among the Ticomanos, for they took some pains in the disposal of the dead. Ordinarily a small shallow hole was dug and lined with matting, probably the petate or sleeping mat which is used even now on the Highlands of Mexico. The friends and family of the dead man then squeezed his body into the grave and inserted their mortuary offerings. Children were less likely to receive funeral furniture than grown-ups, but about two-thirds of the burials contained pots, or bone and stone tools. Some had beads or ear plugs and one woman carried to the next world, besides her pot and a shell bead, a figurine of a very early type that must have been an amulet. Another burial very much disturbed, probably by gophers, contained a bag enclosing cinnabar and a shell necklace as well as a tiny pot of quartzite that also contained cinnabar. After the burial ceremony was over, rocks were usually piled over the grave to keep it from washing out during the time of torrential rains and from being dug out by coyotes or dogs. One grave, with the richest content of pots and tools that we found, was covered over with slabs.

GRAVE FURNITURE OF AN OLD MAN
Showing a leather worker's tools of bone and obsidian. The gopher teeth were found in his lap, and perhaps were ceremonial

After this description of the customs and habits of the Ticomanos, let us consider their origins and their position in Mexican pre-history.

In March, 1929, when we closed our work at Zacatenco, we had discovered three phases of culture. The Early Period was closely connected through its pottery with the Middle, but the figurines of the latter showed the effects of a foreign influence. Figurines similar to these Middle Period examples occurred at Copilco, a site on the other side of the old lake of Mexico, covered by a layer of lava fifteen to thirty feet thick. The late period at Zacatenco saw the intrusion of completely new figurine and pottery types, that through stylistic considerations suggested a reoccupation of the site by a new people. This late Zacatenco complex through its pottery, especially in the use of the tripod support, its figurines foreign to the Early-Middle Period traditions, and its ear plugs, tied in roughly with Cuicuilco, a pyramid surrounded by the same lava flow as Copilco but probably abandoned before that catastrophe. Therefore, if Copilco and Middle Zacatenco are contemporaneous, and if Late Zacatenco and Cuicuilco are roughly of the same period, then Copilco must be earlier than Cuicuilco, and must have been abandoned long before the lava flow. What then brought about the abandonment of Copilco?

According to Professor Kroeber, the settlement of Copilco was on marshy ground. At Zacatenco the strata intermediate between the Early and Middle Periods yield sherds of a curious rusted appearance, as if alternately drenched

FIGURINE, TYPE G
From the Middle Period of occupation. Note the polished surface, but crude features

FIGURINE, TYPE Hiii
(*Above*)
From the Late Period. Note the reasoned attempt to achieve vitality

and dried by water at the shores of a lake. Moreover, while the Early Settlement at Zacatenco is low down on the flanks of the hill, the main Middle Period settlement is on the upper slopes. It would seem that some blocking of the outlet to the streams of the Valley caused the waters to rise, driving the people up the slopes of the hills around the Valley. This conclusion tends to be substantiated when we find that the lowest deposits at Ticoman are on the same level as the "beach" at Zacatenco, and below this level at Ticoman there is no trace of human remains, indicating that the presence of water prevented occupancy. Although we have not compared the levels of Zacatenco with those of Copilco, it would be probable that the rise of the lake waters affected the people there, driving them and other Valley dwellers out of their homes to fresh sites on higher ground. Thus the change in figurine and pottery type between Middle and Early Zacatenco might have been brought about through an amalgamation of the original occupants with some of these exiles.

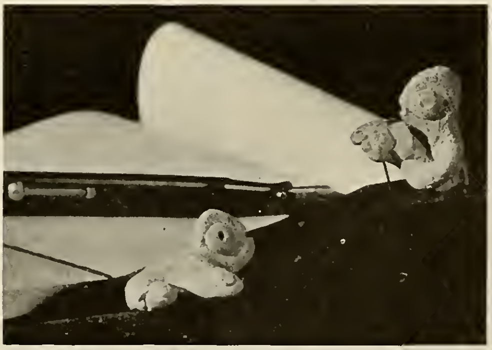
The change between the Middle and the Late Periods at Zacatenco is not possible to explain through natural causes. There is no doubt, judging from their material culture, that the populations of late Zacatenco and Ticoman are the same. Moreover, the difference in material culture between these people and the Middle and Early Zacatencanos is intensified by what Dr. H. L. Shapiro

FIGURINE, TYPE I
(*Below*)
From the Middle Period. Showing, with the Type G specimen above, plastic experimentation

FIGURINE HEADS, TYPE Hi, v, and ii
From the Late Period. The consummation of the artistic experiments of the Middle Period shown on page 614. Note the expression of shame on the little figure at the left

of the American Museum, after a hasty examination of the skeletal material from the two sites, believes to be a slight but sure change in physical type. Zacatenco was probably the immediate base of the invaders but soon they must have shifted to Ticoman, which shows a longer, heavier, and richer occupation.

On the whole we are left with the impression of a group of people relatively well advanced as primitive people go, and capable of great development, given the right religious or social impetus. But this culture, high as it is, does not seem to be the base for the high civilization found at the religious center of Teotihuacan. Perhaps another intrusion brought the elements that crystallized into the mighty Toltec culture. It is certain that here lies a great gap in our knowledge. The chronicles tell us of the collapse of the Toltecs and the infiltration of those wandering tribes of Nahuas who, after learning culture from the survivors of the Toltec era, proceeded in their growing strength, by the destruction and by the amalgamation of their tribal entities, to build up the Aztec Empire, only to be overthrown in their turn by the Spaniards. Beginning with the early inhabitants of the Valley of Mexico, we have been able to give some idea of the many disturbing forces that worked on them. We have seen how they were affected by floods, by volcanic eruptions, and by invasions. More particularly, we have traced the development



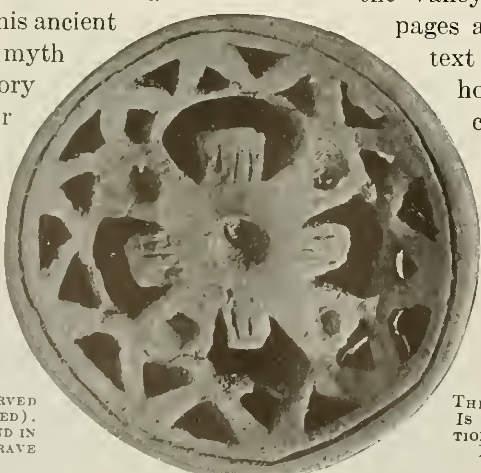
FIGURINES Gii
From the Middle Period. Note animal, perhaps gopher, heads, and how figure at right holds a human in his arms

of the people of Zacatenco, their probable amalgamation with invaders in the Middle Period and their expulsion by a new group who formed the Late Period there. We have seen that these people in their turn moved to Ticoman, where the subsequent growth of their culture took place. But the occupation of Ticoman ceases for no apparent reason, relatively about the same time as the abandonment of Cuicuilco, for similar figurines are found in the latest strata of the two sites. There is evidence to show that Cuicuilco was abandoned before the lava ever came, and its people might have been warned away by volcanic activity previous to the great eruption. But certainly no such catastrophe occurred near Ticoman, nor is there any evidence of what did cause its abandonment.

FIRE GOD, CARVED FROM LAVA
The top is hollow and is much burned. It rests on the bent back of the god

Madame Nuttall pointed out a curious reflection of this ancient history in the Aztecan myth which relates the history of the world. Four periods or suns have existed and we are now living in the fifth. The first four terminated respectively in destruction of the world by jaguars, by a hurricane, by a volcanic rain of fire, and by a flood, and this era is to be terminated by an earthquake. Although the order is transposed according to our data, there is no doubt that, except for jaguars, the Aztecs quite faithfully listed the natural causes militating against the former inhabitants of the Valley.

We have extended our history into the past but it is not continuous. We lack the knowledge of the origins of Toltec Culture, and we are ignorant of the fate, not only of the people who abandoned Ticoman, but also of those whom they may have expelled from Zacatenco. Each season we try to read another page in our history of the Valley of Mexico, but the pages are in disarray and the text is obscure. Slowly we hope to reach historical order as our knowledge increases.



EAR PLUG OF CARVED POTTERY (RESTORED). ONE OF A PAIR FOUND IN AN OLD WOMAN'S GRAVE

THE DUPLICATE, WHICH IS IN PERFECT CONDITION, IS IN THE MUSEO NACIONAL, MEXICO

A frieze in the Temple of the Warriors

COLLECTORS' DAYS AND NIGHTS IN YUCATAN

The Low, Dense Jungles of Yucatan Yield Many Treasures to an American Museum Expedition

By ROBERT T. HATT

Assistant Curator of Mammals, American Museum

PHOTOGRAPHS BY THE AUTHOR EXCEPT WHERE CREDITED

THE peninsula of Yucatan juts out into the warm sea that on one side is called the Gulf of Mexico and on the other the Caribbean. Unlike the parent mass of Central America to which it is attached, Yucatan is but a flat porous sheet of limestone. The Rain-God, Kukulcan, is not unkind to Yucatan; in fact, the visitor wishes that the State was not so blessed with showers. However, so rapidly does the water sink into the rock, seeking the level of the sea, that this country is often described as arid. No river graces the peninsula; the few surface pools are quite anomalous. The State's one city is a forest of American-made windmills, many families having three or four about the house. In the back country, however, the population is largely dependent upon the drip water caught in caves.

The vegetation, of course, reflects this lack of available water. Over the land spreads a vast low jungle of small trees, of cactus and of vines. In the rainy season, which extends from April until October, everything is fully leaved and looks impenetrable. In October, however, the rains diminish and in a few short weeks the country is transformed. Many trees lose their leaves, and the herbaceous vines that before hid the country wither up and die. Then it is that the country does take on an arid aspect.

Yucatan's mammal fauna has been drawn from parent stocks of both South America and North America, but nearly every animal occurring there is a little different from its nearest relative occurring in the neighboring lands of Guatemala and Tehuantepec. Several men have made collections in this land, but no one yet has done it thoroughly and systematically, so that even those who, like us, do a little casual collecting incidental to other work, have the opportunity of discovering un-

NIGHT HUNTING AT NOON

From the dark passages of the ruined Labyrinth of Oxkintok the party has just emerged. Miss Roigneau is putting the catch of vampire bats, geckos, and an opossum out of reach of the hungry yellow dog

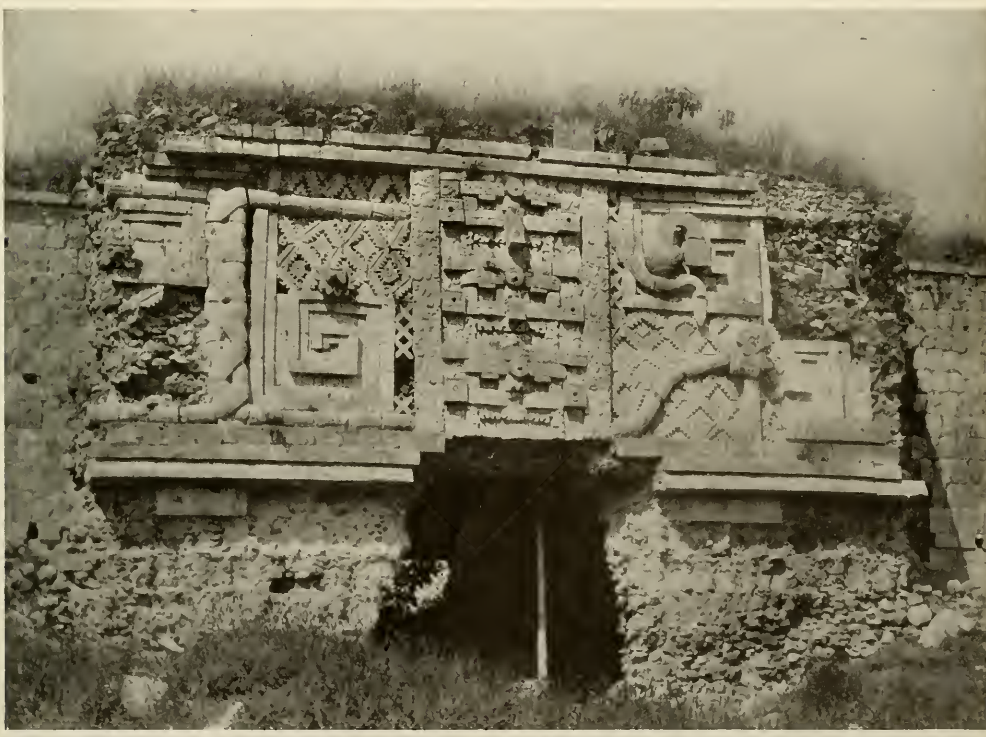
known forms, or of adding to the list species which were not known to occur there.

No species is entirely limited to Yucatan, for the mammals recognize it as a peninsula, even though to modern commerce it is an island served only by boat and plane.

Mérida, the capital, though fascinating to the traveler, is not a site for the vertebrate zoölogist. A cloud of buzzards, birds on which Yucatecans are so dependent for their health, and a few shy lizards are all the casual observer is apt to see by day; while by night, if one goes to a moving picture theater, a few bats fattening on mosquitoes give Draculic effect when they cross the screen. Even the State Museum, which boasts a room devoted to local natural history, is so rarely open because of the continuous procession of fiestas and the interruptions of siestas that one is indeed fortunate to gain access to its corridors, though these well repay the visitor for a dozen ineffectual trips. We tarried in Mérida no longer than was necessary to gain our permits and equipment. A trip by railroad that would be tedious to any but one making it for the first time took us through the great plantations of hennequin to the town of Dzitas. This little settlement would indeed be a jumping-off place if it were not for the miracles wrought by the electric plant and comfortable buildings put up by the Carnegie Institution of Washington at the headquarters of its Mayan researches—an hour's hazardous automobile ride into the brush from here.

Collecting at Chichen Itza was made easy by these conveniences that are available in few other places in Yucatan. Here there were comfortable quarters, trails, and guides. Best of all, the vast jungle stretching unbrokenly to Guatemala was everywhere within a stone's throw. But all these excellent features did not compensate for the distraction of the magnificent, enigmatic buildings of the ruined ceremonial city of the Mayas that rose majestically on every hand and the innumerable less fortunate buildings crumbling hidden away in the brush. It is not unusual, when wielding one's machete along the trails cutting down obstructing tangles, to find before one a rock bearing the image of a warrior in elaborate ceremonial dress, or perhaps the wide-open mouth of a feathered rattlesnake. It is much less usual to encounter a living scaly rattlesnake. These are there, however, along with the deadly fer-de-lance, the beautifully colored and effectively poisonous coral snake, and boa constrictors of impressive size. More frequently one encounters among the ruins a powerful six-foot mahogany snake, which the Mayas call "bohom," harmless to man but a feeder on other snakes. The most surprising of the serpents is a lithe green snake so drawn out that it can with difficulty be distinguished from the climbing vines among which it lives. The most marvelous of all snakes escaped our notice, though the Indians assured us of its existence. The serpent as described is of the same diameter throughout, very poisonous, and, unlike other snakes, progresses by bounding along as though made of rubber. It is said that this strange creature is so soft that when hit with a stick it breaks in two, each part regenerating then into a new individual in a manner previously unknown among vertebrated animals.

Conspicuous on the ruins are the snake's legged relatives, the great gray iguanas, which take refuge in the crevices while everywhere their emerald young dart out of danger. I soon found that



A HUMAN-HEADED SERPENT

In the decorations over a section of the Nunnery of Uxmal is twined this variant of the sacred plumed serpent. This elaborately decorated quadrangle is to be reproduced at the Chicago Fair in 1933

A GIANT TOAD

These mammoth amphibians eat great tarantulas and large poisonous centipedes. The swollen poison glands on the toad's neck poison in turn the dog or cat so indiscreet as to pick one up

shooting was not an easy way to get the big ones, as they did not encourage close approach and carried away tremendous loads of lead. I next resorted to trying to pull them out of their hiding places by their tails, but each time they proved the better opponent. It might be that I was lucky at that, for it is questionable whether I could have avoided their savage jaws when once I got them out. My next move was to set heavy wire nooses about holes which I knew they frequented. To these I would attach a string and to this a rock, so arranged that when the noose took hold, the rock would fall down the wall of the temple, jerking the lizard with it or pulling it out sometime after when its endurance was worn.

The great crested basilisk lizard, which the Mayas know as "tolok," was sometimes seen sunning itself in the trees. Deep in the dark inner rooms of the ruins, as well as in the caves which we later visited, were the most striking of all the lizards, the geckos. We were warned by our several guides that they were deadly poisonous, that they were *parientes de los serpentes*. One does receive a peculiar sensation when one of these distorted creatures with clammy, soft, ill-fitting skin, and bulging, golden catlike eyes, clamps its suction-cupped feet upon one's finger and does its best to bite. In the houses lives another gecko, a diminutive and comic-looking edition of the cave species. The Indians call the big one "nohcan," while the little one is dignified with the name "xpedzkim."

One little chameleon that darted about the small trees would give itself away when it was most effectively concealed. Excitement was too much for it and, if approached, a little fold of skin over the throat would be thrown out and so expose two bright blue spots surrounded by pure white scales inlaid on a yellow ochre skin.

A SPANISH-COLONIAL JAGUAR

Antiquated carvings lend color to the buildings of the modern capital. This curious old slab, with an accompanying verse, is built into the wall of a recent building in Méridá

A GIANT LIZARD
Huge gray iguanas frequent the ruins where their grotesque countenances harmonize well with the gargoyle-like stone lizard heads. Their quick-snapping powerful jaws make them a dangerous reptile to handle

Left undisturbed, the gaudy colors disappeared and again the lizard was well concealed.

Giant toads were a constant source of wonder, but never so much so as when we eviscerated one so that it would be small enough to enter our largest tank. Then we found that its dinner had consisted of a huge tarantula, a five-inch centipede, a big grasshopper and several hard-shelled beetles.

Under a high cone of earth in the ruined site of Oxkintok is a structure known as "El Labyrinto." It is not a true labyrinth for, provided with a light, one could not easily become lost in it. It consists of a series of fifteen long, shoulder-width, head-high tunnels of masonry, each of which typically gives off a door to another at some point before its blind end. By following out all the proper leads one emerges by crawling through a small hole not far from the one by which one enters.

We were warned of the danger from little green snakes (which proved to be our harmless friends, the geckos), but anticipating good bat collecting, we brought with us a short-handled landing net. We had not gone far before the narrow passages were filled with scores of fluttering bats which, confused by our headlights, flew into our faces and were easily knocked down and picked up—for a minute. Then one of our two men, a Maya who was unbalanced in mind, grew excited and ran ahead, followed by his mongrel dog. Between the pair, our little collecting party grew so confused that the bats had the better of us and made good their opportunity to escape. These bats, though vampires, did not bite except when they defended themselves on being more quickly than carefully picked up.

MAYAN JAGUAR
This active-looking cat fallen from the frieze of the "Temple of the Tigers" at Chichen Itza now guards the Ball Court of the famous ruined city

When the uproar had about subsided the little dog discovered an opossum hiding in a small

YUCATAN JUNGLE

The jungle is a low, thorny scrub. Rarely does one find it so open as here where it covers an extensive cave. Though bare rock was prevalent, a Maya was starting a corn field

pocket formed by the falling out of a builder's stone, and with our hands and pockets full of fighting specimens we made our way to the more than ever spacious outdoors, where the catch was more easily disposed of.

One night we were assured that "*Falta poco mas a mi milpa donde hay muchos conejos y pisotes.*" Perhaps it *was* only a little farther to the boy's jungle clearing, but we had been hearing the same thing for two hours and were a little sceptical. I felt, too, that by the way we rushed along over the tortuous dark trail, we frightened away more rabbits and coatimundis than visited his garden in a month. It was at times a temptation to leave this Maya boy to his own hunt, but we had gone too far already and could never have found our own way back to Chichen over these branching trails.

After a long day in the brush we had finished supper and looked forward to a fairly restful evening, preserving what remained of the day's bag and writing the all-important records that alone make museum specimens of value. Outside the door, however, we had found Put quietly awaiting our appearance, erect, smiling, his carbide light fastened to his uncovered head, his calabash with the water for the light over his shoulder, and a sadly-old muzzle-loading gun at his side. He quickly told us that his corn patch was over-run with rabbits and other four-footed robbers, and that if we would join him his *milpa* would be spared and we would get many specimens. Assured that the *milpa* was not far distant, we weighed the possibilities and decided to follow. Now a Maya does not know how to run well, but he walks with a purpose, and a forty-mile day to him is not a feat. And so it was; we went on and on, far too fast for hunting. At the end of two and a half hours we stopped a moment to catch our breath. My wife expressed the opinion that there was no *milpa.* I suggested return, for I knew several *milpas* much closer to our base, but Put became so dejected and insisted so that we were almost there, that we reluctantly went on.

The night was without moon or stars, the forest heavy. Our light was limited to the narrow beams of the headlights which followed our every glance. Focussed to a small point, so that we could see the shining eyes of a jaguar or any lesser night creature at the greatest distance, they were of slight service in defining the general lay of the jungle. A myriad of brilliant spots shone back at us. Most were but drops of water left from the daily rain. Almost as many, and far brighter, were green, yellow, or red spots that would occasionally be seen in pairs and make one's gun fly up. Cautious stalking would invariably, however, show but two tiny spiders standing close together. A few times we would see the black and yellow body of a big tarantula in the trail, with his legs spread out the width of my hand. His eyes, however, never shone. Had they done so, I've no doubt but that we would have sometimes shot at them for larger game. After three hours we came sharply to a bar across the path and there we were. A sweep of our lights showed the usual *milpa* picture of several thin, dead trees, a few tall, standing corn stalks, and a host of fallen, broken stalks, the whole densely clothed with morning glory and such other weeds as chose to grow there, unbothered by any cultivation. Here we advanced slowly, examining critically every reflection of our lights, but nothing furred or feathered met our gaze. A minute more carried us to the little thatched shelter in the clearing's center. Put went in first, signalling us to follow quietly. He pointed up into the thatch. We hoped for a 'possum at least, but a long black scorpion of which we had a hundred in our own roof back at Chichen, was all that was there. Disgusted, we started back home, though the boy wanted us to go on farther. By now our attention was too much dulled for us to hunt well and we went back without incident, seeing nothing but a bat which found hunting good in the path of our lights for the several minutes that it stayed with us.

We soon learned that hunting with an

Photograph by M. Roigneau

ON PARADE

The artisans of Chichen did not carve ordinary men. They chiseled images of their gods, their warriors and priests, elaborately dressed. This stone sculpture was done with hard stone tools. Traces of the original bright coloring of the reliefs may still be discerned

GUARDIANS OF THE NUNNERY AT UXMAL

Animals were favorite subjects for the sculptors that decorated the façades of Mayan buildings. Snakes, jaguars, iguanas, birds, and turtles occur most frequently. The animals shown above with their tails twisted are probably jaguars

Indian was good hunting but poor collecting. In spite of this, I one night persuaded Paquul after shaming him by doubting his courage—to show me where it was that a reputed *tigre* (jaguar) denned in a ruined temple. The trip this time was not long. We circled the tumbled mass of decorated stone, and, seeing no sign of the big cat, went down a twisting high-walled passage that led to rooms which the *tigre* was said to inhabit. We did see two big hornets' nests, for these cursed insects infest every ruin and every cave in Yucatan. If one is not cautious on entering, one is precipitous on leaving. The *tigre* was to be found in a den, dug in the floor of an inner room, reached by crawling on hands and knees through a small hole in the wall of another room. This we did; Paquul first, with a laudable courage—if one can credit his professed conviction that it was the *tigre's* den—and I right after, convinced that it was an unlikely place. An examination of the hole strengthened my belief that no jaguar ever bedded there. Two days later, in confirmation, a large steel trap set there secured a rat. Paquul's verdict was that the *tigre* must have moved.

Standing just outside this temple, I ran my light in all directions. No pairs of eyes that would indicate mammals showed themselves. My gaze came to rest on a single bright eye apparently of a spider, standing on a slender stem of a small bush. I watched this eye for some moments as it seemed of a different color than most spiders' eyes, and, unlike the latter, did not change its color with change in position. Then my light slowly delineated a small mouselike body, a sharp muzzle, a naked, curving tail. I recognized it then as a mouse opossum, most delicate and beautiful of all the furred creatures in the land, the first I'd ever seen. With recognition that it was a mammal, my gun instinctively flew up, but before my finger pulled the trigger the gun came down, for in my right barrel there was buckshot and in the left a rabbit load. At that moment the "opossumlet" dropped to earth and could not again be shone. Though these animals are not rare in Yucatan, but five specimens are known from here, if one excepts a score of broken skulls which we recovered below the perches of those better hunters, the owls.

Bats react strangely to the light. Some little insect feeders fly up and down the beam of one's lamp in an annoying manner. There is no objection to the wings that sometimes brush one's face but, as one's eyes always are following the light's path and see only that which lies in that direction, the bat becomes an annoying distraction. One tree full of fruit bats that had congregated in the particular tree which seemed to suit them, became very alarmed at my light and flew down in a flock so that the air was full of them. It seemed to me, and may have been the case, that they wished to drive me away from the tree, but they made themselves too interesting to succeed. The eyes of these bats would not shine, and when they alighted in the tree it was invariably in a shadowed clump of leaves, so that I could never see them except on wing. For three nights they visited this tree and then, finding its store too near depleted, moved on to another unfound orchard.

The brush hides much life that one is likely never to see, but other species force their attention on one. In some sections cattle are raised and, whereas they themselves are no nuisance, they encourage the presence of Yucatan's worst pest—the garrapatitas—tiny brown ticks that hang in clusters from the plants, waiting for the passer-by. No clothing can entirely protect one from these all-pervading creatures that bite and leave burning little red spots where they stop. It is their specialty to dig into one's epidermis and no evening in the bush country is com-

A DOUBLE-HEADED CHACMOOL
Both human figures and jaguars were used for these ceremonial stones. This double-headed specimen is probably unique. In the back of the jaguar or at the navel of a human figure was a depression for the reception of incense

plete without a search for the day's unwanted catch. Neither gasoline, carbolic acid, nor alcohol will account for all of them. The Mayas, when out cutting wood, roll up their trousers above the knees, and keep switching their bare legs and smearing tobacco juice on their brown skin—men, women and children. And they seem as free of ticks as anyone.

Other like nuisances, too, abound. One of these which we shall long respect is a tree-living shovel-headed ant, whose bite is so powerful that on one occasion it virtually paralyzed my shooting arm for a full half-hour.

The greatest concentration of life occurs not where one would expect it—at a water hole,—but instead in the palm-thatched roofs that cover almost every Mayan domicile. From one such haven that sheltered us, we took two brilliantly red rats which previously were unknown. These rodents did not have this place to themselves, however. By day a few buzzards perching on the ridge waited expectantly for the unwanted portions of our catch. A dozen or two baby lizards found hunting good there. Hundreds of wasps and hundreds of little crablike spiders made this their home. Bloodthirsty praying mantises stalked and seized those which they could handle. This day population, though, was nothing to that which was revealed by night. Then it was that things dropped down around one's feet—huge, black bird-spiders, long scorpions finished off in black laquer, little red scorpions with a sting worse than that of their larger black cousins. A light swept over the surface of the thatch revealed as much life as is found in the sea. Gigantic flying cockroaches, crickets, geckos and bats. In such a room one is glad to have a canopy at night.

Though we saw little of it, Yucatan is not without its big game. The tapir is the largest and the rarest species. Bands of peccaries occur and once we even saw a semi-tame one fighting with the street-roving pigs of a small village.

Deer of two kinds are common; one a small white-tailed race, the other a species of the Central American brocket, which is even smaller than the white-tailed. Near the plantations the Indians hunt in bands of six or so, and such bands rarely come back empty-handed. Indians in the brush carry guns at all times, but it is only luck that brings them deer at such a time. It is estimated that 100,000 head are taken every year, half this number of hides being exported annually from the one port of Progreso.

Photograph by M. Roigneau

Sacred Plumed Serpents at the Doorway of the Temple of the Warriors

Yucatan is not a sportsman's paradise, but its vast, uncultivated brush breeds a great hoard of game to round out the little varied menu of the Mayas, and a far greater inedible fauna that will interest the inquisitive collector for a hundred years to come.

Chicago Academy of Sciences Photograph

Scant vegetation struggled against the drifting sand

THE PIPER OF THE DUNES

Photographic Glimpses of the Home Life of the Piping Plover on the Shores of Lake Michigan

By ALFRED M. BAILEY

Director, Chicago Academy of Sciences

PHOTOGRAPHS BY THE AUTHOR

THE melodious call of a plover came faintly from over the wind-blown waste of sand. It was an eerie, gentle sound, barely audible above the wash of waves against the gravel beach. The long stretch of gray sand was cut at the horizon with a cloud-filled sky, and the blue waters of Lake Michigan rolled softly against the shores. Scant vegetation,—coarse beach grasses, struggled against the drifting sand, while beyond were more hardy growths holding back the shifting dunes.

It was the voice of a piping plover, the hardy little bird which dwells upon the shores of ocean and lake. The friendly call had an anxious note, and as we stumbled across the soft surface of the beach, the small sand-colored bird scurried in a circle about us. As we walked slowly on, the musical note became more anxious, and with drooping wings and spread tail, the plover tried to lead us away. She fell on her breast and kicked sand with her feet, uttering piteous cries,—there was no doubt she was in great distress.

We stopped and scanned the shingled beach carefully. We did not want to step upon the eggs which we knew must be within a short distance. Small, flat, water-worn stones dotted the surface of the ground, and so protectively colored were the eggs, that we searched for half an hour without success, although we knew they were within thirty feet of us.

The anxious little bird was joined by its mate, and they took turns in their attempts to decoy us away. Finally, we resorted to strategy and concealed ourselves among the hummocks of drifted sand and watched the plovers through the glasses. Within a few moments the anxious calls were quieted, and once more we heard that musical voice which seems so much a part of the wind-whipped beaches. Then one of the birds jumped into the air, and on curved wing darted to the water's edge, where it fed uncon-

THE LITTLE PIPER OF THE DUNES REVEALED THE NESTING PLACE
One of the birds trotted across the sand and flat pebbles, paused, looked about, and then settled to the ground

A LARGE RESPONSIBILITY
The four sand-colored mottled eggs seemed too big for such a little bird to cover—the plover seemed scarcely larger than a sparrow

THE "PIPER" SETTLED UPON HER EGGS

She brooded contentedly, and grew quite tame as she became accustomed to the photographers, who benefited by her fearlessness

TWENTY-FOUR DAYS LATER

One of the old birds was guarding three lively gray- and white-coated downy youngsters, and one unhatched egg that still remained in the nest

OPERATING AN "EYEMO" IN THE SHELTER OF THE "BLIND"
The motion-picture machine portrayed the drifted beach and the plovers among the flat pebbles

upon her eggs, where she brooded contentedly. She grew tame as she became accustomed to us, and we benefited by her fearlessness. The pictures tell the story.

Two weeks more passed. We watched the nest for twenty-four days, and on every visit expected that the eggs would be hatched. The wild flowers of the dunes were blooming in profusion, and there was a constant change as the days rolled on. Fields of blue lupine, spiderwort, and phlox were common, and wild roses bloomed in abundance when we first found the nest, but they faded, and other beautiful plants, among them orchids, took their turn.

The waxlike yellow blossoms of the prickly pear were at their height when we made our last visit to the haunts of the piper. The old, familiar, gentle call came from across the waste, as before, and as we approached, the plovers tried to decoy us away. But we had grown impatient with their byplay, and made our way directly to the little cairn of pebbles which marked the nest. Up the beach scurried one of the pipers, while the other circled us with untiring persistence. One egg remained in the nest—the babies were gone. They were fifty yards away and going strong; one of the old ones led them, while the other remained to watch the unhatched egg. The fleet-footed and hardy-lunged youngsters were corralled after a spirited chase, and were replaced in the depression in the sand while the camera was

cernedly along the wash, while the other, with scarcely any hesitation, trotted across the sand and flat pebbles, paused, looked about, and then settled to the ground.

We had found the nest of the little piper of the dunes! And what keen enjoyment we had when we watched the parents from a near-by photographic blind. The four sand-colored, mottled eggs seemed too large for such a little bird to cover—the plovers appeared scarcely larger than sparrows,—but the motion-picture machine was set up and portrayed the scene. We showed the cloud-filled sky and the drifted beach, with the plovers among the flat pebbles, and then the piper settling

Chicago Academy of Sciences Photograph

THE SHORE OF LAKE MICHIGAN

The long stretch of gray sand was cut at the horizon with a cloud-filled sky, and the blue waters of Lake Michigan rolled softly against the wind-blown shores

THE MALE PLOVER DID HIS SHARE OF THE INCUBATING

The old birds showed great solicitude for the remaining egg. They knew well that the hot sun would soon kill the unhatched baby, and one or the other parent was always hovering anxiously over it

AN EXPERIMENT

Both plovers advanced timidly, and then the mother sidled up to the outstretched palm and with her beak rolled the egg upon the sand

WHEN THE EGG WAS REPLACED

With scant hesitation the little plover stepped upon the hand and, with outstretched wings, hovered over the egg and young

AN EXAMPLE OF FEARLESSNESS
The motion-picture camera whirred merrily while the experiment continued, giving the photographers the thrill of a lifetime

THE FATHER BIRD DREW NEAR
He crept alongside his mate, uttering low piping notes. With his breast he shoved her from her place and took his turn at brooding the young

made ready. When the gray-and-white coated downy babies were released, they acted like a miniature bomb. They ran in three directions, and kept going. They repeated the operation as many times as we cared to perform the experiment, and it was only after many attempts that we secured pictures of an old one with the youngsters. The precocious babies of the piper are well able to care for themselves.

One of the old ones showed great solicitude for the remaining egg. She knew well that the hot sun would soon kill the unhatched baby, and she hovered anxiously over it and called plaintively when we returned with the youngsters for another photographic attempt. She was so tame that we performed an experiment, and in return, we received the thrill of a lifetime. My companion stretched upon the sand, with the egg and youngsters in the palm of his hand. Deer flies settled upon various parts of his anatomy and thoroughly enjoyed our efforts at photography,—for he *had* to hold still. Both plovers advanced timidly, and then the mother sidled up to the outstretched palm, and with her beak rolled the egg upon the sand. The egg was replaced. Then, with scant hesitation, the little plover stepped upon the hand and, with outstretched wings, hovered over the egg and young. The motion-picture machine whirred merrily,—and the other plover drew near. He crept alongside his mate, uttering low, piping notes. With his breast he shoved her from her place and took his turn at brooding the young.

Further photography was useless. Never again would we try to photograph the piping plover, for never again would we meet such fearless little creatures as these. We folded our tripods and packed our cameras and then trudged back into the rolling hills, pausing only once to glance back where sand met sky and the waves of the lake washed ceaselessly. Again we heard the melodious call,—surely, we had had our day with the little piper of the dunes.

Chicago Academy of Sciences Photograph
WHERE SAND MEETS SKY

A ZEBRA BUTTERFLY
(*Heliconia charithonia*)

THE SLEEPING HELICONIAS OF FLORIDA

A Biological Mystery in a Fascinating Setting

By FRANK MORTON JONES

The Royal Palm State Park, where the observations on the sleeping Heliconias were made, has already been described in NATURAL HISTORY *by Mr. H. F. Schwarz ("Swinging the Net in Southern Florida," July-August, 1923) and those who know the biological interest of that region hope that it may soon be part of a National Park including all of the nearly primeval subtropics that remains in our country. In connection with the nocturnal gatherings of the Heliconias, it may not be amiss to refer to another butterfly mystery, the assembly of the "monarchs" for their southern migration. A part of one such flock is shown at the entrance to the American Museum's Hall of Insect Life.*—THE EDITORS.

IN the *Atlantic Monthly* for September, 1918, William Beebe gave one of his characteristically vivid and poetic word-pictures of tropical wild life, including a description of the sleeping habits of the Heliconia butterflies. Late one afternoon, in a little glade in the tropical forest bordering the "Convict Trail," he found two groups of Heliconias going to rest. One by one the butterflies alighted on the tips of projecting leafless twigs (two species in separate bushes), folded their wings, and slept—soon so soundly that Beebe was able to pick off one butterfly and then replace it upon its twig without awakening it or the others. All the sleeping butterflies faced northeast. Each had its own particular twig, to which after flight it always returned. When first discovered, sixty-three butterflies were counted, sleeping in the two bushes; three weeks later, "many of the twigs . . . were vacant, and most of the Heliconias were tattered and forlorn, just able to keep at their fluttering level"; and after two more weeks, only three butterflies flapped slowly in to their sleeping-bush from the darkening forest. One by one the others had perished, until only this remnant of the flock remained.

That these, the most "casual and irresponsible" of butterflies, should have a habit presupposing memory, sociability, caution,—for so Beebe interpreted his observations,—seemed to verge on the incredible; and this, doubtless was the reaction of most entomologists upon reading Beebe's paper; but forgotten in our literature are earlier records confirming and almost duplicating these observations.

In view of the fact that these sleeping-assemblages of Heliconia are almost unique in our knowledge of the lepidoptera, and that most of the published references to them are fragmentary and without pretence of prolonged observation, we welcomed the opportunity for closer study afforded by several visits to Royal Palm State Park, Dade County, Florida, covering the period between January 8 and April 6, throughout which these butterflies were always present and usually fairly abundant.

Throughout our first stay (in 1927),

A ROOSTING-PLACE FOR THE NIGHT
The newly-emerged Heliconia selects a dead branch with numerous twigs—often a branch with many dry, dead leaves—and returns to this spot nightly until opportunity occurs to join a sleeping group of its fellows

charithonia was seen every day, but its sleeping-assemblages were not then looked for or observed. It was noted, however, that the butterfly occurred in certain circumscribed areas, within which either singly or in pairs it might always be observed, though unrepresented in the intermediate areas. In the light of later observations, these frequented areas constitute the boundaries of customary flight on the part of distinct sleeping-groups whose components seem to keep within a few hundred feet of their sleeping-bush. Here, in characteristic slow-flapping wavering flight, these insects keep fairly close to the edge of thicket and jungle, to which they retreat when alarmed. Sometimes, with upright wings they feed upon flowers. Often they bask in the sun with wings outspread. If seen in pairs, one is usually in leisurely pursuit of the other, the second in flight following the leader in all its windings above and through the herbage, always maintaining the same short distance between the two, thus suggestive of the spaced flight of pelicans. This was not observed to be a mating flight, and Doctor Wittfeld's observations indicate that mating habitually takes place at the time of the emergence of the female from her pupa.

Upon our arrival at the Park in mid-March, 1929, the warden, Mr. W. D. Wheelock, immediately called our attention to a sleeping-assemblage of Heliconias in a dead and almost leafless bush standing at the edge of other and living herbage less than a hundred yards from the Lodge. He reported that in early January two such assemblages had been present, this one having persisted and absorbed the other, which had been located about a hundred feet distant on a swaying vine in an open-slatted nursery shed. In January, by his count, more than forty butterflies occupied the two roosts. As we observed them from mid-March into early April, between twenty and thirty were usually present, nightly, in the dead bush. Some of these were bright and fresh, apparently recent emergences; others were tattered and worn and might well have been survivors from the January flock. We kept them under daily observation until our departure, April 6, making night and morning visits to the Heliconia roost, and (then) unsuccessful efforts to secure satisfactory photographs of the sleeping insects. Our longer stay in 1930 gave greater opportunity for observation, at earlier seasonal dates; and to avoid repetition we have consolidated our record of observations for the two years.

Of six observed roosting-places, three were at the edge of dense living herbage, in dead bushes or broken branches having many fine twigs; two were in pendulous vines, almost leafless but with twigs and interlaced ramifications; one was among the close-set wiry dead stalks and the bare aërial roots of a neglected fern-basket hanging in a slat-house. None was less than two feet or more than eight feet from the ground. Noise and proximity of buildings had no deterrent effect, for the roost longest in observed occupancy was almost in contact with a corrugated-iron shed in which a noisy engine and pump ran many hours of the night and day.

In the late afternoon, Heliconias, one by one, commence to drift in to the vicinity of the sleeping-bush. With devious slowness they explore the whole neighborhood, pausing here and there on some projecting bit of herbage, sometimes basking for a time in the last horizontal beams of sunlight, sometimes alighting on the roost only to leave it again for further exploring flight. About a populous roost, at sunset, the air is filled with butterflies in swirling flight, which continues in decreasing number of participants as one by one the flock finds a resting-place and hangs motionless in the sleeping posture. Up to almost full darkness, late comers continue to arrive, some apparently flying directly to the roost without preliminary exploring flight and joining the sleeping group; and more

AN EARLY MORNING PICTURE
(Five minutes exposure)
In its sleeping position Heliconia clings to its roost, head upward, its legs extended, its tongue partly uncoiled, and with its wings folded and pendulous

PLACE-MEMORY, SCENT, OR WHAT?
Heliconias on Roost B, after the substitution of new twigs. One has the tip of its wing obliquely clipped for identification

than once, after counting the sleepers at the last moment the fading light permitted, we have found that number increased upon visiting the roost at night. The frequently observed preliminary exploring flight, often exhibiting an unmistakably purposeful thoroughness, was at first attributed to a precaution against lurking danger before going to sleep—a gesture like looking under the bed for a burglar; but later observations suggest a more probable explanation.

For the ability of the Heliconias to find and identify their sleeping-bush, two explanations seem possible; this might be by place-memory, or by scent. We made two experiments which seem conclusive. In 1929 the flock of thirty butterflies occupied a few twigs of a large dead bush. One morning we cut out these few twigs, and tied them up in another bush about ten feet distant from their original location, and at the same height from the ground. The new location was not directly visible from the old one, but was within the usual radius of the preliminary exploring flight of the assembling flock. In the late afternoon we watched the behavior of the arriving butterflies. The usual performance of exploring flight about the roost was manifested. In this flight they coursed back and forth through the space formerly occupied by their roosting-twigs, and it seemed obvious to us that there was some recognition of change. In their wider flight, several butterflies paused upon the old twigs in their new position, only to leave them again and rejoin the flying group. Gradually the flock came to rest upon twigs in the old roosting-bush, close to the vacant space left by the removal of the roost itself. After dark, twenty-seven butterflies were found sleeping on these new twigs, and one, alone, on the transferred twigs ten feet away. Next night, this one rejoined its fellows in the old bush.

Our next experiment, made in February, 1930, even more clearly indicated that recognition of the roost is by place-memory, not by scent. In preparing for a flash-light photograph of the strongest group then under observation, we had attempted, in the daytime, some rearrangement of the twigs of the roost. In this attempt, so many dry leaves and brittle twigs fell off, that we feared we had ruined the roost for further occupancy. As a last and not very hopeful effort, we cut away all the remaining branches of the roost and brought others from a distant brush-heap, tying them into place as nearly as possible in the old site. At dusk, without any obvious hesitation the butterflies accepted this substitution, and that night they slept upon the new twigs in the usual numbers. The roost-location, and not an imparted odor, identified the sleeping-place.

PROTECTIVELY PATTERNED
Five sleeping Heliconias. In color and outline their longitudinal stripes merge into the dry roots and stalks of their roost

Mr. Beebe noted that individual butterflies, recognizable by tears or imperfections in their wings, occupied the same twigs night after night, and he believed that each insect had its own particular twig to which it always repaired for sleep. In 1929, by rough drawings of the furcations of the twigs of the roost and by note of the number of butterflies resting on each, we determined that some nightly shift in the relative positions of the sleeping insects usually takes place. We then discovered that the butterflies could easily be marked for identification by snipping pieces from their wings while they slept. Memorandum was then made of the twigs occupied by insects thus variously marked for individual identification, and night after night their position on the roost was determined and recorded. Many of them *did* occupy the same twig for a short succession of nights. Usually some of the marked butterflies occupied new positions. None maintained the same position for many successive nights, and some of the shifts of position were from one side of the roost to the other, from night to night. That is, there was some evidence that place-memory is definite enough to extend to the location of individual twigs, but abundant evidence that continuous occupancy of them is far from the general rule.

Unless alarmed, or unless the crowding of later arrivals occasions some readjustment of position, each butterfly after assuming its sleeping posture upon the roost usually remains there motionless throughout the night. Each clings to its twig or leaf, head upward, its wings closed over its back and pendant; the legs are somewhat extended and the body is thus held away from contact with the support; the abdomen is hidden within the margin of the hind wings; the antennæ are held straight and erect, slightly divergent, and almost parallel with the costa of the front wings; the tongue is partially uncoiled, forming an open circle of about one-eighth inch diameter, its inner rim often bearing an adherent droplet (sometimes a hardened globule) of nectar (?).

A TROPICAL TREE-SNAIL
In warm, humid weather brightly colored tropical tree-snails creep out from their hiding places in the jungle at Royal Palm State Park

The sleeping flock usually forms a fairly compact group in which twenty or thirty butterflies may be crowded together within a radius of twelve or fifteen inches, sometimes with little outlying groups on adjacent branches or twigs. In these sleeping-assemblages most of the Heliconias face the same way. In attempting to photograph such a group, however, it is often found that a position chosen to secure a broadside picture of the group includes some individuals which present an edgewise view to the camera. Nor do different flocks all face toward the same point of the compass, and one whole flock was observed to reverse its position from one night to the next, perhaps because some change had been made in the adjacent herbage, incident to photographing the group. We believe that the position of the twigs or leaves composing the roost is one determining factor, and that the direction of strongest light has some orienting influence.

While daylight persists, the roosting butterflies continue to be alert and ready to take flight if closely approached. After full darkness they seem unaware of near-by sound or movement, and even brilliant lights unless very close elicit no response. A jarring touch of the supporting twigs or a brilliant light held within a few inches of the roost arouses them; and even if none takes flight, antennæ are waved, feet are shifted uneasily, often the palpi are alternately spread apart and closed, exhibiting conspicuously their pale inner surfaces.

At night, by careful handling, one after another of the sleeping butterflies may be picked off from the group, even sometimes replaced again, without awakening the rest; but never did we succeed in picking off the whole flock without arousing some remnant of them into flight. When violently awakened, the whole flock literally *explodes* into flight in all directions; and although brilliant light exerts a weak attraction to some, most of the members of the flock cling to the first object into which they bump, and in the morning may be found hanging to adjacent herbage within twenty or thirty feet of the roost.

The morning awakening and departure of the Heliconias was repeatedly observed. This may be considered a typical record: March 22, evening, 24 Heliconias sleeping in roost; March 23, 6 A.M., all still asleep; 6.15, one flew slowly away while the light was still too dim for its ready detection as it slipped off into the shadows of the jungle; 6.22, one sat slowly flapping for a few seconds then flew off, followed quickly by another which had given no preliminary signs of approaching flight; 6.35, one departing butterfly bumped into the remaining assemblage, which exploded into flight and immediately dispersed. On other mornings, this explosive flight of the entire flock would be the response to our approach, however cautious.

On cool and cloudy mornings the night's lethargy persists until later in the day, often permitting incautious approach, and continuing until nine o'clock, or even later in time of heavy rain. After repeatedly witnessing the prolonged exploration of the roost neighborhood as a preliminary to assemblage on the roost, and these explosive departures in the morning or at the approach of danger, we concluded that the evening flight is one of orientation, by which place-memory is established and maintained—the sudden departure at dispersal of the flock affording no opportunity for this function.

THE STRUGGLE FOR SUPREMACY
The Fig vine thickens, and tightens its strangling grip, until the supporting tree is completely enveloped

THE STRANGLING FIG
It hangs from many of the trees of the Hammock as a ropelike vine

Upon our arrival at the Park, March 18, 1929, we were shown a group of sleeping Heliconias upon a roost which had been in uninterrupted nightly occupancy since early January. It was still being used at the time of our departure, April 6. That is, this site had been in uninterrupted use for three months, and beyond this period we did not know its beginning or end.

In late September, 1929, a hurricane whipped most of the leaves from the trees at the Park, flooded the country to an almost unprecedented degree, and created conditions most unfavorable to insect life and abundance. The warden, Mr. Wheelock, wrote us that some of the

Heliconias had survived the hurricane and that they were in daily flight about the Lodge. Later, however, their numbers decreased, and on December 3 Mr. Wheelock wrote, "There is not a single Heliconia left." He predicted their return in January, when usually they become more abundant. We arrived at the Lodge on January 8, and on the next day saw a bright freshly-emerged Heliconia at the edge of the jungle. Thereafter we saw one or two each day, but not until the 20th did we succeed in locating a sleeping Heliconia. It slept alone, in a pendent leafless vine; the next night it slept in the same spot; the third night it did not reappear. On February 2 we located another, sleeping alone on a bare fern-stalk; for two more nights it slept there, then it, too, did not reappear. Meanwhile, however, we found three other roosts, all within one hundred yards of the Lodge and of each other, and each with several occupants. For our records we designated these roosts B, C, and D, and in each group we marked some of the individuals for identification. To our surprise, we discovered that there was a constant shift and interchange, from one sleeping-place to another. For example, a marked butterfly which we identified by a single oblique clip from its front wings, was located, sleeping, on twenty-two out of twenty-six consecutive nights; and in this period it made eight changes, back and forth, between roost B and roost C. Its longest observed unbroken stay on one roost was for six successive nights. This explained the previously-observed fluctuations in the numbers present on a roost from night to night, and relieved the Heliconias of the suspicion we had formed, that they frequently stayed out all night; but for that suspicion it seems to have substituted the certainty that some of them maintain two establishments.

One other significant experiment seems worth recording. On February 8 a motor trip was made down the Cape Sable road

THE FINAL STAGE OF THE STRANGLING FIG

Long after the supporting tree has crumbled away, the Fig itself becomes a great tree, whose braced and buttressed roots give independent firm supports to West Lake and beyond—a distance of twenty-seven miles from the Lodge. Here, over a limited area, Heliconias were found flying in some abundance. Two were captured uninjured, transported to the Lodge, marked with conspicuous and unmistakable wing-clippings, and released. One was never seen again. The first night after its release, the other one was found sleeping on roost B; and for eight of the succeeding eleven nights it was identified among the sleepers on either roost B or roost C, in that period making three shifts between these roosts.

It is thus apparent that individual Heliconias sleeping alone develop a place-memory which may persist for a number of nights; that a "capacity for sociability," as Beebe expresses it, may become a stronger stimulus, to which the original place-memory is subordinated; and it may well be that in these observed shifts from roost to roost we are witnessing the chance operation of this social stimulus, rather than the apparent ability to remember and recognize several successive sleeping-sites.

SWAMP LILIES
The glades are not always monotonous expanses of saw-grass, for they maintain a varied though limited flora. Here and there they are starred with the great snowy flowers of *Crinum*

Has the group-sleeping habit of the Heliconias any determinable significance of importance to the species? Of the three primary requisites for continuance—food, safety, progeny—it would seem that we might at once eliminate one—food—as having no conceivable relation to this habit. Nor could we find evidence that it has to do with the mating of the sexes. The populous roost under observation in March and April, 1929, included both sexes in numbers not greatly unequal; but as we observed the formation of new assemblages in 1930, a different condition was found to exist. All the insects we noticed first, roosting alone, were males. The small assemblages beginning in late January were composed exclusively of males, and all Heliconias netted by day were males, which obviously have an earlier seasonal emergence. It was not until almost a month from the observed formation of the sleeping groups, that any females were detected among the sleepers or captured in flight. We could detect no differences of behavior among the insects of the bachelor groups, in comparison with those of the mixed assemblages; and Doctor Wittfeld's detailed observations in regard to the assemblage of males of *charithonia* about the pupæ of females several days before the emergence of the adults, render it even less probable that the sleeping-assemblages relate in any way to the union of the sexes. Do they then contribute toward the *safety* of the species?

As these butterflies cling motionless upon the roost, with folded wings showing only the dulled colors of their under surfaces, the sleeping group is not to our eyes conspicuous. Repeatedly we have approached a roost and believed it to be bare of occupants, until gradually our eyes picked out from the confused mass of narrowly-striped wings and sun-bleached twigs the form of one butterfly after another, and finally the whole group became visible to us. But even if protectively colored—or rather, patterned—why should thirty such butterflies sleeping in a compact group be any safer than thirty sleeping singly and far apart? The reverse would seem nearer the truth.

To this query the behavior of one butterfly, plucked from the sleeping group and held between finger and thumb for inspection, may give a clew. It waves its legs and antennæ, it curves its body out from the concealment of its wings, crescent-formed, and holds it rigid; and from the end of the abdomen it pushes out a rounded, yellow, glandular mass (in the male, double) from which is given off a powerful odor and in some instances a minute drop of fluid. Perhaps we should say perfume, rather than odor, for to our senses it seems flower-like though rank, suggesting the rank sweetness of the Datura blossom. We could detect no difference in scent between that of the male and the female butterfly.

The Heliconias are foremost among classic examples of the theory of "warning coloration"—of the possession of conspicuous easily-recognized colors and patterns (usually yellow, orange, or red, and black) by which their inedibility, through the possession of a nauseous smell or taste or of special means of defense, is advertised to their enemies. A great controversial literature has been built up about them and about this theory. Their behavior by day is not incompatible with this theory; for the "zebra" butterflies, slow of flight, seem to advertise their presence and identity, rather than attempt to elude observation. If Heliconia is protected by a nauseous odor or taste, advertised to its daytime enemies by conspicuous readily-recognized colors and color-patterns, *then* its degree of protection, at night, when these warnings are not so apparent, may be increased by the close proximity of large numbers, under these conditions readily recognizable by form, color, or *scent*, as identical in kind and inedible; for thus the injury or destruction of one of the group might conceivably work for the protection of the many.

A recent and able paper on the sounds produced by insects concludes with the query, "Do they serve a really important purpose in the lives of the insects? If not, why have they developed and how?" Perhaps the sleeping-assemblages of Heliconia are of no real importance in the economy of these insects. On the assumption that they are of significance, we have presented a suggested explanation which seems in agreement with the observed phenomena; and for this suggestion we have been unable to discover any reasonable alternative.

Looking through the Fringe of Palms on the Bay of Antongil

BEVATO

A CAMP IN MADAGASCAR

Experiences of a Collector in an Island Forest

By RICHARD ARCHBOLD

Through the generosity of the late Mr. John F. Archbold, the American Museum of Natural History was enabled to participate in an expedition to Madagascar in 1929 and 1930 for the purpose of collecting birds, mammals, and fossils from this important region. The expedition was organized by Dr. Leonard C. Sanford, and sent out in coöperation with the Paris Museum and the British Museum. The director of the expedition was Mr. Jean Delacour, and the American members were Messrs. A. L. Rand, Richard Archbold, J. C. Greenway, Jr., and Philip DuMont. An important collection was made which will be divided among the three participating institutions.—The Editors.

TWO hundred and fifty miles across the Mozambique Channel from Portuguese East Africa lies Madagascar, one of the three largest islands in the world. Possessing a fauna almost totally different from the huge continent so near which it is located, with no big game—with no indigenous mammal larger than the wild pig (*Potomochaerus larvatus*)—it is nevertheless the former habitat of the giant and only recently extinct *Epiornis,* the huge bird that is now found as a sub-fossil throughout the island and may possibly have served as the original from which the fabled roc of the *Arabian Nights* was developed by the imaginations of the East. Furthermore, it is the only place where that curious little animal called the tenrec is found—the animal that forms a staple food for some of the wilder tribes of Malgach.

Known to the old whalers of New Bedford and Nantucket, colonized by the French, almost on a direct line between the Cape of Good Hope and India, Madagascar still seems to remain detached from the rest of the world—seldom visited, little known to the world of Europe and America. A thousand miles in length from north to south—three hundred and fifty miles across at its widest point—containing mountains and tropical valleys, great rivers and broad plains, this island of the Indian Ocean lies for the most part beneath the tropic sun, barely thrusting its southern end across the Tropic of

Photograph by Brown Bros.

A TYPICAL WEST COAST VILLAGE

Native Madagascar homes vary considerably according to their location. In the interior of the island they are made of dried clay with a roof of branches and thatch. The forest dwellers and coastal tribes build houses with bamboo walls perched on piles

Capricorn into the South Temperate Zone, though this part, containing the deserts of the island, is the hottest portion of the entire land mass.

For a year the "Mission Zoologique Franco-Anglo-Americaine" had been collecting in the south and central parts of the island. We then, to continue the systematic study of its fauna, moved to the head of Antongil Bay, which lies far to the north on the island's east coast, and from this point we planned to penetrate by motorboat and native dugout canoes, or *lakanas*, into the interior where, even from Maroantsetra a town on Antongil Bay, we could see the towering mountains that climbed up and up to the north of us to reach their climax in the great massif of Tsaratanana, which lies within about 150 miles of the island's northernmost tip.

Even the most casual glance at a map of Madagascar shows plainly one of its striking physical features, for the eastern coast, a thousand miles in length, is strangely straight and unbroken. In addition to this there is a very strong current that strikes the coast and blocks with shifting bars of sand the mouths of all the rivers and any but the largest harbors. The only major indentations in this coast line are Antongil Bay, and, still farther to the north, the bays of Loquez and Diego Suarez, the last of these undoubtedly one of the finest of all the world's fine harbors.

We, however, were headed away from the coast, into the hilly interior, toward where, on our western horizon, the mountains rose abruptly in softly rounded outlines, beyond the forest of the coastal lowlands.

The sand banks at the mouths of all the east coast rivers make navigation difficult

THE FOREST AT BEVATO

This shows the cut-over forest with its entanglements of vines. A native guide is standing in the lumber path through which the *lakanas* pass en route to the river

or impossible, and Maroantsetra River is one of the few that one can navigate at all. In order, however, to get to the motorboat that had been lent to us through the generosity of the head of a local lumber concession, we had to load our ton or so of equipment into a *lakana,* paddle across to a sand spit, and carry our belongings to where the boat was waiting in navigable water.

Mr. A. L. Rand, Mr. Philip DuMont, and I, with two natives, made up the expedition party, but with the crew of the motorboat, who were all Malgach, there were ten of us when, uncomfortable and chilly in the rain, we finally managed to stow our belongings and get under way.

For a time after we had started upstream the river wandered through low country covered with swamps of traveler's trees, their fanlike tops spreading wide from their tall slender trunks. Until about noon we wound along the smoothly flowing river, conscious now and then of the flash of a large white heron (*Casmeroides albus*) as it flew up along the bank. Often we saw flocks of paddy birds (*Bulbicus ibis*) as they arose and circled about. A purple heron (*Pyrrperoidia purpurea*) flew over, and Rand brought it down to add to our collection.

Native *lakana* passed us frequently, and our motorboat crew, with a far-fetched idea of humor, would run close to these unseaworthy craft and enjoy the havoc created by our wake. Most of the natives of the interior are very poor seamen and many of them are actually afraid of the water, with the result that near panic was sometimes created, though our own crew roared with

Photograph by Brown Bros.

NATIVES OF TANALA

The population of Madagascar is Negroid with an element of Malay

Photograph by Brown Bros.

MADAGASCAR PORTERS

The carrying method illustrated here is reminiscent of Polynesia. Note the pareu-like costume which consists of a length of cloth wrapped around the waist

laughter at these narrowly averted mishaps.

We passed at last from the lower country of the coast into the more hilly section. The transition was abrupt, and the scenery changed at once. The hills that came down to the river were forest-clad and steep, their sides rising sharply from the banks to support dense growths of hard wood, among which, farther up-stream, the natives find the trees from which they make their *lakanas*. Near the waterways suitable trees are scarce because of the ruthless destruction of the forests, and the native who decides to make a canoe must these days go far afield in search of proper trees.

After a suitable tree is located, it is promptly felled so as to lie in a level position. If the hill is especially steep, a platform is built on which the workmen labor. The *lakana* is roughly cut and gouged out with axes. It is then light enough to be dragged to the nearest stream, which may be two or three miles away. The forest growth being heavy, a pathway must be cut and along this specially constructed way the canoe is hauled by a score of men. When this rough hull has reached the water's edge the finishing touches are put on, but this is always done by the local chief himself.

This method of procedure is, naturally enough, very destructive of the forest, for in the process of making the platforms and clearing the paths, great gaps are cut in the forest, where tangles of vines quickly spring up, and choke the young trees that are just starting to grow.

Thirty kilometers from Maroantsetra, where the low country changes so abruptly into hills, we stopped at a tiny village which consisted of three stores, one of which was run by an Indian. Upon investigation we found that the second was operated by a Chinese, while the third

A MOUSE LEMUR

This lemur (genus *Microcebus*) lives entirely in the traveler's trees on the fruits of which it feeds. It is nocturnal and aestivates during the time the tree does not bear fruit

merchant, judging from the crowd outside his emporium, was undoubtedly Malgach. There were no Europeans in the village, and our *bhoto*, or native servant, was sent to purchase supplies of rice and sugar. The stores contained little except bolts of cheap European cloth and a few simple tools such as knives and the curious native axes. We had been told that we would be able to purchase bread and almost any supplies that we would want, but that "information" proved to be incorrect.

We started upstream again, and DuMont, seeing a swallow (*Phiclenia barbonia madagascariensis*) as it swept across the stream, brought it down with a fine shot. The helmsman immediately turned the boat in order to pick up the fallen bird, but the mechanic whose duty it was to stop the engine, forgot his task in an effort to recover the specimen, with the result that the boat rammed the bank at full speed and we had some difficulty in getting off again. Even when we did, one of the boatmen, who had been pushing against the bank with an oar, forgot to maintain his hold upon it, and left it sticking in the mud. Such a loss was, of course, not to be permitted, so the guilty boatman was forced to swim ashore to recover it while we waited in deeper water.

About six kilometers above the village at which we had made our purchases, the motorboat was forced to stop because of shallow water, and it was necessary to obtain *lakanas* in which to continue our journey upstream. We had not previously made arrangements for them with the result that the boatmen disappeared into the forest in search of natives from whom *lakanas* could be obtained. Within an hour our boatman reappeared with three *lakanas* which were, unfortunately, too

AN EXPEDITION PET

One of the species of lemur collected in Madagascar by the expedition

A VIEW IN THE COASTAL FOREST
The forests of Madagascar contain many valuable timber trees and the characteristic traveler's tree, whose leaves contain quantities of clear watery sap which affords a refreshing drink

small for all our luggage and ourselves. The result was that we loaded what we could (most of it, fortunately), and one or two porters followed up the banks with what remained.

Bevato, the camp for which we were heading, lay on the crest of a small ridge about four kilometers above the point at which we had been forced to leave the motorboat, and when we reached it we found that it consisted of three houses connected by porches. Bevato gets its name from the Malgach words, *be*, meaning large or big, and *vato*, stone or rock. The meaning of Bevato, consequently, is "big stones." The smallest of the three structures at the camp was the cook house, which contained a stove of the type found throughout Madagascar—that is, a box of sand—though this one had the innovation of being raised on legs. No chimney was attached, however, and the smoke made its escape through the door. Our dining room, which was next to the kitchen, was a palatial affair, having three large doors and a window instead of the usual single low door that forces one to stoop. The third, and largest, of our houses was divided by a partition and in one half of this we put our beds, while in the other half we stored our belongings and arranged a workroom. All the buildings were raised from the ground on stilts in the manner common in the interior of the island, though we boasted board floors while the usual structures have floors of reeds.

The construction of these houses was similar to that used by the natives in that the framework was first erected and then the walls were covered with mats made of the ribs of the leaves of the traveler's tree. These mats are simply made by running slender sticks through the ribs until a section four or five feet square or even more is completed, and these are tied on the frame work with sisal or vines. The roofs are made of the dried leaves from the same kind of tree and are usually put on to a thickness of a couple of feet.

All about us spread the forest, with narrow trails leading here and there over the steep clay hills. Below us a native village lay hidden by a row of banana trees. The weather was perfect for several days after our arrival, and the place was really beautiful.

One of the frequently heard noises comes from the babakoto (*Indris breva-*

caudatus) the largest of the lemurs. This animal, if it could straighten out its legs, would stand not quite five feet in height. Its coloring is black, gray, and with a little brownish-red, in varying proportions, and its tail is only rudimentary. It is the only species of the genus, and we were especially interested in it.

Many times I have listened to the weird howling of these animals. Sometimes the calls were plaintive and almost human, reminding one of a crying child as they echoed through the woods. I have often wondered whether the cries were warnings, or if they were, in some wild way, a means of communication, for they were usually answered from some distant hill. The cries are made up of both long and short notes and it is very noticeable to the person who listens closely that these vary in their arrangement, although they seem to be kept to the same two tones.

I have often turned to my porter when these cries were ringing through the forest, to ask "*Isy lavitra*" (Is it far?) and he would invariably nod in the affirmative.

More than once I doubted the fellow's nod, and set out to approach the calling lemur, but always, after stumbling up and down the steep clay hills until I was exhausted or had lost my way, the cries would seem to be as far away as ever. Not until the last day of our stay did I succeed in seeing one of the beasts, and even then he saw me first and was off through the valley trees in a series of tremendous leaps that made pursuit futile.

The weather changed for the worse, and hunting from the camp became daily more difficult. The hills were steep and under the continual rain their clay sides became more and more impassable, and yet our collection grew rapidly.

Every evening the vara-coha (*Lemur variegatus*) and the vara-mena (*Lemur fulvus*) would add their quarrelsome cries to the sounds of the forest. These creatures usually travel in groups of from four to eight, and are by far the most abundant of the lemurs. They are not harmful, save as, now and then, they make a raid on some of the natives' banana groves, but such raids are not often successful, for the animals seem to be utterly unable to feed

Photograph by Brown Bros.

A COUNTRY GIRL

Vegetable fibers of all kinds are skillfully woven by the women into cloth for clothing, mats, and baskets, some of much fineness and delicacy, and often with much taste in color without engaging in noisiy quarreling.

Almost every trail through the forest was dotted with snares, and the careless walker along those woodland ways might, almost at any moment, step into one of the traps. Returning from one of my unsuccessful forays after a howling *Indris*, I suddenly found myself flying down hill head first. I scrambled to my feet and looked questioningly at my guide, while he in turn pointed to a snare I had not seen. It was a bent sapling and a loop of line so arranged that, upon releasing its catch, the sapling sprang up, drawing the noose around whatever part of the animal was inside and lifting him clear of the ground.

For two weeks the weather remained cloudy and rainy, handicapping us and making us a little uncomfortable, when we were on the trail. But during the week preceding our return downstream, the weather turned fine again. Our morning hunting became easier, and we made it a practice to work in the afternoon outdoors in the shade of the house, often moving our table and chairs as sunset came, in order to watch the changing colors on the ranges of mountains, and in the valleys between.

Now and again, too, we went on night hunts—to me the most interesting of all because of the mystery that attends one in the darkness of the tropical forest. There are so many strange sounds at night—frogs that fool one with their excellent imitations of lemur cries—other frogs that seem to explode, now and then, with a sound that is an almost perfect imitation of the bang of a gun. Strange insect sounds come from all about. Sounds that seem to defy explanation whisper through the trees. And even when one shoots at shining targets at night there is usually a mystery as to what the prize may be, for one can rarely be sure exactly what the two balls of fire are; sometimes they are only a pair of stars.

The spell of fine weather which made our final week in camp much easier, turned out to be not entirely an unalloyed blessing, for, owing to the lack of rain, the motorboat that came for us could not travel so far upstream as it had done when we arrived, and even where it floated, the water was so shallow that we could not load all our baggage aboard, but had to put most of it into a large *lakana* that had been sent up at the same time through the kind forethought of the lumberman who supplied our motorboat.

On our way downstream, as we rounded a bend at sunset, we came upon a flock of paddy birds. They were flying low over the water and gave the impression of rows of brilliantly white waves. As they passed us, each row, in obedience to its leader, would rise and then descend until their wings were almost touching the water. We watched them as they passed and left them to dance in the sunset as we rounded another bend. Aided by the current we sped onward toward the coast, having obtained the collection for which we had come.

A BIT OF MADAGASCAR COAST

TAILS

Caudal Appendages Adapted by Nature to the Needs of Her Creatures

By CHARLES E. BURT
Department of Herpetology, American Museum

The raccoon's tail am ringed all 'round; the 'possum's tail am bare;
The rabbit's got no tail at all; but the white spot's always there.
—Negro Folklore

LET us trace, in a general way, the development or formation of the tail in the animal kingdom. One of the simplest and most generalized animals known, the minute, one-celled *Amœba proteus*, is without constant body form. Therefore, there is no tail, just as there can be no head, no mouth, no eyes, no ears, and no legs—the mass of living substance or protoplasm constituting the species serving as all of these and more. In many other simple one-celled forms, however, the body is constant in outline and, in addition, in many of them one part of the body is always behind and another is always in front as the organism moves about. Here we find *longitudinal orientation* of the protoplasmic mass which constitutes the body and hence, as regards the tail, the foreshadowing of future developments.

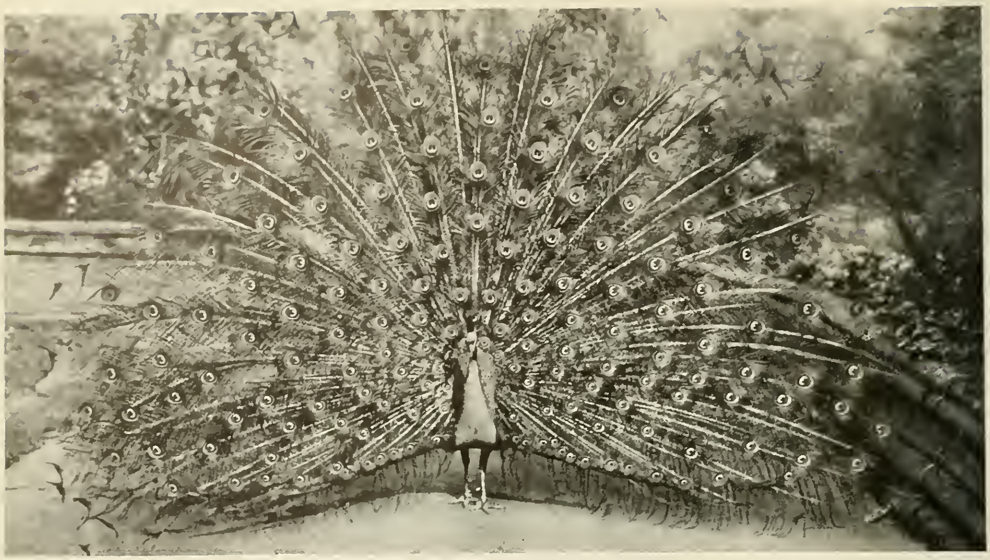
Photograph by Herbert Lang

Monkeys of the New World belonging to the family Cebidæ nearly all have prehensile tails, wheras those of the Old World do not. Above is a picture of an African monkey; the one shown below is Central American

Photograph by Frank M. Chapman

The free-living, fresh-water flatworm *Planaria*, a larger, more advanced, many-celled animal, offers a very perplexing problem when we attempt to divide it into general sections or parts according to the popular method. This curious organism is always cross-eyed, if its tiny "eye-spots" are really to be regarded as eyes, and its mouth is situated near the middle of the body. Now, if we consider the fore part of the animal as the head, including the mouth as usual, we find that most of the planarian is head, but if we regard the portion back from the "ears" or sensory lobes as tail, much of this head really proves to be something else. Thus, at this point we are still unable to positively separate head, body, and tail.

This same indefinite condition or status of the tail holds to a greater or lesser degree throughout the lower or invertebrate series of animal groups, although it is true that certan of these show caudal developments which are worthy of note. The crayfish has a series of five terminal plates which the animal often uses in swimming rapidly backward through the water. Numerous insects, such as the cricket, have conspicuous posterior hairs or filaments which some may regard as a tail. Bees have developed a strong sting behind. Scorpions, which also sting with



Photograph by Arthur Fisher

THE PEACOCK'S FAN

The animal kingdom holds no more elaborate tail than that of the peacock. The fan is spread only during courtship

an apparatus at the terminal part of the abdomen, likewise show no real tail—and so on.

In the back-boned animals or vertebrates the tail appears as a definite structure. Here, in the fish, amphibians, reptiles, birds, and mammals, there is probably no part of the physiognomy that has been subjected to a more interesting series of variations and uses than this appendage.

Photograph by Mary C. Dickerson

WOODPECKERS REST ON THEIR TAILS

The downy woodpecker hangs to the tree with his claws and props himself with the stiffened spike-like quills of the tail feathers

Take for instance, among the reptiles, a fossil form, the ancient *Ichthyosaurus* or "fish-lizard," was obviously specialized for pelagic life like the porpoise and the whale, but the most primitive modern species, the tuatara of New Zealand (*Sphenodon punctatum*) shows none of this. Its tail is merely strongly compressed along its length, as are those of many other reptiles which live in marshy or semi-aquatic habitats—such as the crocodiles and their allies, or certain large South American lizards of the family Teiidæ (*Dracaena guianensis* and *Crocodilurus lacertinus*). Such tails are long and strong, being obviously adapted to aid in swimming movements and in defense. A similar type of modification is found in the marine snakes which occur so commonly in the vicinity of the islands of the Pacific and Indian oceans. These creatures usually have the elongate body and other general characters of the serpents, but their tails, instead of being rounded as in the terrestrial species, are often much compressed, so as to form a helpful rudder which may be waved from side to side while the animal swims about.

The tails of the turtles, like those of the horned lizards (*Phrynosoma* and *Moloch*), are almost too small and insignificant, as reptile tails go, to warrant discussion here, being reduced to but a relatively small fraction of the total length—usually less than thirty per cent.

Many reptiles vibrate their tails when disturbed, but none are better equipped by nature to capitalize this tendency than the venomous rattlers, which, unlike most other poisonous snakes, usually warn their would-be victims before attempting to molest them. The snakes of the genus *Coluber*, known generally as the racers, are unusually nervous and will frequently vibrate the tail when disturbed. Exhibiting this same tendency,

Photograph by Mary C. Dickerson

MOLLY COTTONTAIL

This rabbit carries a tuft of snow-white fur on the underside of its tail. The pursuing hunter can trail the rabbit by this white spot until the rabbit squats and hides its tail

a small lizard, the common spiny-swift of central Kansas (*Sceloporus undulatus*

Photograph by N. Y. Zoological Society

THE THIRD LEG OF THE TRIPOD

Kangaroos habitually sit on their powerful tails. So supported they can even strike an adversary with their hind legs

Photograph by A. J. Ortenburger

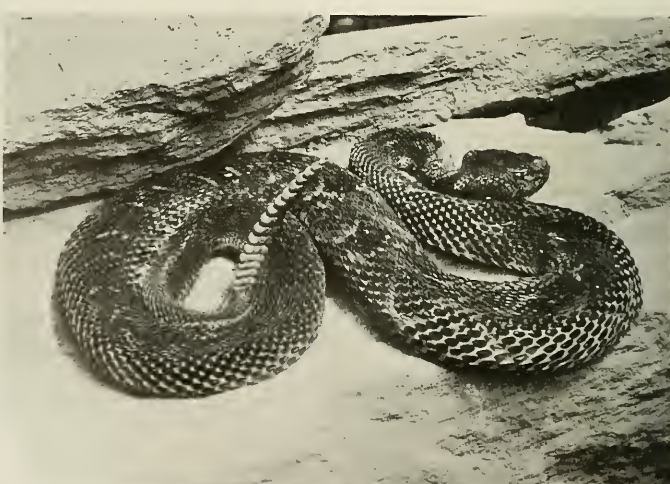
A GILA MONSTER
Our only poisonous lizard, *Heloderma suspectum*, uses its tail as a food reservoir. The tail is rich in fatty tissue and this is absorbed in times of fast

thayerii), reminds one of a pleased dog as it quivers its little tail in anticipation of food.

The Old World chameleons have a prehensile or clinging type of tail somewhat similar to that of the opossum. This is a rather unique development among the reptiles, although it is said also to have taken place in a rare iguanid lizard of the West Indies which is known to scientists as *Xiphocercus valencienni*.

Inhabiting the southwestern United States and the Mexican mainland are the poisonous gila monsters, which have large, rounded tails. These are covered with beadlike scales and are said to act as reservoirs for food, fat being stored in them during times of prosperity and used from them during the periods of inactivity known as hibernation and æstivation.

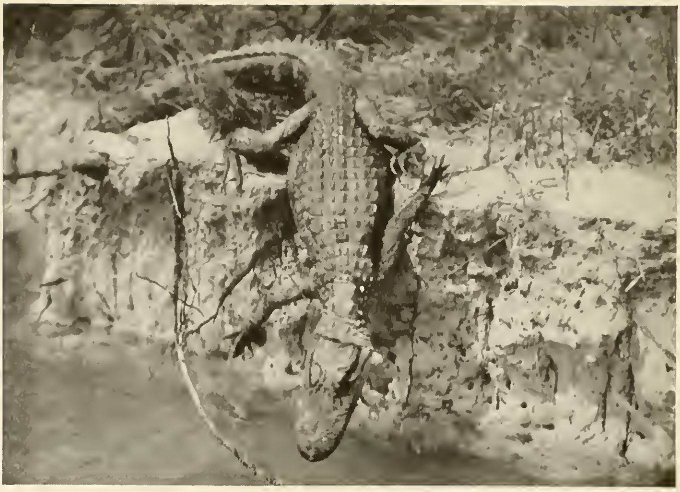
The tails of many lizards, including those of various geckos, skinks, and "glass-snakes," are very delicate and consequently fragile and easily broken. This feature often spares the life of these animals, for an enemy in pursuit, having succeeded in grasping the tail alone, usually gets a section of just that, and nothing more. If the tail of a skink is injured in any way, so that it starts to come off, the section back of the injury is very apt to be shed whether it is firmly held or not. I have personally observed this phenomenon in the field in the case of an adult Sonoran skink (*Eumeces obsoletus*), which severed its long tail by a series of quick muscular contractions after a slight cut had been made accidentally near the base. After the tail has been broken, the wound heals readily and new or regenerated tissue grows. The part that develops in this



THE RATTLE TAIL
At each molt, rattlesnakes fail to shed the tips of their tails, which remain attached to the earlier tips. These tips form the rattle. Rattlesnakes are so deaf they do not hear their own rattle, but its warning sound serves to ward off enemies that might tread on one of these serpents

Photograph by Raymond L. Ditmars

THE ALLIGATOR'S TAIL!
Big alligators have powerful armour-plated tails that are used in swimming and defense. A blow from such a tail could break a man's leg

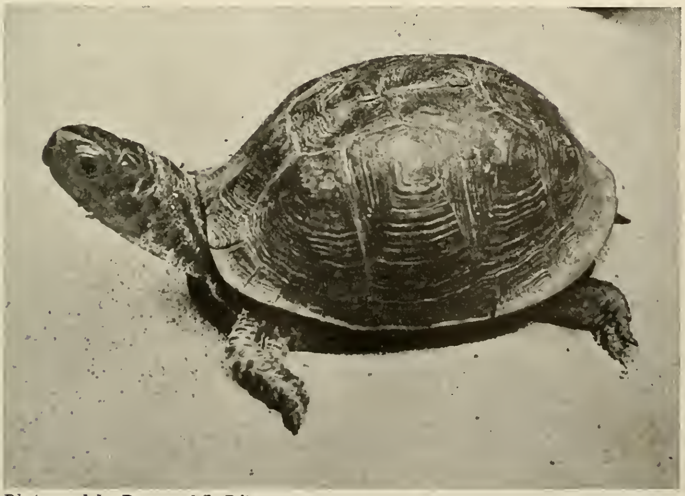


Photograph by Julian A. Dimock

manner, although not as long as the section lost, often becomes fully as long as or even longer than the remaining stub of the original tail. In many regions various adult skinks and, in fact, certain other lizards, too, nearly all have regenerated or incomplete tails, and middle-sized or even young examples frequently show this state as well. Regeneration often produces freaks, as many scientists have shown, and extra tails are sometimes added after an injury. Two tails are found rather frequently in lizards, but three-tailed examples, although occasionally seen, are decidedly rare.

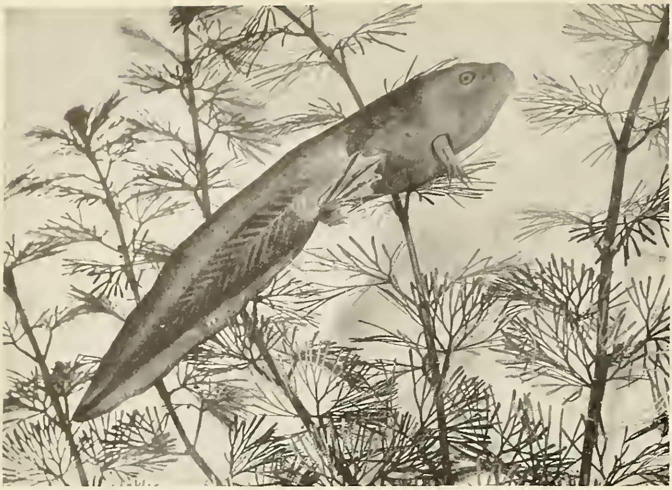
Amphibians have been divided into three main groups, the tailed and the tailless sections, and the section comprised of the little-known, wormlike cæcilians which we need not consider. The tailed amphibians do not undergo a complete change in outline between the young and adult stages, but are much the same in general appearance throughout their existence, whereas the tailless amphibians, named with reference to the adult anatomy, have a primary or tadpole stage in which the tail is present as in the other group and a secondary or adult stage in which the tail is lost. All degrees of transition between these two extremes may be seen in a carefully selected developmental series of our common frogs and toads. It seems appropriate at this point to call attention to the fact that in certain salamanders, particularly in some plethodontids, the base of the tail is constricted for loss at times of danger, thus serving the same protective purpose as the tails of the lizards mentioned above.

Fishes are specialized for aquatic life and pos-



Photograph by Raymond L. Ditmars

THE TURTLE'S TAIL
Tails are of little use to slow-moving creatures and most turtles have them reduced to mere stubs. The box turtle endeavors to protect its tail by turning it sideways under its shell


Photograph by M. C. Dickerson

THE BULLFROG TADPOLE
In its first stage of metamorphosis into a frog the tadpole possesses a long tail with a finlike border

sess flattened, rudder-like tails that aid in swimming as do similar tails in other groups. The fish-tail, although essentially constant in function and compression, is subjected to numerous variations in detail and outline. Therefore, the structure and appearance of the tail has been deemed of great importance in the classification of the group.

In the birds, the tail is formed internally by a short bony support, the pygostyle, and by the surrounding muscles, and externally by dermal elements, particularly feathers. It is in the feathers that the most obvious and interesting avian variation exists.

Perhaps in no group of animals have the tails become more specialized for purposes of ornamentation or display than in the birds, particularly in the males. In this regard, it is only necessary to mention such striking examples as the lyre bird, the bird of paradise, and the peacock. On the other hand, woodpeckers and chimney-swifts have developed the more practical habit of clinging to vertical surfaces and bracing themselves by means of their tail feathers, which in turn have become stiffened and thereby definitely modified for the purpose.

The wide variations shown by the tails of mammals are thoroughly interesting. For instance monkeys of the New World, belonging to the family *Cebidæ*, nearly all have prehensile or grasping tails, but monkeys of the Old World, curiously enough, have only ordinary, non-prehensile ones, which may, perhaps, be considered decorative, but which perform no useful arboreal or gymnastic duties.

Then, there is the very short tail of the "cottontail" rabbit, which is covered by thick, soft, white, downy fur, as the common name implies, and is conse-


PREPARING FOR THE LAND
In the second stage, the finlike border on the tail is absorbed and the legs assume more important functions

Photograph by M. C. Dickerson

FURTHER METAMORPHOSIS

The bullfrog has now grown serviceable legs and comes out on land. His tail, however, is not yet fully absorbed

Photograph by M. C. Dickerson

quently incapable of any monkey-like uses, but for all that it is still useful enough. Since the back and sides are brownish and much darker in color, this fluffy little ball is very conspicuous when the rabbit is running. Therefore, an enemy in pursuit of "bunny," be it man or beast, usually finds his attention fixed upon the "cottontail" rather than upon the prospective victim as a whole. This frequently results in the rabbit's escape, for when it suddenly ceases its zigzag run and as suddenly squats to hide the tail from view, the pursuer frequently finds himself completely baffled, for with the disappearance of the "white spot" the whole animal seems to disappear.

In contrast to the rabbit's type, the tail of the jumping mouse is sparsely haired and of an inconspicuous color. Moreover, instead of being short, and rounded, it is very elongate, measuring about twice the length of the body.

The flying squirrel has a large,flattened, hairy tail, which serves as a balancer in his soaring jumps from branch to branch and tree to tree, but the opossum has a long, hairless, prehensile tail that could not possibly aid its owner in the same manner. Instead, the opossum often grasps objects by winding its tail about them. This trait appears early in life, for each baby opossum thus clings tightly to "mamma" opossum's tail as she swings it over her back and goes for a quiet evening stroll; while later, in the adult, the entire weight of the body may be easily supported from some convenient limb by this remarkable appendage alone.

There is an old saying that "if you pick up a guinea pig by the tail, its eyes will drop out." Since the caudal appendage is so short,

Photograph by Herbert Lang

THE SALT MARSH FROG

The adult frog carries no external tail, but backwards from his hump is a true tail bone lying under the skin being a mere vestige, guinea pig eyes seem perfectly safe. How fortunate it is, however, that the guinea pig does not feel called upon to show its feelings in the same way as does the dog, for it would have to wag the whole end of its body energetically to express a happy emotional state.

Photograph by Julian A. Dimock

THE TARPON JUMPS WITH ITS TAIL

Tails are the chief organs of propulsion in fishes. The tarpon could not leave the water without the aid of the tremendous force exerted by the sculling of its tail

The muskrat and the beaver have much in common, for both of these rodents live in the vicinity of water, both are very fond of vegetable food, and both build more or less elaborate houses or dens for themselves, but when it comes to tails—the resemblances seemingly end. The muskrat's tail is flattened vertically along its length, and while it may serve as a rudder in swimming, it is too weak to be used as a beaver uses his. The beaver's tail, which is flattened crosswise into a broad, paddle-like appendage, has developed an unusually strong set of muscles, so that it may be maneuvered both easily and effectually. This tool is used particularly in swimming and in personal broadcasting when danger threatens. Loud danger signals are often sent out to fellow beavers by a vigorous slap of the alert one's tail on the surface of the water.

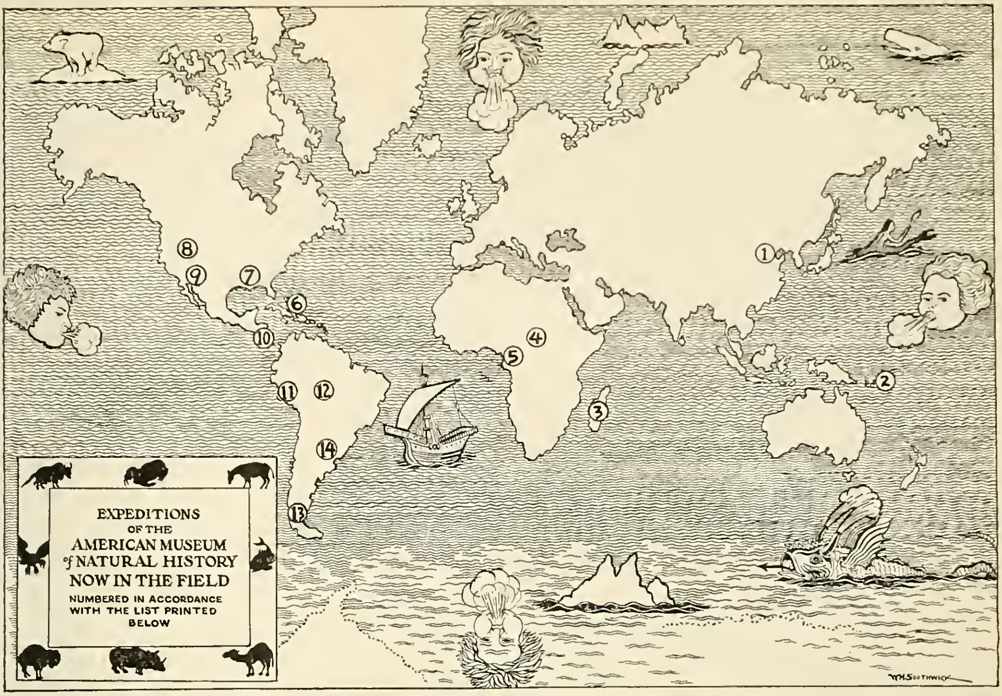
Photograph by J. H. Batty

OPOSSUMS' TAILS ARE SCALY

Even when the opossum feigns sleep, it will usually curl its tail about one's finger if picked up by that appendage. More commonly it serves as a cable by which to hang when gathering persimmons

In remarkable contrast to the types just discussed, the whale and the porpoise have fleshy, bilobed tails, which suggest the fins of fishes but are set cross-wise of the body rather than perpendicular to it. In addition, they lack the bony supporting rays. Like many fishes, both the whale and the porpoise are specialized for life in the open seas.

Again, Nature has been especially generous with the kangaroo, in so far as his tail is concerned, whereas it has decidedly slighted the world's champion heavy-weights, the elephant, the rhinoceros, and the hippopotamus. So strong is the kangaroo's large tail that in times of danger it may support the entire weight of the body while the animal kicks viciously with its hind feet. At other times it is regularly used as a prop in sitting or as a spring or propelling force in locomotion. Exactly contrary to this condition, the elephant's most useful appendage was placed in front of the body instead of behind, while the unlucky hippopotamus was cheated at both ends.



1. Central Asiatic Expeditions; 2. Whitney, South Sea, Solomon Islands, for birds, mammals, and fossils: 3. Madagascar, for birds, mammals, and fossils; 4. Chapin, Congo, for birds; 5. Columbia University-American Museum, to Africa, for anatomical study; 6. Klingel, West Indies and Central America, for lizard studies; 7. National Zoological Park-American Museum, Georgia, for reptiles and amphibians; Archbold, Georgia, for mammals; 8. Predatory mammal control field investigations; 9. Frick-Rak, Southern California, for fossils; 10. Chapman, Barro Colorado, for bird study; Lutz, Barro Colorado, for insect study; 11. Frick-Blick, Ecuador, for fossils; 12. Ollala Brothers, Brazil, for birds and mammals; 13. Scarritt, Patagonia, for fossil mammals; 14. Naumburg-Kaempfer, Southeastern Brazil, for birds

AMERICAN MUSEUM EXPEDITIONS AND NOTES

EDITED BY A. KATHERINE BERGER

It is the purpose of this department to keep readers of NATURAL HISTORY *informed as to the latest news of the Museum expeditions in the field at the time the magazine goes to press. In many instances, however, the sources of information are so distant that it is not possible to include up-to-date data*

THE COLUMBIA UNIVERSITY–AMERICAN MUSEUM ANATOMICAL EXPEDITION.—Mr. Henry C. Raven, leader of the Columbia University and American Museum Expedition to Equatorial Africa, cables that he intends to sail homeward from the French Cameroun on November 15, with his collections. The departments of anatomy and comparative anatomy of Columbia University and the American Museum are eagerly awaiting his return.

DR. DUDLEY J. MORTON, research associate in comparative and human anatomy, who is associate professor of anatomy at the College of Physicians and Surgeons, will report at the annual meeting of the American Association for the Advancement of Science on some of the human footprints which were collected for him by the Columbia University and American Museum Expedition. Dr. William K. Gregory will give a general account of this expedition at the same meeting.

AFTER several years' study of human prehistory in France and China, Dr. George E. Brewer, research associate in somatic anthropology, has returned to the American Museum.

THE SCARRITT-PATAGONIAN EXPEDITION.—Readers of NATURAL HISTORY will undoubtedly be interested in extracts from a letter received from Dr. George Gaylord Simpson dated September 27, 1930, and mailed from Comodoro Rivadavia, Argentina.

We are just entering the gulf of my patron saint, Golfo San Jorge, on the [Argentine] government oil tanker "Ministro Frers." We were due at Comodoro Rivadavia several hours ago, but won't arrive until tomorrow—thanks to violent winds and generally murky weather for the last two days. The empty tanker has done everything but fly, but for a modern miracle I haven't been seasick. Our car and all equipment are on board, happily did not carry away although on deck, and in a few days things can really start.

The revolution was quite a good show and I would have enjoyed it thoroughly if I hadn't been so mad at the delay. On the 6th, just before the Government House capitulated, there was a good deal of street fighting as well as plain and fancy murder on the part of the Irigoyenist forces. For instance, I was standing on a street corner with a small group of unarmed civilians when a detachment of the mounted Escuadrón de Seguridad opened fire on us without warning and then charged us. The man next me was killed, but I escaped and found shelter in a clockshop with steel shutters. I left there, only to have to duck again when horsemen began cleaning up Rivadavia Street with sabres. Eventually I got back to the Avenida de Mayo, only to run right into the most bloody engagement of the day when the Plaza de Congress and upper end of the Avenida were swept by machine guns and field artillery. I managed to escape this unscathed and spent about an hour inside a steel-shuttered café, while the battle raged just outside. I got out in time to see the white flag go up on the Casa Rosada (Government House) and the mad rush of the people to sack the building, the triumphant arrival of Generals Uribum and Justo, leaders of the revolution, and the insane joy of the populace, far into the night.

Monday an enormous crowd, estimated at 350,000, gathered to hear the new government sworn in at the Plaza de Mayo. Four hours later the plaza, still resplendent with lights and flags, was deserted except for dead and wounded, guerillas creeping along and dodging from doorway to doorway, and ambulances dashing through the line of fire to pick up the casualties. This plaza was cleaned out with machine guns, and on the other side of the Casa Rosada, on the Plaza Colón, field guns shelled the new Post Office and the Custom House. I stuck around here 'till the firing died down, but going home, thinking all the excitement over, I had the scare of my life. Two of the numerous guerillas who were looting and murdering all over the city grabbed me, poked rifles into the pit of my stomach, and started interrogating me in rapid gutter Spanish. They were excited and hard cases and I thought my hour had struck, but I talked, explained, and argued my way out of it. I have never before, and probably never will again, talk such fluent Spanish.

After all this and much more, life seems rather dull now. After the revolution it was chiefly a matter of going the rounds every day, arguing, swearing, and pulling strings until finally things came our way and here I am nearly to Comodoro Rivadavia. It is still pretty cold down here, but warm enough to work, and I need hardly add how keen I am to be up and at it at last.

(Signed) George Gaylord Simpson

Predatory Mammal Control.—At the annual meeting of the American Association of Mammals held in May of this year a special committee was appointed to ascertain the facts relating to the control of predatory mammals and to coöperate with the United States Biological Survey in a study of the various problems involved. Mr. George Goodwin and Mr. T. D. Carter left New York late in October to carry on field investigations in this connection.

The control policy of the Survey in the field has involved a very extensive use of poison, and it is the belief of many competent naturalists that such a widespread use of poison threatens the very existence of our predatory mammals. Mr. H. E. Anthony of the American Museum was appointed chairman of this committee and has established relations with the Biological Survey and with other institutions and interests concerned in this crisis.

Mr. Goodwin will travel with a field investigator from the Biological Survey and the party will conduct a joint investigation in the states of Idaho and Utah. The special committee will also have representatives acting jointly with the representatives from the Biological Survey in the states of California, Arizona, New Mexico, Texas, and possibly Nevada and Oregon.

Mr. Carter has a roving commission to interview trappers and raw fur dealers in an effort to learn just how far the fur-bearing mammals are imperiled by present-day methods of control.

The New York Zoological Society is coöperating in this investigation, and is represented jointly with the Museum by Mr. Goodwin. Other institutions which have affiliated themselves with the work of the Commission are the California Fish and Game Commission and the University of Arizona.

The Vernay-Lang Kalahari Expedition.—Early in October Mr. Arthur S. Vernay returned to New York, having brought to a successful conclusion his extensive expedition in Angola and the Kalahari.

This was an undertaking of great importance, and the fact that a party of 14 white men and 16 natives was able to cross the Kalahari, proceed to Ngamiland and thence to Livingstone, a period of three months and a half of travel, without accident or sickness speaks highly of Mr. Vernay's powers of organization and of the efficiency of his personnel. This is the first time that zoological collecting on such a thorough scale has been carried on in this part of Africa, and over part of the itinerary no collecting at all had been done previously.

The expedition started from Gaberones on March 17, 1929, and the work was not completed until the summer of 1930. Mr. Vernay planned the project as a joint expedition for the Field Museum of Natural History, the British Museum of Natural History, and the American Museum of Natural History, and the large collection he brought back will be of the greatest value to these institutions.

The outstanding specimens collected include groups of the following species, some of which are exceedingly rare, blesbok, black wildebeeste, red hartebeeste, gemsbok, lechwe, springbok, steinbok and sassaby, while among the mammals taken for the study series are such species as giraffe, Burchell's zebra, eland, sable, etc. In addition there are, in round numbers, 500 smaller mammals, 700 birds, 200 fishes, 5,000 insects, and 500 specimens of lower invertebrates.

It is hoped that in a later number of Natural History Mr. Vernay will write an article on the Kalahari Expedition, telling some of the many interesting incidents which must have characterized the field work.

A STUDY OF RACE MIXTURES IN HAWAII.—The Universtiy of Hawaii, aided by a Rockefeller Grant, has undertaken a noteworthy project in the Territory of Hawaii. The unique racial situation in Hawaii, where Europeans, Americans, Chinese, Japanese, Filipinos, and Porto Ricans have invaded within the last century and where these people have mixed with the Hawaiians and each other, offers exceptional opportunities for investigations in the study of race mixtures.

Dr. H. L. Shapiro of the American Museum, which is coöperating with the University of Hawaii, has just returned from a summer spent in Hawaii organizing an investigation of the Chinese-Hawaiian crosses. He was accompanied by Mr. W. A. Lessa, who is assisting him. Doctor Shapiro reports that anthropological, psychological, and sociological studies are under way on this group. Studies in blood grouping and basal metabolism are also in progress.

THE GULF OF GUINEA EXPEDITION.—During the ornithological collecting of Mr. and Mrs. José G. Correia at Fernando Po, in the Gulf of Guinea, a project supported for the American Museum of Natural History by the late Mr. S. Brinckerhoff Thorne, the field workers received many courtesies from officials of the Spanish Government as well as from civilian residents.

As an expression of appreciation, on his own behalf and that of the American Museum, Mr. Correia presented to the Colonial Government a series of duplicate specimens. These were subsequently forwarded to Madrid and, since the return of Mr. and Mrs. Correia to the United States, the transaction has been noted as follows in the *Boletin Oficial de los Territorios Españoles del Golfo de Guinea* for August 15, 1930:

ROYAL ORDER NO. 451.

The Director of the National Museum of Natural Sciences, in an official communication, addresses the Government of Morocco and the Colonies as follows:

I have the honor to acknowledge receipt of a collection of birds from Fernando Po, the gift of Don José G. Correia, which the Government forwarded to us on April 5. Because of the scientific value of the species comprised in this collection, and the beautiful preparation of the specimens, the consignment greatly enriches our ornithological material from the Gulf of Guinea region. It seems fitting, therefore, to express appreciation through royal order to the generous donor. In view of this, His Majesty the King has graciously directed that thanks be extended to Don José G. Correia for a gift which has so enriched the collections of the National Museum of Natural Sciences.

By royal command I beg to inform Your Excellency and other interested persons of this action.

God preserve Your Excellency.

DIEGO SAAVEDRA
Director General.

MADRID, JULY 10, 1930.

A FOSSIL REPTILE FROM ARIZONA.—Mr. Barnum Brown, assisted by Mr. L. I. Price of the Oklahoma University, spent a very successful summer in the Triassic beds of the Little Colorado River, chiefly in the vicinity of Cameron, Arizona.

This expedition went out primarily to secure missing parts of a small reptile discovered in November, 1929, which is considered to be the probable ancestor of dinosaurs and phytosaurs. It is thought that the pieces secured are sufficient for a restoration of this rare creature.

A new fossil horizon was discovered in the Triassic beds, and the geologic data obtained by Mr. Brown indicates a three-fold division of the Triassic in America as it is known in Germany.

Another important discovery near Cameron was an ancient house site where all non-perishable contents were preserved, including vessels of several different designs and decorations, the character of which indicates one of the early ancient Pueblo stages.

AN EXPEDITION TO THE WEST INDIES AND CENTRAL AMERICA.—The yawl "Basilisk," built especially for an American Museum expedition, left Baltimore in October for the southern Bahamas on the first leg of a voyage which it is expected will take a year and a half. The "Basilisk" is almost an exact model of the famous "Spray" in which Captain Joshua Slocum sailed alone around the world in the early '90's.

The expedition, under the leadership of Mr. Gilbert C. Klingel, is planning to study the life-histories of lizards and especially the organization of lizard colonies in the American tropics. Mr. Klingel will be assisted by W. Wallace Coleman, a Baltimore naturalist, and by W. G. Hassler of the Museum staff.

The "Basilisk" is apparently the first vessel ever constructed for a museum expedition. Although only fifty feet over all it is well equipped with a dark room and other aids for laboratory work. The name chosen for it is that of a Central American lizard which exhibits great agility in running over the surface of the water. Further notice of the expedition, which is sponsored by both the Maryland Natural History Society and the American Museum of Natural History, will appear in the next number of NATURAL HISTORY.

MAMMALS FROM THE SOUTH.—Mr. Richard Archbold is spending the autumn in southern Georgia where he is collecting mammals for the American Museum.

NOTES

HARRY PAYNE WHITNEY

IN the death of Mr. Harry Payne Whitney, in his fifty-eighth year, the American Museum has lost a member of its class of Benefactors, and the patron of one of the most extensive scientific projects ever undertaken by the institution.

Mr. Whitney's interest in the American Museum of Natural History may be said, in a sense, to have been inherited from his father, the late William C. Whitney, who for many years supported the researches of President Henry Fairfield Osborn on the evolution of the horse. The son's munificent aid was given more especially to the department of birds, to be devoted particularly to that branch of ornithology concerned with birds of the ocean and with those inhabiting remote islands, such as the far-flung archipelagoes of the Pacific. In the spring of 1920 Mr. Whitney gave funds for field work which has since been uninterrupted, and which has enabled the Museum to maintain a corps of naturalists and a well equipped exploring schooner, the "France." During the course of ten years the field party has worked at more than five hundred islands in the south Pacific Ocean. At present writing the vessel is en route from New Guinea to Ponapé in the Japanese Mandate group.

Such complexes of remote islands represent one of the last great fields for zoological exploration. Mr. Whitney became so much impressed with the discoveries of the Whitney South Sea Expedition and with its opportunities for scientific education, that he recently made possible the construction of a new wing of the Museum designed to house the department of birds, and including special provision for exhibiting the island and oceanic birds of all the world. Plans have also been made in this building for a genetic study of birds in modern, well-equipped laboratories and aviaries.

The first step toward the erection of this new wing of the Museum, to be known as the Whitney Memorial Hall and to face Central Park just north of the Roosevelt Memorial, was Mr. Whitney's gift of $750,000, given on condition that the City of New York contribute an equal amount. The city promptly fulfilled its part of the transaction. The plans were subsequently drawn and construction is about to begin.

To an extraordinary degree Mr. Whitney was interested in the new unit of the Museum, and also in the publications and many-sided researches for which he was in so large a measure responsible. While it is hoped that it may still be possible to carry out all of his cherished plans, it is greatly to be regretted that he might not have lived to see them further advanced.

WILLIAM DILLER MATTHEW

ON September 24, 1930, the many friends of Dr. William Diller Matthew learned with great sorrow that he had succumbed to the serious illness which he had been fighting bravely for several months.

Doctor Matthew was born in St. John, New Brunswick, February 19, 1871, his father's family being descendants of the Royalists who settled there at the time of the American Revolution. His mother was descended from American Revolutionary ancestors. His father, Dr. George F. Matthew, was a well-known palæontologist and geologist, an amateur in the best sense, who amassed a great collection of Palæozoic plants, invertebrates and batrachian footprints from the region of New Brunswick and contributed important papers on these and kindred subjects.

William, the eldest of a large family, early absorbed the spirit and viewpoint of the natural sciences from his father and came as a graduate student to Columbia University with an exceptional endowment in these lines. He studied geology, mineralogy, and metallurgy under Professors Eggleston, Kemp, and Moses; his earlier papers, beginning in 1892, dealt with a crystallographic study of topaz from Japan, the antennæ and other appendages of trilobites, the intrusive and effusive rocks near New Brunswick, and similar topics. All his subsequent work in vertebrate palæontology was based upon this solid training in geology. After taking Professor Osborn's courses in vertebrate zoölogy and palæontology, he obtained his doctorate in 1895 and was called to the American Museum of Natural History as assistant in the department of vertebrate palæontology.

He took a great part in the field and laboratory work of the department, at first under the immediate direction of Dr. J. L. Wortman, later as assistant curator, curator, and finally as curator-in-chief of the division of geology, mineralogy and palæontology. It was most fortunate for the Museum that from the first he displayed a passionate ardor for keeping the records straight. He had an almost religious veneration for every specimen, no matter how small or unimportant in appearance, of the tens of thousands that passed through his hands, not because of sentimentality but because he was constantly seeing the value and meaning even of small fragments which had been carefully recorded as to precise geologic level and locality. He never wearied of insisting upon the value of facts as compared with theories; he once said that the skeleton of *Phenacodus* was of incomparably greater value than all the hypotheses that had been based upon it.

He took a keen interest in the problems that were constantly being raised in the attempts to mount fossil skeletons in lifelike poses and that were to be solved only by carefully correlated studies on the postures and skeletons of living animals. During the years before 1905, while the skeleton of the huge *Brontosaurus* was being removed from the matrix and restored and mounted by Adam Hermann and his assistants, Doctor Matthew studied the problems involved in the reconstruction and mounting. Before the limbs and girdles were mounted, he and Walter Granger dissected an alligator, marked the areas of origin and insertion of the limb muscles on the girdles and limb bones, and then identified as far as possible the corresponding areas on the bones of the *Brontosaurus;* finally, by means of scale drawings and paper strips representing the muscles, they endeavored to determine the course and direction of the principal muscle masses in so far as they would influence the posture of the limbs and girdles, especially the angulation of the elbows and knees. This was apparently the first application of the data of comparative myology to the mounting of an extinct animal and the studies that Matthew and Granger made at this time led eventually to further developments of these subjects of comparative myology and osteology by other workers in the Museum and elsewhere.

Photograph by Julian P. Scott

WILLIAM DILLER MATTHEW
(1871–1930)

Soon after Doctor Matthew's coming to the American Museum of Natural History in 1895, he was sent by Professor Osborn to Philadelphia to catalogue, pack, and ship to New York the great collections of Prof. E. D. Cope, which had been purchased by the Museum. In this way Matthew came to know and admire Professor Cope and began the detailed task of checking Cope's identifications and revising his classifications, which was to occupy him, along with many other matters, for the next thirty-odd years.

The two hundred and thirty-odd entries in Doctor Matthew's list of scientific publications cover a multitude of topics relating to the evolution of mammals and other vertebrates, as set forth in broadly conceived comparative studies, chiefly on the skeletons of recent and fossil mammals. It may be said in brief that Evolution was the one theme about which he was always writing, whether he was dealing immediately with the description of newly discovered fossils or comparing the fossil faunas of one region with another, or tracing the routes by which races that first appeared in the northern continents found their way south into tropical and southern countries and often survived there long after the other descendants of the original stock had been exterminated in the primal home of the race.

Scrupulous intellectual honesty was one of his outstanding characteristics, and if the evidence had been adverse to the general theory of evolution he would have been the first to have tried and tested it and then to have renounced Evolution as a colossal error. On the contrary, the most intimate and prolonged study of tens of thousands ot fossil specimens led him to write the following striking passage:

"Broadly speaking, the evolution of the horse in the sense of a regular progression by gradual stages from small primitive four-toed ancestors to the large, highly specialized, one-toed horse, appears not as a theory but a fact of record. It is equally a fact of record that the tapir and rhinoceros are derived from the same primitive stock through a similar series of progressive stages. Widely different in appearance and habits today, they have diverged from a common ancestral stock.

"If, therefore, we turn to the record of geologic history to answer the question whether as a matter of fact the diverse types of existing animals did evolve from common primitive stocks, or whether the various races have remained unchanged since they were created, the answer is perfectly definite and categorical. Whenever the evidence is sufficient, as it is in this instance, it proves the theory to be a fact of record. When the evidence is insufficient for proof, it fits in with the evolution theory, so far as it goes. It is in comparatively few instances out of the millions of existing species that the categorical proof of their evolution is at hand. This will always be true, although the number of proofs and the completeness of the evidence grows year by year.

"It is asserted by some opponents of evolution that 'the evidence is all circumstantial.' Probably what they mean is the anatomical evidence —which, moreover, they totally misconceive in saying that it is 'a matter of resemblances.' The fossil evidence, however, is not circumstantial; it is the direct testimony of the record itself, far better than 'eye-witness testimony,' for eye-witnesses may easily be mistaken, and often are, and there is no way to discover and correct their mistakes save the imperfect and uncertain methods of collation and cross-examination. As for the evidence of comparative anatomy, while it is indirect, and may be compared to circumstantial evidence, its weight lies not at all in 'resemblances' but in identity of structural plan underlying a wide *diversity* of appearance and habits. We regard horse and man as related, not because they resemble each other, for they are utterly diverse in appearance, but because in spite of this diversity the anatomist finds that their underlying structure is fundamentally the same."[1]

In the course of his work for the Museum Doctor Matthew took a leading part in many expeditions in the fossil fields of Wyoming, Colorado, New Mexico, South Dakota, Nebraska, Florida, Mongolia, Java, etc. He studied in the principal museums of England and the Continent, in India, China and South America.

[1]"The Evolution of the Horse. A Record and Its Interpretation." Quart. Rev. Biol., Vol. 1, No. 2, April, 1926, p. 176.

Not the least of his services was his long series of illuminating articles in Natural History on palæontological topics and his admirable handbooks and guide leaflets on the Hall of Fossil Mammals, on Dinosaurs, on The Evolution of the Horse, and many others.

In recognition of his distinguished contributions to science he was elected to fellowship in many learned societies both at home and abroad. He served as president of the Society of Mammalogists in 1926 and as president of the Palæontological Society in 1929. He was also a fellow of the Royal Society of England.

In 1927, after thirty-two years of service in the American Museum, he resigned his position as curator in order to take up new duties as professor of palæontology and curator of the Palæontological Museum of the University of California. His courses in palæontology, notwithstanding their difficult character, were attended by many hundreds of students, and he was thus fast realizing his ambition to train a new generation of palæontologists eager to carry on the work of exploration and research.

Undoubtedly his quite untimely death inflicts a severe loss on the cause of science and enlightenment. But he left to the world a huge legacy of organized knowledge; he opened broad fields for further development, and he trained and inspired many others to carry on his work.

—William King Gregory

ASTRONOMY

Motion Pictures of the Moon shown by Dr. John Q. Stewart of Princeton and his associate Mr. R. F. Arnott, were the main feature of the meeting of the Amateur Astronomers Association held November 5. These photographs were taken in the observatories at Princeton and Mt. Wilson, and show the sun rising and setting on the craters of the moon. Doctor Stewart also talked on "Some Restrictions on the Application of the Rocket Principle to Interplanetary Travel." On November 11 Dr. Giorgio Abetti, director of the Royal Observatory, Arcetri, Italy, spoke on "Galileo and Astronomy in Florence." This was of particular interest because the Arcetri Observatory was dedicated to the memory of Galileo, who lived his last years in the immediate neighborhood of its site.

On December 3 Dr. Clyde Fisher will give an illustrated talk on "An Astronomer's Rambles in Iceland and Lapland." This is reminiscent of Doctor Fisher's recent trip to these countries.

On December 17 Mr. Wallace J. Eckert of the astronomy department, Columbia University, will discuss "The Orbit of Eros as an Astronomical Yardstick." This small asteroid, whose diameter is less than the length of Manhattan Island, will approach the earth during this coming winter more nearly than any other body in the planetary system, with the exception of the moon. By means of observations made at this time, astronomers hope to be able to determine more accurately the distances within the solar system.

Radio broadcasting will be resumed by the Amateur Astronomers' Association on Saturday, December 6 from 5:30 to 5:45 P.M. over station W O R and will be conducted weekly at the same time.

BIRDS

TWO NEW BIRD GROUPS were officially opened on the evening of November 6 immediately after a lecture by Dr. Frank M. Chapman to the members of the American Museum on "My Tropical Air Castle." One of the groups, depicting the bird-life of the Higher Andes, shows a view in the Paramo Zone from near Mt. Aconcagua, Argentina. The studies for this group were made by Doctor Chapman and Frederic C. Walcott in February, 1924.

The second group, "Bird Life of the Pampas," is the gift of Mrs. Anna E. Erickson, and is dedicated to the memory of William Henry Hudson, who passed part of his boyhood near Lake Chascomus, a bit of which is reproduced in this group. Of this region Hudson wrote in *Far Away and Long Ago*, and here he laid the scene of his story *El Ombu*. The birds of this faunal group are characteristic species of the South Temperate Zone. The studies and collections for it were also made by Doctor Chapman and Frederic C. Walcott in March, 1924.

RESEARCH IN THE TROPICS.—Dr. Frank M. Chapman will return to the Canal Zone early in December to carry on further studies at the Barro Colorado Biological Station.

CONSERVATION

THE CONSERVATION OF WHALES.—Apropos of the statement of principles and rules submitted in the form of a draft convention to the Economic Committee of the League of Nations, by the representatives of the eight nationalities who met in Berlin last April, A. Brazier Howell in a letter addressed to the members of the Council for the Conservation of Whales says:

> At the June meeting of the Economic Committee of the League it was recommended that this draft convention should be transmitted to the several governments concerned for their consideration and approval. This document (Official No. C.353. M.146, 1930 II., Series of League of Nations publications) has now been received by the State Department of the United States Government.
>
> This "draft convention for the regulation of whaling" submitted to the Council of the League of Nations by its Economic Committee contains such details, previously recommended by your own council, as: (a) total protection of all species of right whales; (b) protection of calves and nursing females; (c) fullest possible use of whale carcases; (d) remuneration of gunners and crews of whaling boats to depend upon size, species, value and yield of oil of whales taken and not merely on number of whales secured; (e) a license or certificate of notification from all vessels engaged in whaling; and (f) the establishment of a statistical organization to collect and distribute statistics on whaling.
>
> The action of the League of Nations in behalf of conservation measures for the maintenance of the supply of whales and the exploitation of the riches of the sea is correlated with the work on codification of international law. The State Department of the United States informed the League of Nations some time since that "an international conference is desirable to consider the problem of conserving the whale." But the present opinion of several governments, including the United States, is now to the effect that this subject requires further international regulation before inclusion in the Codification Conference.
>
> It should now be the purpose of your Council to contribute as much as feasible toward the attainment of such international regulation, especially as concerns the United States.

EDUCATION

ADULT EDUCATION.—The department of public education of the American Museum has inaugurated a lecture series for adults for the fall season of 1930. It is called the "Know Your Museum Series," is limited in number to twenty-five, and is open to Museum members only. As suggested by the title, the course has been planned to give members a comprehensive knowledge of the exhibition halls. A brief background for each subject will be presented preceding the visit to the Hall. The lectures already held have proved most popular.

For December and January the program will be as follows:

December 5,	Reptile and Amphibian Hall, Mr. William Carr
December 12,	Insect Hall, Mrs. Grace Ramsey
December 19,	Geology Hall, Mr. Sydney Heilprin
January 9,	Dinosaur Hall and Reptiles of the World, Dr. Charles Mook
January 16,	The Hall of the Age of Mammals, Mr. Walter Granger
January 23,	The Hall of the Age of Man, Miss Marcelle Roigneau

RESTAURANT SERVICE

FOR THE CONVENIENCE OF AMERICAN MUSEUM MEMBERS and their friends, the American Museum restaurant will remain open from 6 to 8 o'clock on the evenings of the Members' lectures, when a one-dollar dinner will be served.

HONORS

THE DEPARTMENT OF STATE has appointed Dr. Frank M. Chapman a member of the National Council of International Coöperation, which, at the request of the Governing Board of the Pan American Union, has been formed to collaborate with the International American Central Council.

DR. ROBERT CUSHMAN MURPHY, curator of Oceanic birds, has been appointed a contributing editor of the *Geographical Review*, the leading American quarterly in its field. The staff of contributing editors is made up of about ten geographers, the present list including Professors Robert DeC. Ward, Ellsworth Huntington, Douglas W. Johnson, and Alan G. Ogilvie.

LIBRARY ACCESSIONS

THE AMERICAN MUSEUM LIBRARY has again benefited by the generosity of friends. Captain T. E. Donne, C.M.G., of London, has presented four of his well-known books on New Zealand, *The Maori Past and Present*, *The Game Animals of New Zealand*, *Red Deer Stalking in New Zealand*, *Rod Fishing in New Zealand Waters*, each with a gracious inscription by the author. Mr. William K. Vanderbilt has sent two copies of the "Bulletin of the Vanderbilt Museum," Volume II, constituting a monograph by Lee Boone on the Stomatopoda and Brachyura and forming part of the *Scientific Results of the Cruises of the Yachts 'Eagle' and 'Ara,' 1921–1928, William K. Vanderbilt, Commanding.* In response to urgent requests the Library has for some time been endeavoring to procure a copy of *Histoire Naturelle des Insectes Coleoptères* by Francis L. de Laporte, Le Comte de Castelnau, and takes pleasure in reporting that this rather rare work, in the colored edition, is now on our shelves, thanks to the always helpful efforts of a European dealer. Two copies of Dr. Bruno Oetteking's report on the "Craniology of the North Pacific Coast," forming Volume XI Part I of the *Memoirs of the Jesup North Pacific Expedition*, have also been received.

ASSISTANCE FOR UNEMPLOYED

FOR THE RELIEF OF THE UNEMPLOYED.—In view of the critical situation arising from the unemployment in New York City, the American Museum is coöperating with Mayor Walker's official committee for the relief of unemployment, and has pledged one per cent of the amount of salaries received from the city toward meeting the present emergency.

OTHER MUSEUMS

A NEW IDEA IN EXHIBITION GROUPS.—At the Field Museum of Natural History there is now on exhibition what, so far as is known, is the first group restoration of extinct mammals showing them as they must have in lived North America millions of years ago. This group, a life-size restoration of a species of small three-toed horse, *Mesohippus*, is a gift to the Museum from Ernest R. Graham, a member of the board of trustees, who is sponsoring a comprehensive series depicting scenes and types of life which have existed on the earth as far back as one and one-half million years.

The group was designed and modeled by Frederick Blaschke, sculptor, of Cold Spring-on-Hudson, New York, who was responsible also for the Neanderthal man group opened in Graham Hall last year. The models are based upon a comparative study of fossil skeletons of this animal, in relation to the anatomy of modern animals. They have been faithfully prepared after profound study and consultation with a number of leading authorities on extinct animals.

Copyright, Field Museum

A NEW GROUP AT THE FIELD MUSEUM, CHICAGO

A new development in group presentation is this life-size restoration of a species of small three-toed horse, *Mesohippus*

This is the first time that an attempt has been made to restore extinct animals with the hair superimposed on the model. Mr. Blaschke secured the skin and hair of white horses and appropriately gave it the color he desired, also the characteristic whorls or folding of the skin.

The painted background, a reproduction of a scene in the Black Hills of South Dakota where these animals were fairly common in their day, is the work of Charles A. Corwin, Museum staff artist. Messrs. Blaschke and Corwin had the scientific advice and supervision of the curator and other members of the staff of the department of geology of Field Museum during creation of the group.

Valuable assistance and coöperation were also given by Prof. Henry Fairfield Osborn, president of the American Museum, and the late Prof. William Diller Matthew.

RADIO BROADCASTING

AMERICAN MUSEUM BROADCASTING.—Every Sunday afternoon at 3:45 during the winter months a member of the American Museum scientific staff is giving a talk on a natural history subject over Station WOR. On the first Sunday of each month the New York *Herald-Tribune* gives a full-page spread in its rotogravure section correlated with the talk of that day.

SCIENCE OF MAN

TECHNIQUES AND ART FORMS OF THE OMAHA INDIANS.—Dr. Margaret Mead has just brought back a small representative collection from the Omaha Indians in Nebraska. The most interesting aspect of this collection is the variety of techniques and art forms that are known to the Omaha. It includes the traditional porcupine quillwork used by the American Indian before the importation of beads, but these pieces of porcupine quillwork are decorated with fringes made from small squares of tin beaten into cylindrical form and tufted with dyed chicken feathers. There is also a vest of hide embroidered in porcupine quillwork with designs of flags and horses, both contributions from the white man.

The Omaha Indians replaced their porcupine quillwork with ribbon work more than with beadwork. The collection includes cradle-board bands and bands of ribbon work appliqué used on the borders of broadcloth dancing robes. This ribbon work, although the designs are largely suggestive of patterns formerly in use by the Eastern Woodlands Indians, also suggests the influence of ecclesiastical vestments.

The Omaha have always traded extensively with the Siouan tribes, and the collection includes parfleches, a buffalo skin shirt and tobacco pouch obtained from the Sioux more than a generation ago and carefully cherished by the Omaha.

There is also a representative series of moccasins ranging from the typical black moccasin of the old Omaha to modern forms made from buckskin purchased in the city stores, embroidered with modern glass beads and dyed with yellow ocher purchased from the drug-store.

About twenty-five years ago the department of anthropology made a survey of the bead and quill art of the whole area west of the Mississippi. The resulting collections form the exhibit now in our halls of which so much use is made by students of design. Collections similar to this one from the Omaha, made twenty-five years after, are of special interest in showing the historical development of this aboriginal art under modern conditions.

RECONNAISSANCE OF EUROPEAN ANTHROPOLOGICAL MUSEUMS.—Curator and Mrs. N. C. Nelson, of the anthropology department of the American Museum returned early in October from a lengthy vacation trip to Europe. This journey involved two unusually long ocean voyages, one of them by way of Iceland and the two together occupying no less than thirty-one days' residence on shipboard.

Aside from occasional pleasure excursions in different places and visits to a number of famous one-time royal palaces and castles, most of Mr. Nelson's time was spent in museums of distinctly anthropological character. Such museums were visited, for example, at Reykjavik, in Iceland; Trondjem, Bergen, Lillehammer (outdoor museum), and Oslo, in Norway; Göteborg and Stockholm, in Sweden; Copenhagen, Lyngby (outdoor museum), and Kolding, in Denmark; Berlin and Hamburg, in Germany; Brunn and Prague, in Czechoslovakia; and, finally, Vienna, in Austria. Several other cities, like Dresden and Munich, both the possessors of famous museums, were passed through, but were not actually visited for lack of time.

The purpose of these visits was threefold; to see, primarily, what sort of archæological material was being recovered in the different localities, to observe exhibition methods in vogue, and to learn to what extent it was possible to obtain typical specimens, by purchase or otherwise, with which to fill out gaps in the American Museum exhibition series. Mr. Nelson also inspected a number of private collections offered for sale, but found none suitable for acquisition. The best he could do—it being the time of year when nearly every responsible museum man was away on vacation—was to make preliminary arrangements for a number of possible exchanges. Incidentally, two famous Paleolithic sites were visited in Czechoslovakia, where excavation was observed in progress.

The general impression retained by Mr. Nelson of European museums is both favorable and unfavorable. He thinks that as far as building facilities are concerned Europe as a whole is at a disadvantage as compared with America, in that too often valuable collections are either housed in castles and other old buildings not adapted for exhibition purposes, or they are displayed in modern structures with gorgeously finished palace-like interiors that positively detract from the specimens one wishes to see. There are, however, several exceptions to these extremes.

When it comes to organization and standards of work, Europeans are obviously far and away ahead of us, at least in matters archæological. Thus, in some countries research is so thoroughly planned that they have separate expert curators and field workers for every outstanding culture stage from the earliest beginnings to the present time—Old Stone, New Stone, Bronze, Iron, Medieval, and Modern. The result is conspicuously reflected in instructive exhibits, which are arranged chronologically in a succession of small halls, covering the whole history of local culture so far as known.

ALBERT GÜNTHER

THE CENTENARY OF ALBERT GÜNTHER.—October 3, 1930, marked the centenary of the birth of the great ichthyologist Albert Günther (1830–1914). To commemorate the event, the *Annals and Magazine of Natural History* (London) published a complete bibliography of his writings, with a list of his degrees, honors, etc., in a special number of the magazine.

The bibliography reveals Günther's amazing scientific productivity. He published more than 600 papers, and 15 complete volumes, on fishes, reptiles, and other vertebrates; besides several guide and other museum books, and numerous reports as the Keeper of Zoology at the British Museum.

Günther's most important work is the great *Catalogue of the Fishes in the British Museum*, eight volumes. Although now in large part superseded by later works, it is still a basic reference work in ichthyology. Another noted book of his is the splendid quarto volume on the deep-sea fishes of the famous "Challenger" Expedition. This work gave the world the first extended account of the strange fish life in the great depths of the ocean. He also published a noteworthy popular book on fishes.

It was from the writings of Günther that Charles Darwin derived most of those curious or little-known facts about fishes cited in the *Origin of Species* and his other books on evolution.

—L. HUSSAKOF.

MEETINGS OF SOCIETIES

THE AMERICAN ORNITHOLOGISTS UNION held its annual meeting at Salem, October 20–24. Members of the bird department of the American Museum read papers on the following subjects:

"The Boreal Element in the West Indian Avifauna," "The Turkey Buzzard's Sense of Smell," by Frank M. Chapman.

"Conditions Controlling the Distribution of Sea-birds on the Pacific Coast of South America," by Robert Cushman Murphy.

"Field Notes from Peru," by John T. Zimmer.

NEW PUBLICATIONS

The Book of Bird Life: A Study of Birds in their Haunt; with Photographs by the Author. By Arthur A. Allen, Professor of Ornithology at Cornell University. D. Van Nostrand Company, Inc. New York. 8vo; xix+426 pp.; 275 ills.

For years Doctor Allen, as editor of the school department of *Bird Lore*, has been contributing to that magazine a series of articles based on his wide experience as a student and teacher. Many of these with others before unpublished compose this volume. The method of treatment is subjective. His theme is the significance of things seen. We have not, therefore, a compilation of detached observations but a group of highly suggestive and interesting essays on, for example, Migration, Courtship, Adaptations, Color, Relations to Man, with practical suggestions for attracting, observing, and photographing birds. The book thus appeals to the special student as well as to the general reader. We know of no one better equipped to claim the attention of both than Doctor Allen. A born naturalist, a trained biologist, a keen, discriminating, and patient field student, a pleasing and effective writer, and a skilful photographer, he has used all his exceptional gifts and attainments in preparing these studies.—F. M. C.

The Mound Builders. A reconstruction of the life of a prehistoric American race, through exploration and interpretation of their earth mounds, their burials, and their cultural remains. By Henry Clyde Shetrone, Director and Archæologist, the Ohio State Archæological and Historical Society. D. Appleton and Company, New York and London, 1930.

A good book on the Mound Builders has been wanting until now. Perhaps it had better be said that such a book could not have been written sooner, but certain it is, that the only person to write such a book is the author of this volume. Shetrone, following in the footsteps of the original leader in this field, William C. Mills, has greatly advanced the archæological technique until his achievements are looked upon as the last word on the subject. Shetrone does not dig a mound, he dissects it as carefully and intelligently as a surgeon approaches a complicated internal situation. The reader of the volume before us soon comes to feel the presence of a master hand, when shown how internal wooden structures of mounds, long since decayed, can be traced in the earth, or how one can see the outline of each human load of dirt dumped into the growing pile. Thus, if the reader turns to page 191 he can see a splendid instance of what fine technique will reveal: one of the dirt carriers building the mound did not dump the load, but, for some reason, threw in container and all. It was a basket which, though decayed, left its imprint upon the load, revealing the pattern of the weave. The load weighed about thirty pounds. What can be more moving than to stand before such long-buried concrete evidence of human behavior.

Even from the first, almost every American was interested in mounds. When our Colonial forefathers crossed the Alleghanies and began to clear away the forests of the Ohio country, they discovered that, long before, other mysterious pioneers had come and gone, evidently also clearing farms in the forest, building up a well-organized society, but eventually passing into oblivion, giving the forest a chance to reassert itself. There was no doubt on the part of these Colonial pioneers that mounds were the work of men, for the finding of burials in them "dispelled any tendency toward belief that they might be of natural orgin. Here, then, was romance and mystery indeed." From the first, the author shows, there were two rival theories to account for the Mound Builders, one that they were a race far superior to the Indians who came after them, the other that they were but Indians of a slightly different culture. Of these theories, the latter now has the widest possible acceptance; but, as the author states, it is not fair to say that these Mound Builders were mere crude savage Indians, for they once supported a culture commanding respect. Yet, though the author is interested in putting forward the evidence for the present scientific conclusions, his chief concern is to take the reader upon an excursion in the mound area, show him the inside of the mounds as well as the outside, let him see the handiwork of the Mound Builders, and help him reconstruct their daily life. To this end the three hundred illustrations contribute. The skill of the author appears just as clearly in the selection of these illustrations as in the handling of the text; each picture makes a point.

The plan of the book is good, treating the Ohio mound area in full and from this as a point of regard reviewing the Great Lakes area, the Upper and Lower Mississippi areas, as well as certain marginal areas, like the Tennessee-Cumberland and Pennsylvania areas. In the final summary the author commits himself to the idea that the Mound Builders migrated from Mexico after the initial development of Middle American civilizations. Upon this point there is less agreement among the experts, nor do the data presented make the case more probable than before. The general reader, however, need not be troubled over this.

Finally, the book presents data upon some of the recent finds in mound exploration, for instance, the astonishing examples of sculpture in stone from the Tremper Mound, almost the last word in realistic figurines of animals and birds. These objects promise to hold their place as the masterpieces of prehistoric North American art.—Clark Wissler.

Animal Life of Yellowstone National Park. By Vernon Bailey, Chief Naturalist, United States Biological Survey. 1930. Pp. 241. Charles C. Thomas, Springfield, Ill.

Mr. Bailey has written another splendid book on our native animals. Since it is both entertainingly written and authoritative, it is an ideal handbook for the region that it covers.

The volume consists essentially of an account of every mammal and many of the birds known to occur in Yellowstone National Park. The best known of these are, of course, treated the most adequately. For almost each species there is a resume of its distribution, migration movements, its abundance past and present, relations to other animals, and of course information concerning food habits and general mode of life.

In the sportsman's world there is a strong tendency to classify every animal under one of the two headings of *game* or *vermin.* Those in the *game* list are of course to be encouraged, but those species which do not interest the sportsman or which perhaps live to some extent at the expense of game populations are treated as enemies. It is regrettable to see so sympathetic a student of animal habits as Mr. Bailey take one side. He remarks, for example, that wolves and game cannot successfully be maintained on the same range. He seems to believe that wolves are none too few in the Park. In 1926 one was seen and tracks of a few others. No more recent records are known. Yet there are some 35,000 elk in this region, and this reviewer, for one, would like to feel that there was a wolf for each thousand head of elk. Just why preference should be shown to "game" animals inside the Park is not clear, when no animal is supposed to be hunted in the area. To many persons it is far more thrilling to see a wolf, a mountain lion, or even a coyote, than it is to see an elk or deer.

The lions are, according to Mr. Bailey, no longer a serious menace to the elk. With this we can agree, since the cougar is so scarce that those intent upon killing them have not been able to get one since 1924.

The coyotes are here recognized as largely beneficial, though the few young of the great herds of elk are grudged them. Mr. Bailey has chosen for illustration two photographs of coyotes hunting mice, which is certainly a typical occupation. Though some two hundred individuals are killed in the Park every year, the species fortunately seems to hold its own.

No comment is made upon the recently altered boundaries of the Park. Probably about as much has been gained as lost in the changes made, yet there is at this time great danger that a large section along the southern boundary may be sacrificed to lumber interests—at serious cost to the animal life and forests, embracing as this section does one of the chief autumnal migration routes of the larger mammals. If boundaries are to be changed we should extend them outward. Only thus can we adequately protect the mammals.

Mr. Bailey's book should do much to stimulate public interest in our native animals, an interest let us hope that will develop into recognition of our responsibility to conserve our wild animal life, great and small, with prejudice toward none.

—Robert T. Hatt.

MIGRATIONS of the Cod.—A recent 136-page document published by the United States Bureau of Fisheries on "Migrations and other Phases in the Life History of the Cod off Southern New England," by William C. Schroeder, forms an important contribution to our knowledge of fish migration. It is based primarily on the recapture of tagged fish, correlated with much other statistical information.

Nantucket shoals is an important cod ground, whence, each fall, large numbers of these fish move southwestward along the coast into waters inhabited by the species only in the colder months of the year, and from where some at least return to spend the ensuing summer on the shoals. The same individual cod may remain there for two or three years, or, if some of them winter to the westward, they may be found on the shoals for several successive summers.

The stock of cod on Nantucket shoals is kept up chiefly by young adult and nearly adult fish which immigrate from other regions, appearing in the fall, and by the year following their first appearance forming a dominating group there. During certain summers a smaller number of fish than go westward in fall move eastward off the shoals into deeper water. This seems to be a true emigration of relatively large individuals to waters more favorable for large fish.—J. T. N.

NEW MEMBERS

Since the last issue of Natural History, the following persons have been elected members of the American Museum, making the total membership 12,054.

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Misses Ada M. Barr, H. Mary Berry, Anita Browne, Florence E. Bruning, Louise Kreischer, Grace Laird, Helen Clarkson Miller, Helen L. Neuman, Helen C. Ormond, Emma L. Schirmer, Carrie M. Weir, Nan Whiteley.

Doctors John Duff, Wm. A. Kellogg.

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THE AMERICAN MUSEUM OF NATURAL HISTORY

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MEMBERSHIP MORE THAN TWELVE THOUSAND

For the enrichment of its collections, for the support of its explorations and scientific research, and for the maintenance of its publications, the American Museum of Natural History is dependent wholly upon membership fees and the generosity of friends. More than 12,000 members are now enrolled who are thus supporting the work of the Museum. The various classes of membership are:

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

FREE TO MEMBERS

NATURAL HISTORY: JOURNAL OF THE AMERICAN MUSEUM

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

AUTUMN AND SPRING COURSES OF POPULAR LECTURES

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

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

MEMBERS' CLUB ROOM AND GUIDE SERVICE

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

SCIENCE
EDUCATION

RESEARCH
EXPLORATION

SIXTY years of public and scientific service have won for the American Museum of Natural History a position of recognized importance in the educational and scientific life of the nation and in the progress of civilization throughout the world. With every passing year the influence of the Museum widens, as is witnessed by the increasing number of visitors who daily enter its halls without the payment of any admission fee whatever.

THE NEW SCHOOL SERVICE BUILDING, with the increased facilities it offers, makes it possible to augment greatly the Museum's work not only in New York City schools but also throughout the country. About thirteen million contacts were made during 1929 with boys and girls in the public schools of New York and the vicinity alone. Inquiries from all over the United States, and even from many foreign countries, are constantly coming to the School Service Department. Information is supplied to, and thousands of lantern slides are prepared at cost for distant educational institutions, and the American Museum, because of this and other phases of its work, can properly be considered not a local, but a national—even an international—institution. Through its loan collections, or "traveling museums," which are circulated locally, 557 schools were reached last year, and 1,857,729 direct contacts were made with the pupils. More than a million lantern slides were lent to the New York City schools, and 4,297 reels of the Museum's motion pictures were shown in 271 public schools and other educational institutions in Greater New York, reaching 1,725,865 children.

COLLEGE AND UNIVERSITY SERVICE. The President and the Curator of Public Education have extended and intensified the courses of college and university instruction. Among the institutions with which the Museum is coöperating are Columbia University, New York University, College of the City of New York, Hunter College, Rutgers College, University of Vermont, Lafayette College, and Yale University.

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

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

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

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

EXPEDITIONS from the American Museum are constantly in the field, gathering information in many odd corners of the world. During 1929 thirty expeditions visited scores of different spots in North, South, and Central America, Europe, Asia, Africa, and Polynesia, and nearly as many are now in the field continuing last year's work or beginning new studies.

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

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

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TEXT AND ILLUSTRATIONS

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